METHOD FOR CODING DATA ON MICROBIAL STRAINS FOR COMPUTERS (EDITION AB)

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INTRODUCTION

Experience with computers in microbial identification and classification is now sufficient to warrant planning for the establishment of an international data bank for cultures and culture collections. This would be an invaluable resource to be used in many profitable ways. In fact, the present population of computers with the available machine operating and storage capacities and software (i.e., programs and programming versatility) makes the concept of an international microbiological data bank feasible. The maximum data grid for present information can easily be handled by the models of computers available to major university and research centers in many countries of the world.

A microbiological data bank, as a centralized repository of information of all types, should include historical, nomenclatural, classificatory, and epidemiological information for groups and clones of such microorganisms as bacteria, rickettsiae, chlamydiae, and viruses.

The great potential value of a data bank outweighs the onerous task of transferring currently available data to an international computer center. The very magnitude of the unflagging increase in information produced daily in the outflow from thousands of laboratories in the United States and other countries of the world requires some concerted, unified effort to catalogue and file these new data for future reference. In tandem, of course, runs the need for constant updating of major microbiological reference works such as Bergey's Manual of Determinative Bacteriology (1957) and Index Bergeyana (1966). In spite of these needs, no solutions to the information explosion problem have been proposed on an international basis. In fact, Bergey's Manual is at present being updated by international committees, whose efforts, by present methods, can provide a volume revision and updating only about every ten or fifteen years because of the sheer volumes of information to be sorted, analyzed and collated.

As one example of the value of computer assistance, references to the literature on taxonomy of microorganisms can be located on computer at an international center for rapid call-up and consultation by any individual in any other country at any time. Identification, classification and nomenclature of microorganisms require the same diligence in literature search as other scientific activities and the lack of immediate access to pertinent literature on microorganisms as is available, for example, on chemical compounds, puts a major obstacle in the way of those microbiologists seeking to identify and classify microorganisms, whether for purposes of pure taxonomy or for such applications as medical diagnosis. A computer library with ready call-up to all or specific components of appropriately stored data would meet these needs. Information is never "lost" since all data put into computer storage are retained and can be called up by appropriate query
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to the computer at any time.

The classes of information acceptable for computer storage include clonal data, with strain number specified where applicable, and morphology, physiology, biochemistry, genetics, serology, ecology, nomenclature, pathogenicity, and all other data anticipated to be obtained by clinical and research investigators at the present time or in future. The Index Bergeyana (1966), for example, provides a format suitable for transfer to the computer by present keypunching operations without major modifications or rearrangements. That is, synonyms, as listed in the Index Bergeyana (1966), keypunched for computer entry, provide a cross-indexed list of taxonomic epithets. Similarly, laboratory data record books may, in many cases, be amenable to immediate entry to the computer.

Selection of data for a variety of purposes is possible with present programming versatilities. The kinds of questions which can be put to a data center are virtually unlimited. That is, requests for strain nomenclatural information, location of specific microbial strains in world repositories, or enumeration of specific strains with given biochemical properties, or a combined request for any or all of these, may be answered within a matter of seconds if done by a computer system. Controls centrally located, or computer-linked terminals at points remote from the computer installation, would provide instant access to computer memory storage. For example, an individual investigator relays diagnostic data to the central computer unit from a remote terminal and requests identification of the organism in question. By any one of several internally programmed methods, the organism is identified. If insufficient data were provided, the list of additional tests necessary for positive identification would be relayed back to the investigator at the remote control terminal station. Thus, an investigator-computer dialogue ensues, constituting, in essence, a feed-back control system for diagnostic purposes.

With these points in mind, it is timely to pay serious attention to the data gathering and recording procedures for efficient computer applications. From our combined experience in computer analyses of microbiological data, we are able to avoid the common pitfalls and errors in programming and data handling. In addition, a mechanism for transfer of data to a computer system has been derived which involves a minimum amount of time and labor. Finally, we have compiled a comprehensive set of criteria currently used in microbiology for describing, identifying, and classifying microorganisms which comprises the bulk of a microbial data storage system. The major sources of this information were Bergey's Manual (1957) and Skerman's Guide to the Identification of Genera of Bacteria (1968). The list of characteristics provided by Skerman (1962) formed the backbone of the documentation. Pertinent monographs, reviews and individual papers were also consulted.

Appropriate data format planning for a microbiological data
INTRODUCTION

center are underway which take into account general needs. Allowance is made for information as yet uncollected or to be gained in the future as research work in microbiology progresses. Suitable programs for handling literature references are already available in some laboratories (Simpson, 1968).

The documentation for computer storage, retrieval and analysis of data descriptive of microbial taxa has been prepared in the form of a questionnaire.

Questions have been generally designed to be test and taxon independent. There are difficulties in comparing results of some methods presently in use in many microbiological laboratories. The assumption has been made that, regardless of how determined, the test result is acceptable for coding so long as a method is reproducible and reliable within available knowledge and technology.

Once the tests and test methods are entered from the files into the data bank, where the particular tests used give conflicting results, either in the same laboratory or among laboratories, the computer will be programmed to detect discrepancies and calculate efficiencies of tests and test methods. The verification or comparison of test results from contributing laboratories would be possible with this information as would be a calculation of indices of efficiency of various testing methods for specific characteristics. These points, incidently, represent two of the many advantages derived from computer-assisted microbial data storage and retrieval. Ultimately the problem of tests and testing methods will have to be the subject of a separate and intensive scrutiny. For the moment, simply keeping a file of the methods used in any given case will prevent loss of information on the specific tests used.

Variability of a character of a strain is not scored because of the practical matter that most tests are scored in a binary or "YES" or "NO" fashion. Variability would be determined only by multiple entries for the same strain. Each individual answer is assumed to be the answer to only one determination of a property.

One could search the proposed data bank for a list of characteristics (or array of test results) required to identify or classify a set of microorganisms by requesting a minimum set of criteria required, a set for a given reliability, or indeed, by any other codable constraint on the search. Individuals wishing to analyze data by computer in an array compatible with internationally accepted testing schema would use the suggested format for their data input to the data bank. Comparisons with stored information would then be possible.

The need for standardization of methods for collecting and reporting data is more urgently appreciated when considering the many facets of information storage and retrieval. Many investigators, since the earliest days of microbiology, have pointed out the lack of standardization of microbiological laboratory methods for isolation,
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identification, classification and description of microorganisms. This document with its underlying theme of establishment of an international data bank perhaps will focus attention on this need. Scientific committees, as well as interested clinical, teaching and research microbiologists, may thereby be motivated in the proper directions for meeting the need.

It was not intended that this initial documentation of microbial information be at once all inclusive because of the very real limitation of the individual investigator's capacity in terms of time, funds and personnel to transfer masses of data from his record books to computer records and ultimately to computer storage. With this limitation in mind, the criteria for describing microbial taxa as completely and concisely as possible at the present time have been assembled. The ultimate aim of the document is to encourage transfer of microbiological strain data from laboratory notebooks to an international data facility. A less dramatic objective of the effort represented by this document is to provide a sample or "pilot project" for eliciting comment and constructive criticism from the scientific community. The attention focused on the document may thereby be further directed towards establishment of an internationally accepted set of criteria for identification and classification of microorganisms and serve as a mechanism for the transfer of this information to an international repository. The National Institutes of Health pilot project, set up specifically for studying methods for microbiological data storage and retrieval is participating closely in the development of the International Data Center for Culture Collections in Brisbane and will act as one receiving center for data.

If it develops that individual investigators or laboratories are reluctant or unwilling to deposit data in national or international centers, the only alternatives which remain are to establish a microbiological data bank from published sources or to set up working laboratories specifically designed to provide the necessary microbiological data using standardized methods of isolation, culture and testing for each taxon of microorganisms as was proposed at the International Conference on Culture Collections in Tokyo, 1968.

With regard to the kind of data to be placed in a central bank, clone, or strain, data are preferable to information summarized for species, genera or other higher categories. The original data scored for clones or strains are, at present, the ideal. Grouped results or summed data, particularly for "taxonomically shifting" organisms, that is, those isolates whose taxonomy is in dispute, generate more problems than they solve.

A data center must necessarily be independent of any philosophy of classification. Programs for microbiological data storage and retrieval should permit call-up of data with or without exercise of taxonomic prejudice. Numerical taxonomy (Sokal and Sneath, 1963) or any other taxonomy can, of course, be applied to the deposited data without
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Pre-evaluation or judgment as to what data may be stored. There is no selection, "weeding-out," or hierarchical sorting of the input data. We have made no judgment as to which criterion is to be left out or which is more important. Naturally, erroneous data, when recognized, would either be eliminated or the fact noted. Most computer procedures, such as calculation of phylogenetic relationships, identification of strains, species, genera, etc., and retrieval of information for strains with specified characteristics, are all independent programs, utilizing identical data and linked through a central command series of programmed instructions.

Certain restrictions of the computer must be met. A standard data code, fixed location of related data, and specific ordering of data must be rigorously followed. Binary logic was chosen in order that all questions could be accessed by the same methods. No attempt was made to render each question a "one gene -> one enzyme query." There are questions included in the set which encompass pathways. Much of the presently available microbiological data fall into this category. That the form is nevertheless useful is demonstrated by the example provided in the completed set of questions for some strains of the genus LACTOBACILLUS, a group for which a large volume of information and long history of study exists.

The list of criteria has been left open-ended. Keying of the forms is by number assigned to the completed forms. Some of the advantages of such serially numbered forms are: 1. protection against misplacing data since each form, answer sheet, and punched card will be uniquely coded; and 2. new editions of the forms can be produced at any time without causing major programming problems in the data bank. Any time the questions change, the data will be flagged and updated accordingly by keying on the form number and edition. When new data become available from any given investigator, continuous updating of the data repository will be done. New information would include not only records for new strains but also additional test information on old strains, recent publications, receipt of strains, etc. Lists of culture collections, literature references of the type utilized by the National Library of Medicine, synonyms, other systems of taxonomy, viz. French, Russian, and Japanese, etc., are suitable information for a microbiological data bank. However, questionnaires or specific formats must be carefully designed and rigorously adhered to so that automatic cross-indexing can be accomplished easily and efficiently.

The document, as designed, was edited, rewritten and rearranged with the aid of a computer (the WYLBUR system of text-editing, originally written at Stanford University, Palo Alto, California). Any number of forms can be prepared on cards or by photo-offset from on-line typewritten output. IT SHOULD BE EXPLICITLY UNDERSTOOD THAT THE ENTIRE DOCUMENT DOES NOT HAVE TO BE FILLED OUT BY EVERY INVESTIGATOR OR LABORATORY. The forms can be provided with a list of any combination of characteristics or expanded to include an index. An index is being
INTRODUCTION

However, it is not included in this document, since the total number of pages would be quadrupled, at least. In addition, we have allowed for institutions without computers or with only limited computer facilities to work directly with card decks as such. Upper case and lower case letters are permitted without having to go through typewriter output. That is, a high-speed printer with an upper and lower case character set will provide any desired number of forms for distribution to laboratories either on cards, in text, or ready for photo-offset printing. Master copies for multilith printing or line printing can readily be provided. The text editor programming system which we have employed permits modification of the form, as for example change of card deck lists, test categories, etc. We chose to be inclusive rather than selective, since it is easy to discard data, but going back to the laboratory bench and obtaining missing data is far more difficult. Thus, if it appears that the same genes or gene effects are scored a number of times, the redundancy in these data can be removed from the form or listing.

There is an element of arbitrariness in selection of genus and species names for storing and search by computer. No significance is indicated since any tag would be quite acceptable for search and coding procedures. It is simply that some label is necessary. Special purpose forms have been prepared, published or put into use (viz. Quadling and Martin, 1968). These, and other, programming systems for handling culture collection data (viz. Simpson, 1968) are easily accommodated within this document. There is no question or intent that one form supersedes or replaces another. The document described here has been written to be expandable to include all available or proposed microbiological information and documentation. Fixed field format was used to simplify the programming tasks required to generate the desired query system capability, allowing cheaper, more efficient use of computer and programmer time. Existing software for sort and search routines can be utilized. Open formats can of course be used, but they require larger computer facilities and more sophisticated programs. Since one of the objectives in this effort was to standardize the internal form of the data storage, everything, even including this text itself, was keyed to the 80 column Hollerith punch card. A simple card sorter can be used to handle the data if necessary.

The difficulties of interpretation of the questionnaire by individuals whose mother tongue is not English may require that the form be translated into French, Spanish, Russian and/or other languages. Translation can be done when conditions and need dictate.

In conclusion, classification is simply the grouping together and ordering of objects which have characteristics in common. Regardless of the method or the objectives of the classification, the data should be accumulated and assembled so as to be available to all interested microbiologists on an equal basis. Modern taxonomic analyses involving several thousands of strains, for which several hundred features have
INTRODUCTION

Individually been scored, can no longer be scanned efficiently without computer assistance no matter how expert the taxonomist. We propose the following compilation of microbiological criteria as an aid to definition of microbial taxa.

ACKNOWLEDGMENTS

We wish to acknowledge the following contributors to the development of the ideas and concepts in this effort: the invaluable advice and encouragement of Professor V.B.D. Skerman, Brisbane, Australia during the preparation of the final draft of this document; Miss Lesley Jones, Brisbane, for her most intelligent general editorial help; Mr. Keith E. McNeil, Brisbane, for expanding and updating Section 7; Miss Elwyn G. McIntyre, Brisbane, for putting some semblance of order into the mysteries of Section 8; Dr. A.J. Wicken, Sydney, for expanding and updating Section 23; Mr. Graham Manderson and Dr. Horst W. Doelle, Brisbane, for the basic idea and enzyme list for Section 34; (the foregoing contributors should not be held responsible for the distortion of their ideas imposed by the constraints of our computer and personal bias); the marvelously accurate typing of some very difficult material for the Australian Group done, primarily, by Miss Ann Rosetta; the ideas gleaned for the coding methods from discussions with Mr. John J. Wilson, Bethesda, Miss Lesley Jones and Mr. Graham J. Moxey, Brisbane; the published and unpublished information and ideas supplied by the Canadian group (Drs. C. Quadling, S.M. Martin and F.J. Simpson); and, most important, the cheerful willingness of Mrs. Mary Anne Carter to persevere with the typing and text editing, draft after draft, despite WYLBUR's occasional lack of cooperation.

We wish to acknowledge support of grant GB-18274 from the National Science Foundation to one of us (RRC).

When the computer was good, it was very very good; when it was bad, it was horrid.

(High Technology nursery rhyme)
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DIRECTIONS FOR CODING DATA

This questionnaire is designed to employ computer technology in the storage, retrieval, and analysis of data descriptive of individual strains. A filled out example of the answer forms to be used is appended and should be consulted while reading the following directions. Special answer forms are to be used for Section 1 (CODE SHEET FOR GENERAL INFORMATION - A, B, C, and D) and part of Section 2 (Questions 02001-02005 on CODE SHEET FOR STRAIN CHARACTERISTICS-I and Questions 02006-02012 on the CODE SHEET FOR STRAIN CHARACTERISTICS-III), as many as possible of the questions must be answered for a complete entry into the data bank. Those questions in Section 2 (02013-02023 and 99002, see below) which can be answered YES or NO are to be coded on the generalized answer sheets described below (CODE SHEET FOR STRAIN CHARACTERISTICS-III).

All responses in a given set are to be for a single genus, i.e., a new set of answers is needed for each genus that a respondent wishes to include. The limitation of each response to a single genus is not meant to imply any taxonomic prejudgement. It only serves to provide a nominal boundary condition for ease of coding and cross-indexing of the data set. Section 1 (GENERAL INFORMATION FORMS) IS FILLED OUT IN ALL CASES.

In certain cases the genus will not have been determined. The data being supplied is for an arbitrary set of strains (e.g., a series of isolates from soil, water or clinical patients, etc.). The information should still be supplied as described below with the following simple exceptions. An arbitrary NUMERICAL code may be supplied in place of the genus name if grouping of organisms is desired. In this case a new form must be used for each group designated. Alternatively, the genus name may be left blank and the information supplied in one batch.

In Section 1: General Information, answer all questions where applicable. Use only the spaces provided. Separate all words and/or names with a blank space. Where specific word or number answers are called for, place one letter or number in a space. Where specific word or number answers are called for, place one letter or number in a space. If a number is called for (see Questions 01001, 01004, 01009, 01031), use leading zeros (e.g., 01031).

The answer to Question 4 (Edition used) is to be found on the title page of the Questionnaire itself. If one person, from one address and one
DIRECTIONS

collection, submits a set of answers for several genera, simultaneously, IN ONE PACKAGE, Questions 01001 through 01005 (on General Information CODE SHEET A and B) need only be answered once. However, please leave the unanswered FORMS A and B in their proper place.

In Section 2: Strain Information, use the special answer sheets as follows. Answer Questions 02001 through 02005 on CODE SHEET-I. If more than 20 strains are being coded, use identical continuation sheets (CODE SHEET-I). Serially number each code sheet used in the space provided (PAGE NUMBER) in the upper left corner. Answer each question in the columns on the answer sheets as denoted in parentheses after each question in the text.

After Questions 02001-02005 are answered for all strains, answer Questions on CODE SHEET-II. Again, enter the page numbers in the upper left, beginning with the integer following the last number used on the CODE SHEET-I series for the previous 5 questions.

The upper right corner of all CODE SHEETS (except for Section 1) is for identifying information which is filled out under the same rules as for Section 1. In the spaces provided, the following information MUST be entered on each answer sheet: 1. The respondent's surname; 2. The Genus; 3. The data; and 4. The form edition. Items 1, 2, and 3 should be the same as the corresponding answers in Section 1. The answer to item 4 is to be found on the Title Page of the Questionnaire. These answers are to insure correspondence with the file. The spaces for Form Number should be left blank.

CODE SHEET-III is to be used as follows. It is to be used for Section 2, Questions 02013 through 02023 and 99002 (see below), and all following sections. The set of questions to be answered in any given response is decided on first. Enter these from left to right on as many copies of CODE SHEET-III as are required to hold them. (There is space for 60 questions per sheet.) Enter the question identification numbers one over each column VERTICALLY, by section first and then question, e.g., Question 146 of Section 19 and Question 3 of Section 4 would be entered as (N.B. the order is not important):

```
|Q1|I
|4|9|
|1|1|
|0|4|
|2|8|
```

Thus, always use leading zeros or blanks where appropriate. The questions may be answered in ANY order. The computer will rearrange the questions, in order, automatically. The blank margin above the spaces may be used for the convenience of the respondent (e.g., for mnemonics of the questions).

Place the strain identifier (as many as 10 characters, i.e., any letters, numbers, punctuation, i.e., .,:,-, etc.) in the leftmost 10
DIRECTIONS
spaces, one strain to each row. Use of blanks or zeros is optional in this case. The information for as many as 20 strains may be entered for as many as 60 questions on each answer sheet. Thus, answers to 190 questions for 105 strains would require 24 sheets.

In the body of the general answer sheets (as previously), code a "yes" as a "1"; a "no" as a "0"; and a blank space means no knowledge. There are questions about characters, such as the presence of spore production, which are followed by indented questions on the various characteristics of the spores. In such a case, if the first question has a negative answer, all the following indented questions must be negative as well. There is no need to answer the indented questions if the first question is negative since the computer is being programmed to insert the negative answers in the proper places. (Single indented questions have * attached to the question number for easy recognition in long series. Double indented questions, for which the same rules apply, have ** after the question number. (DO NOT enter the asterisks (*) on the CODE SHEETS.) However, if the first (unindented) question has a positive answer none of the following group of questions which are indented may be skipped unless the answer is unknown.

If a question is of a multiple component type, such as Question 16 of Section 7 (07016): "Myxospores are aggregated into sessile mucoid fruiting bodies without sporocyst formation:" it should only be answered as positive if each component is positive. To be positive, the aggregate of myxospores must be sessile, the aggregate must be mucoid and the fruiting bodies must give no evidence of sporocysts. If the fruiting bodies are dry instead of mucoid, but all other characteristics are positive, the answer is still negative.

Obviously there will be questions which we have not asked. In these cases, please do the following: for the last question of each Section (a) note that the question number begins with "99" (99002 for Section 2 through 99034 for section 34), (b) answer this question as if it were a descriptive characteristic on CODE SHEET-III, as described above, by writing "1" if you wish to contribute information which we have not asked about or if you feel the answers should be expanded or qualified. For example:

CELL MORPHOLOGY:COMMENT 1

Then on a properly headed separate sheet for each case give the additional information. The reason for this is practical. For example, under Metabolic Reactions there may very well be enzyme functions which we have not asked about. In the face of the remarkable versatility of microorganisms, no one can anticipate all the many questions that might be asked.

There might also be cases in which we have not included subjects and naturally these would not be included in the Index. An example of this might be Fine Structure. In these cases also head a separate
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sheet, as for example:

FINE STRUCTURE

Then give the appropriate information on that same sheet.

Please use pencil, marking heavily, for those sections requiring coded answers. PRINT CLEARLY. Correct any errors by erasing, NOT by crossing out and/or writing over the error.

In addition to filling out the FORMS and CODING SHEETS as described above, it would be extremely useful for each respondent to provide a list of the methods used to obtain the answers to the various questions. While we have no provision yet for cross referencing this information in the data bank, it seems to be the obvious next step. Therefore, it would be important to have information on the nature of the tests on file.

DIRECTIONS FOR EDITING DATA PRIOR TO KEYPUNCHING

Upon receipt of answer forms make sure that the set is complete and in order: CODE SHEETS A, B, C, D and then all CODE SHEETS I, then all CODE SHEETS II, CODE SHEETS III and finally any uncoded paper (comments, methods, etc.). This sequence should be repeated for each of the genera for which answers are being supplied.

Overall readability is determined. Answers should be entered such that there is no more than 1 character within each allotted space. If errors are not too numerous and serious and the correction is obvious, the corrections may be made by hand. If they are a disaster, send it all back. In all that follows, if the entry of a number is required, always enter leading zeros.

Assign a FORM NUMBER to each set of answers. Even if CODE SHEET A and CODE SHEET B are left blank a FORM NUMBER is entered in spaces 71-76 on CODE SHEET A. The numbers are assigned serially beginning with 000001 through 100,000 being assigned by the personnel at the University of Queensland and 100,001-200,000 being used by NIDR, NIH. Other groupings will be assigned as more data collection centers are established.

Since the FORM NUMBER will be used as an accession number to correlate all information pertaining to a given answer set, it must be entered on every piece of paper associated with the answer sheet--including the mailing envelope, cover letter, list of methods (if sent), history and any other unformatted documents. An unformatted document (such as a list of methods) could have more than one FORM NUMBER on it if its contents apply to multiple genera or sets of answers. These documents are filed under the FORM NUMBER concerned. Photocopies should be made if multiple FORM NUMBERS apply.
DIRECTIONS

Check question 01004. If it is blank, assign a provisional number (990,001-999,999 assigned by The University of Queensland; 980,001-989,999 by NIDR, NIH). Inform the University of Queensland so that the respondent can be sent a questionnaire for assigning a valid World Federation of Culture Collections Number.

On all Hollerith cards produced from this coding, the format of the card is described by a card type number in columns 77-78. Within a card type, sequential CODE SHEET page numbers are in columns 79-80 where applicable. In order to set up these numbers for the key punch operator, the following must be done.

On each CODE SHEET I, II, and III, the FORM NUMBER (from CODE SHEET A, 71-76) is entered in columns 71-76 of the top row of data. Indicate by vertical arrows that this number is to be repeated for all cards.

Check the page numbers entered in the upper left hand corner of CODE SHEET I, II, and III for their proper place in the sequence. They should be serial by CODE SHEET number. That is, all the CODE SHEET I should be together, followed by CODE SHEET II and finally, by all CODE SHEET III. Enter the page number from the upper left hand corner in columns 79-80 of the top data row on each CODE SHEET.

Finally enter the proper card type on the CODE SHEET as follows. In the top data row, in columns 77-78, enter, for CODE SHEET 1: 05; for CODE SHEET II: 06; and for CODE SHEET III: 09. In order to keep track of data as it flows through the system, a DATA INPUT JOURNAL is established. It contains the following sequence of entries for each set of data received.

1. FORM NUMBER
2. GENUS NAME
3. CONTRIBUTING COLLECTION NUMBER
   (if necessary the provisionally assigned collection is used pending assignment of an official number.)
4. DATE CODE SHEETS FILLED OUT
   (obtained from CODE SHEET A)
5. DATE DATA RECEIVED
6. DATE COPIES OF DATA (FORMATED AND UNFORMATED) FILED OR MICROFILMED
7. DATE JOURNAL ENTRY CIRCULATED TO OTHER CENTERS. (a list of newly received data should be interchanged among all interested centers as frequently as possible. Thus, if a set of data is applicable to a given query, but has not been processed, at least each center will be aware of its existence and can make a rational choice as to the importance
DIRECTIONS

of waiting for completion of processing.
8. DATE FORM SENT TO KEYPUNCH
9. DATE RECEIVED FROM KEYPUNCH
10. DATE DATA ADDED TO MAGNETIC TAPE FILE
11. DATE TAPE COPIES SENT TO OTHER CENTERS
12. DATE COMPUTER REFORMATED DATA SENT TO ORIGINAL CONTRIBUTOR

INSTRUCTIONS TO KEYPUNCH OPERATOR

The following instructions are for developing a deck of standard 80 column Hollerith cards using keypunch equipment such as the IBM 026 or 029. If key to magnetic tape or punched paper tape is used, it should be done in card image and ASCII code if possible. This will minimize writing of special translation codes and programs.

In all cases, the forms and coding sheets are identified by descriptors on the bottom of each sheet.

All cards punched from one set of answers must have the numbers as those in columns 71-76 of the first card. A set of answers is defined as each series beginning with CODE SHEET A and ending with one or more of CODE SHEET III. No more than one CODE SHEET A or B can be in one set. Each set must have a different number for columns 71-76. Cards need not be inserted for blank rows.

SECTION 1: GENERAL INFORMATION CODE SHEETS A, B, C, D

Card column numbers are found preprinted under the data to be punched:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Ignore "FOR OFFICE USE ONLY" instructions, they are for the document originator. However, if no hand coded information has been entered between FOR OFFICE USE ONLY lines, that card may be omitted.
DIRECTIONS

SECTION 3: CODE SHEET III

1. Gangpunch or duplicate 5 cards with a) the numbers found in columns 71-77, b) an 8 in column 78 (instead of a 9), and c) and as shown in 79-80.

2. Punch the 5 cards from (1) with a) the numbers 1-5 in column 1, b) leave 2-10 blank, and c) columns 11-70 as entered on the code sheet.

3. Gangpunch or duplicate the numbers entered in columns 71-80 as many times as there are rows on the CODE SHEET.

4. Keypunch columns 1-70 as is.

5. Repeat 1-4 for CODE SHEET III for each one in the set.
SECTION 2: SPECIFIC STRAIN INFORMATION

02001: What is your laboratory strain number? Use any combination of 10 numbers and/or letters (CODE SHEET-I, Columns 1-10 and Columns 1-10 on all subsequent CODE SHEETS).

02002: Is the strain a mutant of another strain which mutated in your collection (for other known mutants as well as the general history of each strain, see 02013, below)? (CODE SHEET-I, Column 11)

02003: If the strain mutated in your collection, what is the parent strain number? (CODE SHEET-I, Columns 12-21)

02004: What is the specific epithet? (CODE SHEET-I, Columns 22-46)

02005: What is the authority for the specific epithet, i.e., Author's name, Journal, Year)? (CODE SHEET-I, Columns 47-70)

02006: Is the specific epithet listed in Index Bergeyana? (CODE SHEET-II, Column 11)

02007: What is the G.C. content of the strain DNA, in moles % (to the nearest whole number)? (CODE SHEET-II, Columns 12-13)

02008: Which culture collection is the strain deposited in? Use any combination of 6 letters or, if known, use the World Directory of Culture Collections Number. (CODE SHEET-II, Columns 14-19)

02009: What month and year was the strain deposited in the culture collection? Use 01 for January through 12 for December (CODE SHEET-II, Columns 20-21) and the last two digits of the year. (CODE SHEET-II, Columns 22-23)

02010: Is the geographic place of isolation known? (CODE SHEET-II, Column 24) If known, please supply, as much as possible, the following information on a separate sheet of paper; (a) name of place (b) latitude and longitude, both in degrees, minutes, seconds (d) altitude in meters, + or - from sea level.

02011: Date of isolation? Use 01 for January through 12 for December (CODE SHEET-II, Columns 25-26) and the last two digits of the year. (CODE SHEET-II, Column 27-28)

02012: What was the specific source of isolation, i.e., kind of water, soil, etc., species and organ of plant, animal, etc. (give specific type). (CODE SHEET-II, Column 29-70)
SECTION 2: SPECIFIC STRAIN INFORMATION

NOTE: ANSWER THE FOLLOWING QUESTIONS ON CODE SHEET-III.

02013: Is the history of the culture known? If it is, indicate by answer on CODE SHEET-III (see DIRECTIONS for the method of using CODE SHEET III). If known, please supply, as much as possible, the following information on a separate sheet of paper; (a) origin of the culture (b) name and address of depositor of the culture (c) previous designations of the culture (d) names of the culture collections where the culture was previously held (e) applications of the culture.

02014: Have bacteriophage(s) been demonstrated for this strain?

02015: Has transduction been demonstrated for this strain?

02016: Has transformation been demonstrated for this strain?

02017: Has this strain been used in a numerical taxonomy study?

02018: Has this strain been examined by electron microscopy?

02019:* Was the electron microscopy technique of shadow casting used?

02020:* Was the electron microscopy technique of negative staining used?

02021:* Was the electron microscopy technique of thin sectioning used?

02022:* Was the electron microscopy technique of freeze etching used?

02023:* Was the scanning electron microscope used?

99002: Specific strain information: Comments (including special features).
SECTION 3: INDIVIDUAL CELL MORPHOLOGY

NOTE 1: The questions in this section apply to individual cells whether they occur free or as part of a multicellular structure or organism.

NOTE 2: For arrangement and physical relationships among cells, see Section 15.

NOTE 3: For symbiotic relationships, see Section 16.

NOTE 4: If the cells are branched, also see Section 8.

03001: Cells are spherical.
03002: Cells are cuboid or angular.
03003: Cells are bean shaped (kidney shaped).
03004: Cells are ellipsoid.
03005: Cells are pear-shaped.
03006: Cells are disc-shaped.
03007: Cells are triangular.
03008: Cells are rod-shaped.
  03009:* Rod axis is straight.
  03010:* Rod axis is irregular.
  03011:* Rod axis is curved in one plane.
  03012:* Rod axis is sigmoid in one plane.
  03013:* Rod axis is helical (spiral).
    03014:** Helical cells have axial filaments.
    03015:** Helical cells have crista.
  03016:* Rods have tapered ends.
  03017:* Rods have rounded ends.
  03018:* Rods have square ends.
  03019:* Rods have recurved ends (bent into a semicircular hook).
    03020:* Individual cell is flexuous.
  03021: Cells produce tubular outgrowths (0.2-0.3 microns wide) on the end of which daughter cells are formed (also see Section 11).
  03022: Internal cell contents (cytoplasm) is concentrated at one end of cells.
  03023: Pleomorphic cells are characteristic.
  99003: Individual Cell Morphology: Comments.
SECTION 4: INDIVIDUAL VEGETATIVE CELL SIZE

04001: Longest axis of each cell less than 0.5 micrometer.
04002: Longest axis of each cell 0.5 - 1 micrometer.
04003: Longest axis of each cell 1.1 - 2.0 micrometers.
04004: Longest axis of each cell 2.1 - 3.0 micrometers.
04005: Longest axis of each cell 3.1 - 4.0 micrometers.
04006: Longest axis of each cell 4.1 - 5.0 micrometers.
04007: Longest axis of each cell 5.1 - 10 micrometers.
04008: Longest axis of each cell 11 - 15 micrometers.
04009: Longest axis of each cell 16 - 100 micrometers.
04010: Longest axis of each cell 101 - 160 micrometers.
04011: Shortest axis of each cell less than 0.5 micrometer.
04012: Shortest axis of each cell 0.5 - 1 micrometer.
04013: Shortest axis of each cell 1.1 - 2.0 micrometers.
04014: Shortest axis of each cell 2.1 - 3.0 micrometers.
04015: Shortest axis of each cell 3.1 - 4.0 micrometers.
04016: Shortest axis of each cell 4.1 - 5.0 micrometers.
04017: Shortest axis of each cell 5.1 - 10 micrometers.
04018: Shortest axis of each cell 11 - 15 micrometers.
04019: Shortest axis of each cell 16 - 100 micrometers.
04020: Shortest axis of each cell 101 - 160 micrometers.
04021: Cells are filterable through filters having a pore size of 0.45 micrometer or less.
04022: Cells are visible by light microscopy (resolution of > 0.2 micrometer).
99004: Individual vegetative cell size: Comments.
SECTION 5: INSOLUBLE INTRACELLULAR AND EXTRACELLULAR DEPOSITIONS

05001: Calcium carbonate inclusions in the cell.
05002: Sulfur granule inclusions in the cell (see question 05012).
05003: Starch inclusions in the cell.
05004: Poly beta-hydroxybutyric acid inclusions in the cell.
05005: Hydroxyapatite inclusions in the cell (see question 05016).
05006: Poly metaphosphate inclusions (volutin) in the cell.
05007: Granulose inclusions in the cell.
05008: Glycogen inclusions in the cell.
05009: Lipid globules in the cell (also see Section 12 and Section 21).
05010: Discrete pigment globules in the cell.
05011: Gas vacuoles (aerosomes) in the cell.
05012: Sulfur deposited outside the cell.
05013: Iron deposited outside the cell (also see Section 11 and Section 12).
05014: Manganese deposited outside the cell (also see Section 11).
05015: Iodinin crystals deposited outside the cell (also see Section 20).
05016: Hydroxyapatite deposited outside the cell.
99005: Insoluble intracellular and extracellular depositions:
   Comments.
SECTION 6: ENDOSPORES

06001: Endospores produced (any refractile intracellular body capable of germination into a new vegetative cell).
   06002:* Endospores produced singly per cell.
   06003:* Endospores produced in pairs or larger numbers per cell.
   06004:* Endospore(s) round.
   06005:* Endospore(s) cylindrical.
   06006:* Endospore(s) ellipsoidal.
   06007:* Endospore(s) central in sporangium.
   06008:* Endospore(s) terminal.
   06009:* Endospore(s) sub-terminal.
   06010:* Germination of spores terminal.
   06011:* Germination of spores lateral.
   06012:* Germination of spores by dissolution of spore coat.
   06013:* Endospores up to 0.9 micrometer wide.
   06014:* Endospores wider than the vegetative cell (sporangium swollen).
   06015:* Endospores contain di-picolinic acid (pyridine-2,6-dicarboxylic acid).
   06016:* Endospores survive 80 C for 10 minutes.
   06017:* Endospores survive 85 C for 10 minutes.
   06018:* Endospores survive 100 C for 10 minutes.
   06019:* Endospores survive 100 C for 30 minutes.
   06020:* Parasporal crystal formed during sporulation.
   06021:* Manganese cation essential for sporulation.
   06022:* Antisera prepared against spores cross react with vegetative cells.
   06023:* Germination of spores activated by sub-lethal heat.

99006: Endospores: Comments.
SECTION 7: MYXOSPORES, SPOROCYSTS AND FRUITING BODIES

07001: Organisms with gliding motility produce myxospores (microcysts, resting cells) during growth.

07002:* Myxospores are spherical.
07003:* Myxospores are ellipsoidal.
07004:* Myxospores are cylindrical.
07005:* Longest axis of myxospore is 0.5 - 1.0 micrometer.
07006:* Longest axis of myxospore is 1.1 - 1.5 micrometers.
07007:* Longest axis of myxospore is 1.6 - 2.0 micrometers.
07008:* Longest axis of myxospore is 2.1 - 3.0 micrometers.
07009:* Longest axis of myxospore is 3.1 - 4.0 micrometers.
07010:* Longest axis of myxospore is 4.1 - 5.0 micrometers.
07011:* Longest axis of myxospore is > 5.1 micrometers.
07012:* Shortest axis of myxospore is 0.5 - 1.0 micrometer.
07013:* Shortest axis of myxospore is 1.1 - 1.5 micrometers.
07014:* Shortest axis of myxospore is > 1.6 micrometers.
07015:* Myxospores are produced from and lie at random amongst vegetative cells in the colony.
07016:* Myxospores are aggregated into sessile mucoid fruiting bodies without sporocyst formation.
07017:* Myxospores are aggregated into mesenteric tubular structures within a sessile fruiting body.
07018:* Myxospores are aggregated into discrete sporocysts.

07019:** Sporocysts occur singly.
07020:** Sporocysts are grouped into distinct fruiting bodies.
07021:** Sporocysts are microscopic.
07022:** Sporocysts are macroscopic.
07023:** Sporocysts are angular.
07024:** Sporocysts are apiculate.
07025:** Sporocysts are cylindrical.
07026:** Sporocysts are disc-shaped.
07027:** Sporocysts are ellipsoidal.
07028:** Sporocysts are spherical.
07029:** Sporocysts have no regular shape.
07030:** Longest axis of sporocyst is 0.5 - 2.0 micrometers.
07031:** Longest axis of sporocyst is 2.1 - 5.0 micrometers.
07032:** Longest axis of sporocyst is 5.1 - 10 micrometers.
07033:** Longest axis of sporocyst is 10.1 - 20 micrometers.
07034:** Longest axis of sporocyst is 20.1 - 50 micrometers.
07035:** Longest axis of sporocyst is 50.1 - 100 micrometers.
07036:** Longest axis of sporocyst is 100.1 - 150 micrometers.
07037:** Shortest axis of sporocyst is 0.5 - 2.0 micrometers.
07038:** Shortest axis of sporocyst is 2.1 - 5.0 micrometers.
07039:** Shortest axis of sporocyst is 5.1 - 10 micrometers.
07040:** Shortest axis of sporocyst is 10.1 - 20 micrometers.
07041:** Shortest axis of sporocyst is 20.1 - 50 micrometers.
SECTION 7: MYXOSPORES, SPOROCYSTS AND FRUITING BODIES

07042:** Shortest axis of sporocyst is 50.1 - 100 micrometers.
07043:** Sporocysts are sessile.
07044:** Sessile sporocysts are grouped in fruiting bodies.
07045:** Sessile fruiting bodies are flat.
07046:** Sessile fruiting bodies are low convex.
07047:** Sessile fruiting bodies are high convex.
07048:** Sessile fruiting bodies are columnar.
07049:** Sessile fruiting bodies produce aerial projections of a regular form.
07050:** Sessile fruiting bodies produce aerial projections of an irregular form.
07051:** Sporocysts are born on stalks.
07052:** Sporocysts stalks are branched.
07053:** Sporocysts occur singly on a stalk.
07054:** Sporocysts occur singly on a stalk branch.
07055:** Sporocysts occur in whorls at the tips of stalks.
07056:** Sporocysts occur in whorls at the tips of stalk branches.
07057:** Sporocysts occur in compact clusters (not whorls) at or near the tips of stalks.
07058:** Sporocysts occur in compact clusters (not whorls) at or near the tips of stalk branches.
07059:** Sporocysts occur at random on stalks.
07060:** Sporocysts occur at random on stalk branches.
07061:** Fruiting bodies are butyrous.
07062:** Fruiting bodies are deliquescent.
07063:** Fruiting bodies are mucoid.
07064:** Fruiting bodies are cartilagenous.
07065:** Fruiting bodies are red.
07066:** Fruiting bodies are orange.
07067:** Fruiting bodies are yellow.
07068:** Fruiting bodies are brown.
07069:** Fruiting bodies are pink.
07070:** Fruiting bodies are some other color.

99007: Myxospores, sporocysts and fruiting bodies: Comments.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

NOTE 1: The term "primary", as used here, refers to the initial growth following the germination of conidia, arthrospores, zoospores, sporangiospores, and products of hyphal fragmentation. This growth may be ALONG AND IN the substratum (substratal) or AERIAL with no growth along or in the substrate.

NOTE 2: The term "secondary" refers to AERIAL GROWTH originating from substratal primary growth.

NOTE 3: The term "conidium" is here employed for asexual spores other than the "exogenous arthrospore" and the "sporangiospore".

NOTE 4: The term "sporophore" refers to that portion of the growth, either of primary or secondary origin, which supports conidia or sporangia. In the absence of such supports they are "sessile".

BRANCHING AND SEPTATION

08001: Cells branch.
08002: Branching occurs only in pleomorphic cultures.
08003: Branch is rudimentary (limited to Y,T,V or L shapes).
08004: Primary hyphae are produced.
08005: Primary growth is in the form of branched hyphae lying on the substrate.
08006: Primary growth is in the form of branched hyphae lying in the substrate (substratal).
08007: Primary growth is in the form of aerial hyphae, the initial cell being fixed to the substrate as a holdfast.
08008: Secondary hyphae are produced.
08009: Branching hyphae have clavate ends.
08010: Branching hyphae are septate.
08011: Secondary hyphae curve back to the substratum in the form of an arch.
08012: Septa are produced at the origins of the branches in addition to any in the parent filament.
08013: Septa are produced transversely.
08014: Septa are produced transversely and longitudinally.

FRAGMENTATION AND SPORE FORMATION

08015: Hyphae fragment.
08016: Primary hyphae fragment.
08017: Secondary hyphae fragment.
08018: Fragmentation of hyphae at septa is complete.
08019: Fragmentation of hyphae at septa takes place only on terminal hyphae.
08020: Fragmentation results in exogenous arthrospores.
08021: Fragmentation produces rods.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

08022: Fragmentation produces cocci.
08023: Fragmentation produces diphtheroids.
08024: Fragmentation produces motile cells.
08025: Intercalary vesicles are produced.
08026: Subterminal vesicles are produced.
08027: Sclerotia are produced.
08028: Coremia are produced.
08029: Asexual spores are produced in pycnidia.

CONIDIA

08030: Conidia are produced.

CONIDIAL LOCATION AND ARRANGEMENT

08031: Conidia on primary hyphae are sessile.
08032: Conidia on primary hyphae are on sporophores.
08033: Conidia on primary hyphae are branched verticillately in one series.
08034: Conidia on primary hyphae are branched verticillately in two series.
08035: The distance between verticils of conidia on primary hyphae is regular.
08036: Conidia on primary hyphae are branched dichotomously.
08037: Conidia on primary hyphae are branched bifurcately.
08038: Conidia on primary hyphae are branched monopodially.
08039: Conidia on primary hyphae are branched randomly.
08040: Conidia on primary hyphae are arranged in palisades.
08041: Conidia on secondary hyphae are sessile.
08042: Conidia on secondary hyphae are on sporophores.
08043: Conidia on secondary hyphae are branched verticillately in one series.
08044: Conidia on secondary hyphae are branched verticillately in two series.
08045: The distance between verticils of conidia on secondary hyphae is regular.
08046: Conidia on secondary hyphae are branched dichotomously.
08047: Conidia on secondary hyphae are branched bifurcately.
08048: Conidia on secondary hyphae are branched monopodially.
08049: Conidia on secondary hyphae are branched randomly.
08050: Conidia on secondary hyphae are arranged in palisades.

PROPERTIES OF CONIDIA AND CHAINS OF CONIDIA

08051: Conidia on primary sessile hyphae are produced as endogenous arthrospores.
08052: Conidia on primary sessile hyphae occur singly.
08053: Conidia on primary sessile hyphae occur in chains of two.
08054: Conidia on primary sessile hyphae occur in chains of three.
08055: Conidia on primary sessile hyphae occur in chains of four.
08056: Conidia on primary sessile hyphae occur in chains of five.
08057: Conidia on primary sessile hyphae occur in chains of six to ten.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

08058:* Conidia on primary sessile hyphae occur in chains of > ten.
08059:* Conidia on primary sessile hyphae occur in straight chains.
08060:* Conidia on primary sessile hyphae occur in flexuous chains.
08061:* Conidia on primary sessile hyphae occur in looped chains.
08062:* Conidia on primary sessile hyphae occur in hooked chains.
08063:* Conidia on primary sessile hyphae occur in short, compact, spiral chains.
08064:* Conidia on primary sessile hyphae occur in long, extended, spiral chains.
08065:* Conidia on primary sessile hyphae occur in open spiral chains.
08066:* Conidia on primary sessile hyphae are spherical.
08067:* Conidia on primary sessile hyphae are cylindrical.
08068:* Conidia on primary sessile hyphae are smooth.
08069:* Conidia on primary sessile hyphae are spiny.
08070:* Conidia on primary sessile hyphae are hairy.
08071:* Conidia on primary sessile hyphae are warty.
08072:* Conidia on primary sessile hyphae are motile.
08073:* Conidia on primary sessile hyphae are 0.1 - 1.0 micrometer long.
08074:* Conidia on primary sessile hyphae are 1.1 - 2.0 micrometers long.
08075:* Conidia on primary sessile hyphae are 2.1 - 3.0 micrometers long.
08076:* Conidia on primary sessile hyphae are 0.1 - 1.0 micrometer wide.
08077:* Conidia on primary sessile hyphae are 1.1 - 2.0 micrometers wide.
08078:* Conidia on primary sessile hyphae are 2.1 - 3.0 micrometers wide.
08079:* Conidial masses on primary sessile hyphae are dry and powdery.
08080:* Conidial masses on primary sessile hyphae are embedded in slime.
08081:* Conidia on primary hyphae on sporophores are produced as endogenous arthrospores.
08082:* Conidia on primary hyphae on sporophores are produced by abstriction from the sporophore.
08083:* Conidia on primary hyphae on sporophores occur singly.
08084:* Conidia on primary hyphae on sporophores occur in chains of two.
08085:* Conidia on primary hyphae on sporophores occur in chains of three.
08086:* Conidia on primary hyphae on sporophores occur in chains of four.
08087:* Conidia on primary hyphae on sporophores occur in chains of five.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

08088:* Conidia on primary hyphae on sporophores occur in chains of six to ten.
08089:* Conidia on primary hyphae on sporophores occur in chains of > ten.
08090:* Conidia on primary hyphae on sporophores occur in straight chains.
08091:* Conidia on primary hyphae on sporophores occur in flexuous chains.
08092:* Conidia on primary hyphae on sporophores occur in looped chains.
08093:* Conidia on primary hyphae on sporophores occur in hooked chains.
08094:* Conidia on primary hyphae on sporophores occur in short, compact, spiral chains.
08095:* Conidia on primary hyphae on sporophores occur in long, extended, spiral chains.
08096:* Conidia on primary hyphae on sporophores occur in open spiral chains.
08097:* Conidia on primary hyphae on sporophores are spherical.
08098:* Conidia on primary hyphae on sporophores are cylindrical.
08099:* Conidia on primary hyphae on sporophores are smooth.
08100:* Conidia on primary hyphae on sporophores are spiny.
08101:* Conidia on primary hyphae on sporophores are hairy.
08102:* Conidia on primary hyphae on sporophores are warty.
08103:* Conidia on primary hyphae on sporophores are motile.
08104:* Conidia on primary hyphae on sporophores are 0.1 - 1.0 micrometer long.
08105:* Conidia on primary hyphae on sporophores are 1.1 - 2.0 micrometers long.
08106:* Conidia on primary hyphae on sporophores are 2.1 - 3.0 micrometers long.
08107:* Conidia on primary hyphae on sporophores are 0.1 - 1.0 micrometer wide.
08108:* Conidia on primary hyphae on sporophores are 1.1 - 2.0 micrometers wide.
08109:* Conidia on primary hyphae on sporophores are 2.1 - 3.0 micrometers wide.
08110:* Conidial masses on primary hyphae on sporophores are dry and powdery.
08111:* Conidial masses on primary hyphae on sporophores are embedded in slime.
08112:* Conidia on secondary sessile hyphae are produced as endogenous arthrospores.
08113:* Conidia on secondary sessile hyphae occur singly.
08114:* Conidia on secondary sessile hyphae occur in chains of two.
08115:* Conidia on secondary sessile hyphae occur in chains of three.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

08116:* Conidia on secondary sessile hyphae occur in chains of four.
08117:* Conidia on secondary sessile hyphae occur in chains of five.
08118:* Conidia on secondary sessile hyphae occur in chains of six to ten.
08119:* Conidia on secondary sessile hyphae occur in chains of > ten.
08120:* Conidia on secondary sessile hyphae occur in straight chains.
08121:* Conidia on secondary sessile hyphae occur in flexuous chains.
08122:* Conidia on secondary sessile hyphae occur in looped chains.
08123:* Conidia on secondary sessile hyphae occur in hooked chains.
08124:* Conidia on secondary sessile hyphae occur in short, compact, spiral chains.
08125:* Conidia on secondary sessile hyphae occur in long, extended, spiral chains.
08126:* Conidia on secondary sessile hyphae occur in open spiral chains.
08127:* Conidia on secondary sessile hyphae are spherical.
08128:* Conidia on secondary sessile hyphae are cylindrical.
08129:* Conidia on secondary sessile hyphae are smooth.
08130:* Conidia on secondary sessile hyphae are spiny.
08131:* Conidia on secondary sessile hyphae are hairy.
08132:* Conidia on secondary sessile hyphae are warty.
08133:* Conidia on secondary sessile hyphae are motile.
08134:* Conidia on secondary sessile hyphae are 0.1 - 1.0 micrometer long.
08135:* Conidia on secondary sessile hyphae are 1.1 - 2.0 micrometers long.
08136:* Conidia on secondary sessile hyphae are 2.1 - 3.0 micrometers long.
08137:* Conidia on secondary sessile hyphae are 0.1 - 1.0 micrometer wide.
08138:* Conidia on secondary sessile hyphae are 1.1 - 2.0 micrometers wide.
08139:* Conidia on secondary sessile hyphae are 2.1 - 3.0 micrometers wide.
08140:* Conidial masses on secondary sessile hyphae are dry and powdery.
08141:* Conidial masses on secondary sessile hyphae are embedded in slime.
08142:* Conidia on secondary hyphae on sporophores are produced as endogenous arthrospores.
08143:* Conidia on secondary hyphae on sporophores are produced by abstriction from the sporophore.
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08144:* Conidia on secondary hyphae on sporophores occur singly.
08145:* Conidia on secondary hyphae on sporophores occur in chains of two.
08146:* Conidia on secondary hyphae on sporophores occur in chains of three.
08147:* Conidia on secondary hyphae on sporophores occur in chains of four.
08148:* Conidia on secondary hyphae on sporophores occur in chains of five.
08149:* Conidia on secondary hyphae on sporophores occur in chains of six to ten.
08150:* Conidia on secondary hyphae on sporophores occur in chains of > ten.
08151:* Conidia on secondary hyphae on sporophores occur in straight chains.
08152:* Conidia on secondary hyphae on sporophores occur in flexuous chains.
08153:* Conidia on secondary hyphae on sporophores occur in looped chains.
08154:* Conidia on secondary hyphae on sporophores occur in hooked chains.
08155:* Conidia on secondary hyphae on sporophores occur in short, compact, spiral chains.
08156:* Conidia on secondary hyphae on sporophores occur in long, extended, spiral chains.
08157:* Conidia on secondary hyphae on sporophores occur in open spiral chains.
08158:* Conidia on secondary hyphae on sporophores are spherical.
08159:* Conidia on secondary hyphae on sporophores are cylindrical.
08160:* Conidia on secondary hyphae on sporophores are smooth.
08161:* Conidia on secondary hyphae on sporophores are spiny.
08162:* Conidia on secondary hyphae on sporophores are hairy.
08163:* Conidia on secondary hyphae on sporophores are warty.
08164:* Conidia on secondary hyphae on sporophores are motile.
08165:* Conidia on secondary hyphae on sporophores are 0.1 - 1.0 micrometer long.
08166:* Conidia on secondary hyphae on sporophores are 1.1 - 2.0 micrometers long.
08167:* Conidia on secondary hyphae on sporophores are 2.1 - 3.0 micrometers long.
08168:* Conidia on secondary hyphae on sporophores are 0.1 - 1.0 micrometer wide.
08169:* Conidia on secondary hyphae on sporophores are 1.1 - 2.0 micrometers wide.
08170:* Conidia on secondary hyphae on sporophores are 2.1 - 3.0 micrometers wide.
08171:* Conidial masses on secondary hyphae on sporophores are dry.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

and powdery.

Conidial masses on secondary hyphae on sporophores are embedded in slime.

Asexual spores are produced in sporangia (spore vesicles).

Sporangia on primary hyphae are sessile.
Sporangia on primary hyphae are on sporophores.
Sporangia on primary hyphae are branched verticillately in one series.
Sporangia on primary hyphae are branched verticillately in two series.
The distance between verticils of sporangia on primary hyphae is regular.
Sporangia on primary hyphae are branched dichotomously.
Sporangia on primary hyphae are branched bifurcately.
Sporangia on primary hyphae are branched monopodially.
Sporangia on primary hyphae are branched randomly.
Sporangia on primary hyphae are arranged in palisades.

Sporangia on secondary hyphae are sessile.
Sporangia on secondary hyphae are on sporophores.
Sporangia on secondary hyphae are branched verticillately in one series.
Sporangia on secondary hyphae are branched verticillately in two series.
The distance between verticils of sporangia on secondary hyphae is regular.
Sporangia on secondary hyphae are branched dichotomously.
Sporangia on secondary hyphae are branched bifurcately.
Sporangia on secondary hyphae are branched monopodially.
Sporangia on secondary hyphae are branched randomly.
Sporangia on secondary hyphae are arranged in palisades.

The walls of sporangia are loose and clearly separated from the spores.
The walls of sporangia form a tight sheath around the spores.
Sporangiospores are released from a pore in the sporangial wall.
Sporangiospores are released through a rupture in the sporangial wall.
The sporangial wall disintegrates prior to the release of spores.
The sporangial wall disintegrates concurrent with the
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

release of spores.
08200:* The sporangial wall remains after the release of spores.
08201:* Sporangia separate from the sporophore at the point of connection.
08202:* Sporangia separate from the sporophore at a point below their connection.
08203:* Sporangia on primary hyphae are apiculate.
08204:* Sporangia on primary hyphae are bell-shaped.
08205:* Sporangia on primary hyphae are clavate.
08206:* Sporangia on primary hyphae are cylindrical.
08207:* Sporangia on primary hyphae are digital.
08208:* Sporangia on primary hyphae are fusiform.
08209:* Sporangia on primary hyphae are irregular.
08210:* Sporangia on primary hyphae are oval.
08211:* Sporangia on primary hyphae are pod-like.
08212:* Sporangia on primary hyphae are spherical.
08213:* Sporangia on primary hyphae are urceolate.
08214:* Sporangia on primary hyphae are vermiforme.
08215:* Sporangial walls on primary hyphae are smooth.
08216:* Sporangial walls on primary hyphae are spiny (echinulate).
08217:* Sporangial walls on primary hyphae are warty (tubercular).
08218:* Sporangia on primary hyphae occur singly.
08219:* Sporangia on primary hyphae occur in clusters.
08220:* Sporangia on primary hyphae occur in rows.
08221:* Sporangia on primary hyphae are produced acropetally.
08222:* Sporangia on primary hyphae are produced laterally.
08223:* Sporangia on primary hyphae are 1.0 - 2.0 micrometers long.
08224:* Sporangia on primary hyphae are 2.1 - 5.0 micrometers long.
08225:* Sporangia on primary hyphae are 5.1 - 10.0 micrometers long.
08226:* Sporangia on primary hyphae are 11.0 - 15.0 micrometers long.
08227:* Sporangia on primary hyphae are 16.0 - 20.0 micrometers long.
08228:* Sporangia on primary hyphae are 21.0 - 30.0 micrometers long.
08229:* Sporangia on primary hyphae are 31.0 - 50.0 micrometers long.
08230:* Sporangia on primary hyphae are 1.0 - 2.0 micrometers wide.
08231:* Sporangia on primary hyphae are 2.1 - 3.0 micrometers wide.
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08232:* Sporangia on primary hyphae are 3.1 - 4.0 micrometers wide.
08233:* Sporangia on primary hyphae are 4.1 - 5.0 micrometers wide.
08234:* Sporangia on primary hyphae are 6.0 - 10.0 micrometers wide.
08235:* Sporangia on primary hyphae are 11.0 - 15.0 micrometers wide.
08236:* Sporangia on primary hyphae are 16.0 - 20.0 micrometers wide.
08237:* Sporangia on primary hyphae are 21.0 - 30.0 micrometers wide.
08238:* Sporangia on secondary hyphae are apiculate.
08239:* Sporangia on secondary hyphae are bell-shaped.
08240:* Sporangia on secondary hyphae are clavate.
08241:* Sporangia on secondary hyphae are cylindrical.
08242:* Sporangia on secondary hyphae are digital.
08243:* Sporangia on secondary hyphae are fusiform.
08244:* Sporangia on secondary hyphae are irregular.
08245:* Sporangia on secondary hyphae are oval.
08246:* Sporangia on secondary hyphae are pod-like.
08247:* Sporangia on secondary hyphae are spherical.
08248:* Sporangia on secondary hyphae are urceolate.
08249:* Sporangia on secondary hyphae are vermiciform.
08250:* Sporangial walls on secondary hyphae are smooth.
08251:* Sporangial walls on secondary hyphae are spiny (echinulate).
08252:* Sporangial walls on secondary hyphae are warty (tubercular).
08253:* Sporangia on secondary hyphae occur singly.
08254:* Sporangia on secondary hyphae occur in clusters.
08255:* Sporangia on secondary hyphae occur in rows.
08256:* Sporangia on secondary hyphae are produced acropetally.
08257:* Sporangia on secondary hyphae are produced laterally.
08258:* Sporangia on secondary hyphae are 1.0 - 2.0 micrometers long.
08259:* Sporangia on secondary hyphae are 2.1 - 5.0 micrometers long.
08260:* Sporangia on secondary hyphae are 5.1 - 10.0 micrometers long.
08261:* Sporangia on secondary hyphae are 11.0 - 15.0 micrometers long.
08262:* Sporangia on secondary hyphae are 16.0 - 20.0 micrometers long.
08263:* Sporangia on secondary hyphae are 21.0 - 30.0 micrometers long.
08264:* Sporangia on secondary hyphae are 31.0 - 50.0 micrometers long.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

- 08265:* Sporangia on secondary hyphae are 1.0 - 2.0 micrometers long.
- 08266:* Sporangia on secondary hyphae are 2.1 - 3.0 micrometers long.
- 08267:* Sporangia on primary hyphae are 3.1 - 4.0 micrometers long.
- 08268:* Sporangia on primary hyphae are 4.1 - 5.0 micrometers long.
- 08269:* Sporangia on secondary hyphae are 6.0 - 10.0 micrometers long.
- 08270:* Sporangia on secondary hyphae are 11.0 - 15.0 micrometers long.
- 08271:* Sporangia on secondary hyphae are 16.0 - 20.0 micrometers long.
- 08272:* Sporangia on secondary hyphae are 21.0 - 30.0 micrometers long.

SPORANGIOSPORES

- 08273:* Sporangiospores are motile.
- 08274:* Sporangiospores have single polar flagella.
- 08275:* Sporangiospores have tufts of polar flagella.
- 08276:* Sporangiospores have lateral flagella.
- 08277:* Sporangiospores on primary hyphae occur singly.
- 08278:* Sporangiospores on primary hyphae occur in chains of two.
- 08279:* Sporangiospores on primary hyphae occur in chains of three.
- 08280:* Sporangiospores on primary hyphae occur in chains of four.
- 08281:* Sporangiospores on primary hyphae occur in chains of five.
- 08282:* Sporangiospores on primary hyphae occur in chains of > five.
- 08283:* Sporangiospores on primary hyphae occur in masses.
- 08284:* Chains of sporangiospores on primary hyphae are straight.
- 08285:* Chains of sporangiospores on primary hyphae are coiled.
- 08286:* Sporangiospores on primary hyphae are spherical.
- 08287:* Sporangiospores on primary hyphae are cylindrical.
- 08288:* Sporangiospores on primary hyphae are 0.1 - 1.0 micrometer long.
- 08289:* Sporangiospores on primary hyphae are 1.1 - 2.0 micrometers long.
- 08290:* Sporangiospores on primary hyphae are 2.1 - 3.0 micrometers long.
- 08291:* Sporangiospores on primary hyphae are 3.1 - 4.0 micrometers long.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

08292: Sporangiospores on primary hyphae are 4.1 - 5.0 micrometers long.
08293: Sporangiospores on primary hyphae are 0.1 - 1.0 micrometer wide.
08294: Sporangiospores on primary hyphae are 1.1 - 2.0 micrometers wide.
08295: Sporangiospores on primary hyphae are 2.1 - 3.0 micrometers wide.
08296: Sporangiospores on secondary hyphae occur singly.
08297: Sporangiospores on secondary hyphae occur in chains of two.
08298: Sporangiospores on secondary hyphae occur in chains of three.
08299: Sporangiospores on secondary hyphae occur in chains of four.
08300: Sporangiospores on secondary hyphae occur in chains of five.
08301: Sporangiospores on secondary hyphae occur in chains of > five.
08302: Sporangiospores on secondary hyphae occur in masses.
08303: Chains of sporangiospores on secondary hyphae are straight.
08304: Chains of sporangiospores on secondary hyphae are coiled.
08305: Sporangiospores on secondary hyphae are spherical.
08306: Sporangiospores on secondary hyphae are cylindrical.
08307: Sporangiospores on secondary hyphae are 0.1 - 1.0 micrometer long.
08308: Sporangiospores on secondary hyphae are 1.1 - 2.0 micrometers long.
08309: Sporangiospores on secondary hyphae are 2.1 - 3.0 micrometers long.
08310: Sporangiospores on secondary hyphae are 3.1 - 4.0 micrometers long.
08311: Sporangiospores on secondary hyphae are 4.1 - 5.0 micrometers long.
08312: Sporangiospores on secondary hyphae are 0.1 - 1.0 micrometer wide.
08313: Sporangiospores on secondary hyphae are 1.1 - 2.0 micrometers wide.
08314: Sporangiospores on secondary hyphae are 2.1 - 3.0 micrometers wide.

ZOOSPORES
08315: Cells in a multilocular structure (resulting from transverse and longitudinal septation) produce zoospores.
08316: Zoospores on primary hyphae are spherical.
08317: Zoospores on primary hyphae are cylindrical.
SECTION 8: BRANCHING AND PRODUCTION OF ASEXUAL SPORES

08318:* Zoospores on primary hyphae are 0.1 - 1.0 micrometer long.
08319:* Zoospores on primary hyphae are 1.1 - 2.0 micrometers long.
08320:* Zoospores on primary hyphae are 2.1 - 3.0 micrometers long.
08321:* Zoospores on primary hyphae are 3.1 - 4.0 micrometers long.
08322:* Zoospores on primary hyphae are 4.1 - 5.0 micrometers long.
08323:* Zoospores on primary hyphae are 0.1 - 1.0 micrometer wide.
08324:* Zoospores on primary hyphae are 1.1 - 2.0 micrometers wide.
08325:* Zoospores on primary hyphae are 2.1 - 3.0 micrometers wide.
08326:* Zoospores on secondary hyphae are spherical.
08327:* Zoospores on secondary hyphae are cylindrical.
08328:* Zoospores on secondary hyphae are 0.1 - 1.0 micrometer long.
08329:* Zoospores on secondary hyphae are 1.1 - 2.0 micrometers long.
08330:* Zoospores on secondary hyphae are 2.1 - 3.0 micrometers long.
08331:* Zoospores on secondary hyphae are 3.1 - 4.0 micrometers long.
08332:* Zoospores on secondary hyphae are 4.1 - 5.0 micrometers long.
08333:* Zoospores on secondary hyphae are 0.1 - 1.0 micrometer wide.
08334:* Zoospores on secondary hyphae are 1.1 - 2.0 micrometers wide.
08335:* Zoospores on secondary hyphae are 2.1 - 3.0 micrometers wide.

99008: Branching and production of asexual spores: Comments.
SECTION 9: STALKS

09001: Cells are borne on stalks.
09002:* Stalks are attached to one pole of the cell.
09003:* Stalks are attached in a sub-polar position on the cell.
09004:* Stalks are attached to the side of the cell (other than sub-polar).
09005:* The stalk is an extension of the cell wall.
09006:* Stalks develop at the flagellated end of a cell.
09007:* The stalk is a secretion of the cell.
09008:* One end of the stalk is attached to a substratum.
09009:* Holdfasts are produced.
09010:** The holdfast is located at the tip of the stalk.
09011:** The holdfast is produced on the cell at a point from the origin of the stalk.
09012:** Stalks are very short, almost reduced to a simple holdfast.
09013:** Stalks are elongated.
09014:** Stalks are branched.
09015:** Stalks are dichotomously branched.
09016:* Stalks are dumbbell shaped in cross section.
09017:* Stalks are circular in cross section.
09018:* Stalks are ribbon-like.
09019:* Stalks are horn-shaped.
09020:* Stalks are lobate.
09021:* Stalks are slender.
09022:* Stalks are twisted.
09023:* Stalks contain ferric hydroxide.
09024:* Stalks are soluble in HCl.
09025:* Cells are permanently attached to the stalks and in this state are non-motile.
09026:* Motile daughter cells are liberated from the mother cell.

99009: Stalks: Comments.
SECTION 10: SHEATHS

NOTE: The term "sheath" as used here does not apply to the tightly fitting sporangial walls encountered in the Actinomycetales (for this see Section 8).

10001: Sheaths present.
   10002:* Several filaments, trichomes or chains of cells enclosed in a common sheath.
   10003:* One filament, trichome or chain of cells to a sheath.
   10004:* Sheathed filaments attached, by a holdfast.
   10005:* Sheath uniform in width throughout.
   10006:* Sheaths taper from wide base to narrow tip.
   10007:* Sheaths taper from narrow base to wide tip.
   10008:* Sheaths split longitudinally releasing the filaments.
   10009:* Electron microscopy reveals sheaths have uniform structure.
   10010:* Electron microscopy reveals sheaths have alveolar structure.

99010: Sheaths: Comments.
SECTION 11: CAPSULES

11001: Capsule is present.
11002:* Capsule is predominantly polysaccharide.
11003:** Capsule polysaccharide is antigenic.
11004:* Capsule is predominantly polypeptide.
11005:* Each cell has an individual capsule (capsules do not fuse).
11006:* Cells separated from each other within a common capsule (zoogloea).
11007:** Zoogloea are encysted.
11008:* Cells are in pairs in a common capsule.
11009:* Cells are in chains in a common capsule.
11010:* Cells are in compact masses surrounded by a common capsule.
11011:* Secondary capsules are formed.
11012:* Attachment to a substrate is by means of capsular material.
11013:* Thinly capsulated cells have marginal thickening ("torus") of the capsule.
11014:** "Torus" appears to completely surround the cell.
11015:** "Torus" is open at one end like a horseshoe.
11016:** "Torus" is impregnated with iron compounds (also see Section 5).
11017:* Iron compounds are incorporated in cell capsules (also see Section 5).
11018:* Iron compounds are deposited on cell capsule surface (also see Section 5).
11019:* Manganese compounds are incorporated in cell capsules (also see Section 5).
11020:* Manganese compounds are deposited on cell capsule surface (also see Section 5).

99011: Capsules: Comments.
SECTION 12: STAIN REACTIONS

12001: Cells stain by Gram methods.
12002:* Gram positive in early exponential growth.
12003:* Gram negative in early exponential growth.
12004:* Gram variable in early exponential growth.
12005:* Cells lose Gram positive character after cessation of active growth (cells in stationary phase).
12006:* Cells appear barred when stained by Gram methods.
12007: Cells stain with Giemsa.
12008: Morphology is best determined by dissolving iron or manganese compounds from cells in dilute mineral acid followed by staining with Schiff's reagent (also see Sections 5 and 11).
12009: Cells are acid fast by Ziehl-Neelsen method.
12010: Cells are alcohol fast by modified Ziehl-Neelsen method.
12011: Methylene blue stains reveal inclusion granules (also see Section 5).
12012: Methylene blue stains reveal bipolar bodies (also see Section 3).
12013: Methylene blue stains reveal barred structures.
12014: Sudan black B reveals intracellular lipids (fat bodies) (also see Sections 5 and 21).
12015: Iodine reveals intracellular polysaccharides (glycogen, "granulose", etc.) (also see Section 5).
12016: Cellulose stain reveals cellulose compounds.
12017: Prussian blue test reveals iron compounds (also see Section 5 and 11).
99012: Stain reactions: Comments.
SECTION 13: MOTILITY AND FLAGELLATION

13001: Cells motile.
13002:* Cells motile by flagella.
13003:* Cells motile by spirochaetal motility (rotatory flexion).
13004:* Cells demonstrate creeping or gliding motility on a solid surface.
13005:* Groups of cells creep or glide as an aggregate unit (also see Sections 16).
13006:* Conidia are motile.
13007:* Cells are motile within a sheath.
13008: Whole colonies of flagellated cells are motile (also see Section 16).
13009: Cells have flagella.
13010:* Flagella polar.
   13011:** A single flagellum at one pole.
   13012:** A single flagellum at both poles.
   13013:** Several flagella at one pole.
   13014:** Several flagella at both poles.
13015:* Flagella sub-polar.
   13016:** A single flagellum near the pole.
   13017:** Several flagella near the pole.
13018:* Flagella inserted frankly laterally (from the middle of the cell).
   13019:** A single lateral flagellum.
   13020:** Several lateral flagella.
   13021:** Flagella attached to the concave curve of the cell.
13022:* Flagella peritrichous.
13023:* Two or more flagella of distinctly different appearance in different locations on the cell.
13024:* Average wavelength of flagella is < 1.0 micrometer.
13025:* Average wavelength of flagella is 1.00 - 1.49 micrometers.
13026:* Average wavelength of flagella is 1.50 - 1.99 micrometers.
13027:* Average wavelength of flagella is 2.00 - 2.49 micrometers.
13028:* Average wavelength of flagella is 2.50 - 2.99 micrometers.
13029:* Average wavelength of flagella is 3.00 - 3.49 micrometers.
13030:* Average wavelength of flagella is 3.50 - 4.00 micrometers.
13031:* Average wavelength of flagella is > 4.0 micrometers.
13032:* Average amplitude of flagella is < 0.30 micrometer.
13033:* Average amplitude of flagella is 0.30 - 0.39 micrometer.
13034:* Average amplitude of flagella is 0.40 - 0.49 micrometer.
13035:* Average amplitude of flagella is 0.50 - 0.59 micrometer.
13036:* Average amplitude of flagella is 0.60 - 0.70 micrometer.
13037:* Average amplitude of flagella is < 0.70 micrometer.
13038:* Cells flagellated but not motile.
13039:* Flagellum in a sheath.

99013: Motility and flagellation: Comments.
SECTION 14: MODE OF CELL DIVISION

NOTE: For conidia and sporangia spore formation see Section 7. For arthrospore formation or mycelial fragmentation see Section 8.

14001: Cells divide transversely by binary fission.
14002: Cells divide longitudinally by binary fission.
14003: Cells reproduce by budding directly from mother cell.
14004: Daughter cells bud on tubular outgrowth from mother cells (also see Section 7).
14005: Microfilaments give rise to elementary bodies (round bodies).
99014: Mode of cell division: Comments.
SECTION 15: ARRANGEMENT

NOTE: For symbiotic arrangements see Section 16.

15001: Cells occur singly.
15002: Cells occur in pairs.
15003: Cells arranged in angular fashion after division (snapping).
15004: Cells occur in chains.
15005: Cells arranged in irregular aggregates.
15006: Cells arranged in two-dimensional tetrads.
15007: Cells arranged in cubical packets (three-dimensional).
15008: Cells arranged in palisade fashion.
15009: Cells occur in flat sheets.
15010: Cells occur in rosettes.
15011: Cells connected in a regular open network.
15012: Cells form half-circles.
15013: Curved rods join ends to form a complete ring.
15014: Organisms multicellular; character may be observed without staining.
15015: Organisms multicellular; character revealed only after staining.
15016: Aggregates of cells break up into small clusters.
15017: Organisms filamentous, greater than 10 micrometers, if multicellular the organism has little or no indentation at each septum (For branched filaments also see Section 8).

15018:* Filaments are twisted into bundles.
15019:* Filaments lie loosely, longitudinally together in slightly spirally twisted rolls.
15020:* Filaments are firmly attached to a substrate.
15021:* Filaments are swollen at the tip.
15022:* Cells arranged in cross-hatched configuration (Lieskeella).

99015: Arrangement: Comments.
SECTION 16: CULTURAL AND NUTRITIONAL CHARACTERISTICS
(VEGETATIVE STAGES)

SOLID MEDIA
16001: Isolated agar colonies are less than 1 mm. diameter within a
week.
16002: Isolated agar colonies are less than 2 mm diameter within a
week.
16003: Isolated agar colonies are 2-6 mm diameter within a week.
16004: Isolated agar colonies are greater than 6 mm diameter within
a week.
16005: Agar colonies are translucent.
16006: Agar colonies are transparent.
16007: Agar colonies are opaque.
16008: Agar colony margin is entire.
16009: Agar colony margin is erose.
16010: Agar colony margin is filamentous (rhizoid).
16011: Agar colony margin is irregular.
16012: Agar colony margin is undulate or lobate.
16013: Agar colony is low convex.
16014: Agar colony is high convex.
16015: Agar colony is convoluted.
16016: Agar colony is flat (membranous).
16017: Agar colony is raised but not convex.
16018: Agar colony is umbonate.
16019: Colony swarming is exhibited on agar (also see Section 13).
16020: Entire colony moves as a unit (also see Section 13).
16021: Colonial dissociation occurs regularly.
16022: Colony consistency is butyrous (soft, buttery).
16023: Colony consistency is viscid (mucoid).
16024: Colony consistency is elastic.
16025: Colony consistency is cartilaginous (rubbery).
16026: Colony consistency is brittle (breaks up into granules).
16027: Colony surface is glistening.
16028: Colony surface is dull (matte).
16029: Colony surface is powdery, dry.
16030: Colony surface is smooth.
16031: Colony surface is rough.
16032: Colorless crystals formed within colony during growth.
16033: Mycoplasma or L-form colony (also see Section 3).

LIQUID MEDIA
(NOTE: Opacity tubes are described in: World Health Technical Report
Series, 1953, vol. 68, p. 7. The tubes are available from Burroughs
16034: Maximum turbidity in liquid cultures approximates Brown's
Opacity Tube No. 1.
16035: Maximum turbidity in liquid cultures approximates Brown's
SECTION 16: CULTURAL AND NUTRITIONAL CHARACTERISTICS

Opacity Tube No. 2.

16036: Maximum turbidity in liquid cultures approximates Brown's
Opacity Tube No. 3.

16037: Maximum turbidity in liquid cultures approximates Brown's
Opacity Tube No. 4.

16038: Maximum turbidity in liquid cultures approximates Brown's
Opacity Tube No. 5.

16039: Maximum turbidity in liquid cultures approximates Brown's
Opacity Tube No. 6.

16040: Maximum turbidity in liquid cultures approximates Brown's
Opacity Tube No. 7.

16041: Cells form an easily dispersible sediment in liquid culture.

16042: Colonies form in bladder-like masses resembling puff-balls in
liquids.

16043: Floccular growth in liquid culture.

16044: Ring growth on the wall of the tube in liquid culture.

16045: Culture grows on walls of container without clouding the
medium.

16046: Pellicle in liquid culture.

16047: Liquid culture becomes viscous slime.

GROWTH KINETICS

16048: Fastest mean generation time is less than 1 hour.

16049: Fastest mean generation time is 1-4 hours.

16050: Fastest mean generation time is 4-12 hours.

16051: Fastest mean generation time is more than 12 hours.

16052: Termination of exponential growth phase, under optimal
conditions, occurs within 48 hours.

pH LIMITS OF GROWTH

16053: Growth takes place at an initial pH of 9.0.

16054: Growth takes place at an initial pH of 7.0.

16055: Growth takes place at an initial pH of 6.0.

16056: Growth takes place at an initial pH of 5.0.

16057: Growth takes place at an initial pH of 4.0.

16058: Growth takes place at an initial pH of 3.5.

RELATIONSHIP TO OXYGEN AND CARBON DIOXIDE

16059: Growth from loop inocula spread on surface of solid media
incubated in air.

16060: In 1.5-2.0% previously solidified agar, inoculated by stab,
growth is confined to the surface or a depth from the surface
of approximately no greater than 1 mm. (i.e., an obligate
aerobe)

16061: In 1.5-2.0% previously solidified agar, inoculated by stab,
growth takes place at all depths in tube. (facultative)

16062: In 1.5-2.0% previously solidified agar, inoculated by stab,
growth begins BELOW THE SURFACE when incubated in air.

16063: In agar 1.5-2.0% previously solidified agar, inoculated by
seeding or by stab, incubated in air, growth is largely
SECTION 16: CULTURAL AND NUTRITIONAL CHARACTERISTICS

Confined to a linear dimension of approximately 5 cm from the bottom of the tube in a 16 x 150 mm tube filled with medium to a depth of 9-10 cm. (i.e., obligate anaerobe)

16064: Organisms will grow optimally from relatively small inocula (1000 cells or less/ml) only if strict anaerobic operating conditions are observed.

16065: Increased partial carbon dioxide pressure decreases the lag period.

16066: Increased partial carbon dioxide pressure decreases the mean generation time.

16067: Increased partial carbon dioxide pressure increases total cell yield.

16068: Carbon dioxide is fixed (also see Section 34).

LIGHT REQUIREMENTS - PHOTOSYNTHETIC ORGANISMS

16069: Organisms are photosynthetic.

16070: Regardless of medium or any other experimental condition, growth occurs only in the light.

16071: Growth occurs anaerobically in the light.

16072: Growth occurs anaerobically in the dark.

16073: Growth occurs aerobically in the light.

16074: Growth occurs aerobically in the dark.

TOLERANCE OF INHIBITORY SUBSTANCES (also see Sections 18,19 and 23)

16075: Grows in media containing 10% bile salts.

16076: Grows in media containing 0.005% sodium lauryl sulfate.

16077: Grows in media containing 0.004% basic fuchsin.

16078: Grows in media containing 0.0005% brilliant green.

16079: Grows in media containing 0.001% crystal violet.

16080: Grows in media containing 0.1% methylene blue.

16081: Grows in media containing 0.001% pyronin.

16082: Grows in media containing 0.0033% thionine.

16083: Grows in media containing 0.0075% potassium cyanide.

16084: Grows in media containing 0.4% sodium selenite.

16085: Grows in media containing 0.02% potassium tellurite.

16086: Grows in media containing 0.04% sodium azide.

16087: Grows in media containing 0.25% lithium ion.

16088: Grows in media containing 0.75% potassium ion.

16089: Grows in media containing 0.025% sodium oleate.

16090: Glucose, autoclaved in the medium, inhibits growth.

16091: Peptone or amino acids added to a mineral salts medium, inhibits growth.

NUTRITIONAL CHARACTERISTICS - GROWTH IN COMPLEX MEDIA

16092: The organisms have been isolated and grown in pure culture.

16093: Cells have not been cultivated free of living host cells.

16094: Organisms are intracellular parasites of man or other vertebrates.

16095: Ascitic fluid, serum, or other body fluid is required for growth.
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16096: Bovine serum albumin plus fatty acid or fatty acid ester stimulate growth.

16097: Mixtures of vitamins (growth factors), purines or pyrimidines, amino acids and fatty acids will support growth through five or more serial transfers.

16098: Mixtures of vitamins (growth factors), purines or pyrimidines, amino acids will support growth through five or more serial transfers.

16099: Mixtures of vitamins (growth factors), and amino acids will support growth through five or more serial transfers.

16100: Mixtures of amino acids can serve as the source of C and N for growth through five or more serial transfers.

16101: A single amino acid can serve as the sole source of C and N for growth through five or more serial transfers (also see Section 29).

16102: Optimal growth occurs in sugar-free peptones.

16103: Added fermentable carbohydrate is required for optimal growth.

16104: Filter-sterilized glucose, when added aseptically to sugar-free media, promotes optimal growth; without added glucose continued growth is relatively poor or absent.

16105: Glucose must be autoclaved in the medium to support optimal growth in an otherwise sugar-free medium.

16106: P-Aminobenzoic acid is required for growth.

16107: Biotin is required for growth.

16108: Folic acid is required for growth.

16109: Lipoic acid is required for growth.

16110: Niacin (nicotinic acid) is required for growth.

16111: Pantothenic acid is required for growth.

16112: Pyridoxal or pyridoxamine is required for growth.

16113: Riboflavin is required for growth.

16114: Thiamine is required for growth.

16115: Trigonelline is utilized.

16116: Vitamin B12 (cyanocobalamin) is required for growth.

16117: Hemin (X factor) is required for growth.

16118: Nicotinamide-Adenine di- (or tri-) phosphate nucleotide (V factor) is required for growth.

16119: Adenine is required for growth.

16120: Cytosine is required for growth.

16121: Guanine is required for growth.

16122: Hypoxanthine is required for growth.

16123: Thymine is required for growth.

16124: Uracil is required for growth.

16125: Xanthine is required for growth.

16126: Sterols are required for growth.

16127: Acetyl cholesterol is utilized.

16128: Cholesterol (delta-4-cholesterol) is utilized.

16129: Desoxycorticosterone is utilized.
SECTION 16: CULTURAL AND NUTRITIONAL CHARACTERISTICS

16130: Digitonin is utilized.
16131: Testosterone is utilized.

NUTRITIONAL CHARACTERISTICS - GROWTH ON MINERAL SALTS MEDIA

16132: Synthetic mineral salts media will support growth in the absence of vitamins (growth factors) and organic nitrogen compounds, provided other sources of carbon, nitrogen and energy are supplied.

16133: Synthetic mineral salts media will support growth in the absence of organic nitrogen compounds, provided other sources of carbon, nitrogen and energy and also vitamins (growth factors) are supplied.

16134: Natural sea water is required for growth.
16135: Addition of complex organic compounds (such as in animal and plant tissue extracts) to a mineral salts medium inhibits growth (renders it toxic).

16136: Molecular nitrogen can be used as the sole source of nitrogen.
16137: Ammonium salts can serve as the sole source of nitrogen for growth.
16138: Nitrate can serve as the sole source of nitrogen for growth.
16139: Nitrite can serve as the sole source of nitrogen for growth.
16140: Molecular hydrogen can serve as the sole source of energy.
16141: An inorganic sulfur compound can serve as the sole source of energy (also see Section 24).
16142: Ammonium ion can serve as the sole source of energy.
16143: Nitrite can serve as the sole source of energy.
16144: Carbon monoxide can be used as the sole source of carbon and energy.
16145: Carbon dioxide can be used as the sole source of carbon.
16146: Methane can be used as the sole source of carbon and energy.
16147: Methanol can be used as the sole source of carbon and energy.

BIOASSOCIATIONS - PARASITES

16148: Bacteria are parasites on other bacteria (Bdellovibrio).

BIOASSOCIATIONS - SYMBIOSIS

16149: Organisms grow in symbiosis.
16150: Organisms grow in symbiosis with other bacteria.
16151: Cells grow in symbiosis with short ovoid bacteria in a barrel-shaped arrangement.
16152: Cells grow in symbiosis with large cylindrical bacterial cells.
16153: Cells grow in symbiosis with protozoa.
16154: Cells grow in symbiosis with leguminous plants.
16155:* Produce root nodules.
16156:* Produce leaf nodules.
16157: Cells grow in symbiosis with non-leguminous plants.
16158:* Produce root nodules.
16159:* Produce leaf nodules.
16160: Organisms grow in symbiosis with invertebrate animals.
SECTION 16: CULTURAL AND NUTRITIONAL CHARACTERISTICS

BIOASSOCIATIONS - VECTORS
16161: Insects are vector hosts for the organism.
16162: Arthropods are vector hosts for the organism.
99016: Cultural and nutritional characteristics: Comments.
SECTION 17: VEGETATIVE CELL TEMPERATURE RELATIONS

17001: Optimum temperature 0-10 C.
17002: Optimum temperature 11-20 C.
17003: Optimum temperature 21-30 C.
17004: Optimum temperature 31-40 C.
17005: Optimum temperature 41-50 C.
17006: Optimum temperature 51-60 C.
17007: Optimum temperature 61-70 C.
17008: Optimum temperature 71-80 C.
17009: Optimum temperature 81-90 C.
17010: Optimum temperature 91-100 C.
17011: Growth at 0 C.
17012: Growth at 10 C.
17013: Growth at 15 C.
17014: Growth at 25 C.
17015: Growth at 37 C.
17016: Growth at 41 C.
17017: Growth at 45 C.
17018: Growth at 50 C.
17019: Growth at 55 C.
17020: Growth at 60 C.
17021: Growth at 65 C.
17022: Growth at 70 C.
17023: Growth at 80 C.
17024: Growth at 90 C.
17025: Growth at 100 C.
17026: Organisms survive 60 C for 30 minutes.
17027: Organisms survive 70 C for 2.5 minutes.
17028: Organisms survive 72 C for 15 minutes.
17029: Organisms survive 80 C for 10 minutes.
17030: Organisms survive 100 C for 10 minutes.
17031: Organisms survive 100 C for 30 minutes.
99017: Vegetative cell temperature relations: Comments.
SECTION 18: SODIUM CHLORIDE - TOLERANCE AND REQUIREMENTS

18001: No growth in the absence of at least 50 mM of sodium ion.
18002: No growth in the presence of sodium ion.
18003: Growth in the presence of 0.5% NaCl.
18004: Growth in the presence of 3% NaCl.
18005: Growth in the presence of 4% NaCl.
18006: Growth in the presence of 5% NaCl.
18007: Growth in the presence of 7% NaCl.
18008: Growth in the presence of 10% NaCl.
18009: Growth in the presence of 15% NaCl.
18010: Growth in the presence of 20% NaCl.
18011: Growth in the presence of 25% NaCl.
18012: 0.5%-5% NaCl essential for growth.
18013: 6-10% NaCl essential for growth.
18014: 11-15% NaCl essential for growth.
18015: 16-20% NaCl essential for growth.
18016: 21-25% NaCl essential for growth.
18017: More than 25% NaCl essential for growth.
18018: Synthetic sea salt substitutes for sea water requirement (also see Section 16).
99019: Sodium Chloride - Tolerance and requirements: Comments.
SECTION 19: ANTIBIOTIC SENSITIVITY

AMPICILLIN

19001: Sensitive to ampicillin concentration (disc) 2 ugm.
19002: Sensitive to ampicillin at any concentration in medium of up to or greater than 1600 ugm/ml.
19003:* Sensitive to ampicillin concentration in medium of .025 ugm/ml.
19004:* Sensitive to ampicillin concentration in medium of .05 ugm/ml.
19005:* Sensitive to ampicillin concentration in medium of .1 ugm/ml.
19006:* Sensitive to ampicillin concentration in medium of .2 ugm/ml.
19007:* Sensitive to ampicillin concentration in medium of .4 ugm/ml.
19008:* Sensitive to ampicillin concentration in medium of .8 ugm/ml.
19009:* Sensitive to ampicillin concentration in medium of 1.6 ugm/ml.
19010:* Sensitive to ampicillin concentration in medium of 3 ugm/ml.
19011:* Sensitive to ampicillin concentration in medium of 6 ugm/ml.
19012:* Sensitive to ampicillin concentration in medium of 12 ugm/ml.
19013:* Sensitive to ampicillin concentration in medium of 25 ugm/ml.
19014:* Sensitive to ampicillin concentration in medium of 50 ugm/ml.
19015:* Sensitive to ampicillin concentration in medium of 100 ugm/ml.
19016:* Sensitive to ampicillin concentration in medium of 200 ugm/ml.
19017:* Sensitive to ampicillin concentration in medium of 400 ugm/ml.
19018:* Sensitive to ampicillin concentration in medium of 800 ugm/ml.
19019:* Sensitive to ampicillin concentration in medium of 1600 ugm/ml.

BACITRACIN

19020: Sensitive to bacitracin concentration (disc) .4 unit.
19021: Sensitive to bacitracin concentration (disc) 2 units.
19022: Sensitive to bacitracin concentration (disc) 5 units.
19023: Sensitive to bacitracin concentration (disc) 10 units.

CEPHALOTHIN

19024: Sensitive to cephalothin concentration (disc) 10 ugm.
SECTION 19: ANTIBIOTIC SENSITIVITY

19025: Sensitive to cephalothin at any concentration in medium of up to or greater than 1600 ugm/ml.

19026:* Sensitive to cephalothin concentration in medium of .025 ugm/ml.
19027:* Sensitive to cephalothin concentration in medium of .05 ugm/ml.
19028:* Sensitive to cephalothin concentration in medium of .1 ugm/ml.
19029:* Sensitive to cephalothin concentration in medium of .2 ugm/ml.
19030:* Sensitive to cephalothin concentration in medium of .4 ugm/ml.
19031:* Sensitive to cephalothin concentration in medium of 25 ugm/ml.
19032:* Sensitive to cephalothin concentration in medium of 1.6 ugm/ml.
19033:* Sensitive to cephalothin concentration in medium of 3 ugm/ml.
19034:* Sensitive to cephalothin concentration in medium of 6 ugm/ml.
19035:* Sensitive to cephalothin concentration in medium of 12 ugm/ml.
19036:* Sensitive to cephalothin concentration in medium of 25 ugm/ml.
19037:* Sensitive to cephalothin concentration in medium of 50 ugm/ml.
19038:* Sensitive to cephalothin concentration in medium of 100 ugm/ml.
19039:* Sensitive to cephalothin concentration in medium of 200 ugm/ml.
19040:* Sensitive to cephalothin concentration in medium of 400 ugm/ml.
19041:* Sensitive to cephalothin concentration in medium of 800 ugm/ml.
19042:* Sensitive to cephalothin concentration in medium of 1600 ugm/ml.

CHLOROMYCETIN (CHLORAMPHENICOL)

19043: Sensitive to chloromycetin (chloramphenicol) concentration (disc) 5 ugm.
19044: Sensitive to chloromycetin (chloramphenicol) concentration (disc) 30 ugm.
19045: Sensitive to chloromycetin (chloramphenicol) at any concentration in medium of up to or greater than 1600 ugm/ml.
19046:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of .025 ugm/ml.
19047:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of .05 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19048:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of .1 ugm/ml.
19049:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of .2 ugm/ml.
19050:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of .4 ugm/ml.
19051:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of .8 ugm/ml.
19052:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 1.6 ugm/ml.
19053:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 3 ugm/ml.
19054:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 6 ugm/ml.
19055:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 12 ugm/ml.
19056:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 25 ugm/ml.
19057:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 50 ugm/ml.
19058:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 100 ugm/ml.
19059:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 200 ugm/ml.
19060:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 400 ugm/ml.
19061:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 800 ugm/ml.
19062:* Sensitive to chloromycetin (chloramphenicol) concentration in medium of 1600 ugm/ml.

CHLOROTETRACYCLINE (AUREOMYCIN)
19063: Sensitive to chlorotetracycline (aureomycin) concentration (disc) 30 ugm.

COLISTIN
19064: Sensitive to colistin concentration (disc) 2 ugm.
19065: Sensitive to colistin concentration (disc) 10 ugm.
19066: Sensitive to colistin at any concentration in medium of up to or greater than 1600 ugm/ml.
19067:* Sensitive to colistin concentration in medium of .025 ugm/ml.
19068:* Sensitive to colistin concentration in medium of .05 ugm/ml.
19069:* Sensitive to colistin concentration in medium of .1 ugm/ml.
19070:* Sensitive to colistin concentration in medium of .2 ugm/ml.
19071:* Sensitive to colistin concentration in medium of .4 ugm/ml.
19072:* Sensitive to colistin concentration in medium of .8 ugm/ml.
19073:* Sensitive to colistin concentration in medium of 1.6
SECTION 19: ANTIBIOTIC SENSITIVITY

\( \text{ugm/ml.} \)

19074:* Sensitive to colistin concentration in medium of 3 ugm/ml.
19075:* Sensitive to colistin concentration in medium of 6 ugm/ml.
19076:* Sensitive to colistin concentration in medium of 12 ugm/ml.
19077:* Sensitive to colistin concentration in medium of 25 ugm/ml.
19078:* Sensitive to colistin concentration in medium of 50 ugm/ml.
19079:* Sensitive to colistin concentration in medium of 100 ugm/ml.
19080:* Sensitive to colistin concentration in medium of 200 ugm/ml.
19081:* Sensitive to colistin concentration in medium of 400 ugm/ml.
19082:* Sensitive to colistin concentration in medium of 800 ugm/ml.
19083:* Sensitive to colistin concentration in medium of 1600 ugm/ml.

2,4-DIAMINO-6,7-DIISOPROPYLPTERIDINE (0/129 VIBRIOSTAT)
19084: Sensitive to 2,4-diamino-6,7-diisopropylpteridine (0/129 vibriostat) crystals on agar.
ERYTHROMYCIN (ILOTYCIN)
19085: Sensitive to erythromycin (ilotycin) concentration (disc) 2 ugm.
19086: Sensitive to erythromycin (ilotycin) concentration (disc) 15 ugm.
19087: Sensitive to erythromycin (ilotycin) at any concentration in medium of up to or greater than 1600 ugm/ml.
19088:* Sensitive to erythromycin (ilotycin) concentration in medium of .025 ugm/ml.
19089:* Sensitive to erythromycin (ilotycin) concentration in medium of .05 ugm/ml.
19090:* Sensitive to erythromycin (ilotycin) concentration in medium of .1 ugm/ml.
19091:* Sensitive to erythromycin (ilotycin) concentration in medium of .2 ugm/ml.
19092:* Sensitive to erythromycin (ilotycin) concentration in medium of .4 ugm/ml.
19093:* Sensitive to erythromycin (ilotycin) concentration in medium of .8 ugm/ml.
19094:* Sensitive to erythromycin (ilotycin) concentration in medium of 1.6 ugm/ml.
19095:* Sensitive to erythromycin (ilotycin) concentration in medium of 3 ugm/ml.
19096:* Sensitive to erythromycin (ilotycin) concentration in medium of 6 ugm/ml.
19097:* Sensitive to erythromycin (ilotycin) concentration in medium of 12 ugm/ml.
19098:* Sensitive to erythromycin (ilotycin) concentration in
SECTION 19: ANTIBIOTIC SENSITIVITY

19099:* Sensitive to erythromycin (Ilotycin) concentration in medium of 25 ugm/ml.

19100:* Sensitive to erythromycin (Ilotycin) concentration in medium of 50 ugm/ml.

19101:* Sensitive to erythromycin (Ilotycin) concentration in medium of 100 ugm/ml.

19102:* Sensitive to erythromycin (Ilotycin) concentration in medium of 200 ugm/ml.

19103:* Sensitive to erythromycin (Ilotycin) concentration in medium of 400 ugm/ml.

19104:* Sensitive to erythromycin (Ilotycin) concentration in medium of 800 ugm/ml.

KANAMYCIN

19105: Sensitive to kanamycin concentration (disc) 5 ugm.

19106: Sensitive to kanamycin concentration (disc) 30 ugm.

19107: Sensitive to kanamycin at any concentration in medium of up to or greater than 1600 ugm/ml.

19108:* Sensitive to kanamycin concentration in medium of .025 ugm/ml.

19109:* Sensitive to kanamycin concentration in medium of .05 ugm/ml.

19110:* Sensitive to kanamycin concentration in medium of .1 ugm/ml.

19111:* Sensitive to kanamycin concentration in medium of .2 ugm/ml.

19112:* Sensitive to kanamycin concentration in medium of .4 ugm/ml.

19113:* Sensitive to kanamycin concentration in medium of .8 ugm/ml.

19114:* Sensitive to kanamycin concentration in medium of 1.6 ugm/ml.

19115:* Sensitive to kanamycin concentration in medium of 3 ugm/ml.

19116:* Sensitive to kanamycin concentration in medium of 6 ugm/ml.

19117:* Sensitive to kanamycin concentration in medium of 12 ugm/ml.

19118:* Sensitive to kanamycin concentration in medium of 25 ugm/ml.

19119:* Sensitive to kanamycin concentration in medium of 50 ugm/ml.

19120:* Sensitive to kanamycin concentration in medium of 100 ugm/ml.

19121:* Sensitive to kanamycin concentration in medium of 200 ugm/ml.

19122:* Sensitive to kanamycin concentration in medium of 400 ugm/ml.

19123:* Sensitive to kanamycin concentration in medium of 800 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19124:* Sensitive to kanamycin concentration in medium of 1600 ug/ml.

LINCOMYCIN
19125: Sensitive to lincomycin concentration (disc) 2 ug/ml.

MANDELAMINE (METHENEAMINE MANDELATE)
19126: Sensitive to mandelamine (metheneamine mandelate) concentration (disc) 5 mg/ml.

METHICILLIN
19127: Sensitive to methicillin concentration (disc) 5 ug/ml.

NALIDIXIC ACID
19128: Sensitive to nalidixic acid concentration (disc) 5 ug/ml.
19129: Sensitive to nalidixic acid concentration (disc) 30 ug/ml.
19130: Sensitive to nalidixic acid at any concentration in medium of up to or greater than 1600 ug/ml.
19131:* Sensitive to nalidixic acid concentration in medium of .025 ug/ml.
19132:* Sensitive to nalidixic acid concentration in medium of .05 ug/ml.
19133:* Sensitive to nalidixic acid concentration in medium of .1 ug/ml.
19134:* Sensitive to nalidixic acid concentration in medium of .2 ug/ml.
19135:* Sensitive to nalidixic acid concentration in medium of .4 ug/ml.
19136:* Sensitive to nalidixic acid concentration in medium of .8 ug/ml.
19137:* Sensitive to nalidixic acid concentration in medium of 1.6 ug/ml.
19138:* Sensitive to nalidixic acid concentration in medium of 3 ug/ml.
19139:* Sensitive to nalidixic acid concentration in medium of 6 ug/ml.
19140:* Sensitive to nalidixic acid concentration in medium of 12 ug/ml.
19141:* Sensitive to nalidixic acid concentration in medium of 25 ug/ml.
19142:* Sensitive to nalidixic acid concentration in medium of 50 ug/ml.
19143:* Sensitive to nalidixic acid concentration in medium of 100 ug/ml.
19144:* Sensitive to nalidixic acid concentration in medium of 200 ug/ml.
19145:* Sensitive to nalidixic acid concentration in medium of 400 ug/ml.
19146:* Sensitive to nalidixic acid concentration in medium of 800 ug/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19147:* Sensitive to nalidixic acid concentration in medium of 1600 ugm/ml.

NEOMYCIN (MYCIFRADIN)
19148: Sensitive to neomycin (mycifradin) concentration (disc) 5 ugm.
19149: Sensitive to neomycin (mycifradin) concentration (disc) 30 ugm.
19150: Sensitive to neomycin at any concentration in medium of up to or greater than 1600 ugm/ml.
19151:* Sensitive to neomycin concentration in medium of .025 ugm/ml.
19152:* Sensitive to neomycin concentration in medium of .05 ugm/ml.
19153:* Sensitive to neomycin concentration in medium of .1 ugm/ml.
19154:* Sensitive to neomycin concentration in medium of .2 ugm/ml.
19155:* Sensitive to neomycin concentration in medium of .4 ugm/ml.
19156:* Sensitive to neomycin concentration in medium of .8 ugm/ml.
19157:* Sensitive to neomycin concentration in medium of 1.6 ugm/ml.
19158:* Sensitive to neomycin concentration in medium of 3 ugm/ml.
19159:* Sensitive to neomycin concentration in medium of 6 ugm/ml.
19160:* Sensitive to neomycin concentration in medium of 12 ugm/ml.
19161:* Sensitive to neomycin concentration in medium of 25 ugm/ml.
19162:* Sensitive to neomycin concentration in medium of 50 ugm/ml.
19163:* Sensitive to neomycin concentration in medium of 100 ugm/ml.
19164:* Sensitive to neomycin concentration in medium of 200 ugm/ml.
19165:* Sensitive to neomycin concentration in medium of 400 ugm/ml.
19166:* Sensitive to neomycin concentration in medium of 800 ugm/ml.
19167:* Sensitive to neomycin concentration in medium of 1600 ugm/ml.

NITROFURANTOIN
19168: Sensitive to nitrofurantoin concentration (disc) 100 ugm.
19169: Sensitive to nitrofurantoin concentration (disc) 300 ugm.
19170: Sensitive to nitrofurantoin at any concentration in medium of up to or greater than 1600 ugm/ml.
19171:* Sensitive to nitrofurantoin concentration in medium of .025 ugm/ml.
19172:* Sensitive to nitrofurantoin concentration in medium of .05 ugm/ml.
19173:* Sensitive to nitrofurantoin concentration in medium of .1 ugm/ml.
19174:* Sensitive to nitrofurantoin concentration in medium of .2 ugm/ml.
19175:* Sensitive to nitrofurantoin concentration in medium of .4 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19176:* Sensitive to nitrofurantoin concentration in medium of .8 ugm/ml.
19177:* Sensitive to nitrofurantoin concentration in medium of 1.6 ugm/ml.
19178:* Sensitive to nitrofurantoin concentration in medium of 3 ugm/ml.
19179:* Sensitive to nitrofurantoin concentration in medium of 6 ugm/ml.
19180:* Sensitive to nitrofurantoin concentration in medium of 12 ugm/ml.
19181:* Sensitive to nitrofurantoin concentration in medium of 25 ugm/ml.
19182:* Sensitive to nitrofurantoin concentration in medium of 50 ugm/ml.
19183:* Sensitive to nitrofurantoin concentration in medium of 100 ugm/ml.
19184:* Sensitive to nitrofurantoin concentration in medium of 200 ugm/ml.
19185:* Sensitive to nitrofurantoin concentration in medium of 400 ugm/ml.
19186:* Sensitive to nitrofurantoin concentration in medium of 800 ugm/ml.
19187:* Sensitive to nitrofurantoin concentration in medium of 1600 ugm/ml.

NOVOBIOCIN (ALBAMYCIN)
19188: Sensitive to novobiocin (albamycin) concentration (disc)
      30 ugm/ml.

OXACILLIN
19189: Sensitive to oxacillin concentration (disc) 1 ugm.
19190: Sensitive to oxacillin at any concentration in medium of up
to or greater than 1600 ugm/ml.
19191:* Sensitive to oxacillin concentration in medium of .025 ugm/ml.
19192:* Sensitive to oxacillin concentration in medium of .05 ugm/ml.
19193:* Sensitive to oxacillin concentration in medium of .1 ugm/ml.
19194:* Sensitive to oxacillin concentration in medium of .2 ugm/ml.
19195:* Sensitive to oxacillin concentration in medium of .4 ugm/ml.
19196:* Sensitive to oxacillin concentration in medium of .8 ugm/ml.
19197:* Sensitive to oxacillin concentration in medium of 1.6 ugm/ml.
19198:* Sensitive to oxacillin concentration in medium of 3 ugm/ml.
19199:* Sensitive to oxacillin concentration in medium of 6 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19200:* Sensitive to oxacillin concentration in medium of 12 ugm/ml.
19201:* Sensitive to oxacillin concentration in medium of 25 ugm/ml.
19202:* Sensitive to oxacillin concentration in medium of 50 ugm/ml.
19203:* Sensitive to oxacillin concentration in medium of 100 ugm/ml.
19204:* Sensitive to oxacillin concentration in medium of 200 ugm/ml.
19205:* Sensitive to oxacillin concentration in medium of 400 ugm/ml.
19206:* Sensitive to oxacillin concentration in medium of 800 ugm/ml.
19207:* Sensitive to oxacillin concentration in medium of 1600 ugm/ml.

OXYTETRACYLINE (TETRAMYCIN)
19208: Sensitive to oxytetracycline (tetramycin) concentration (disc) 30 ugm.

PENICILLIN G
19209: Sensitive to penicillin G concentration (disc) 1 unit.
19210: Sensitive to penicillin G concentration (disc) 2 units.
19211: Sensitive to penicillin G concentration (disc) 10 units.
19212: Sensitive to penicillin G at any concentration in medium of up to or greater than 1600 ugm/ml.
19213:* Sensitive to penicillin G concentration in medium of .025 units/ml.
19214:* Sensitive to penicillin G concentration in medium of .05 units/ml.
19215:* Sensitive to penicillin G concentration in medium of .1 units/ml.
19216:* Sensitive to penicillin G concentration in medium of .2 units/ml.
19217:* Sensitive to penicillin G concentration in medium of .4 units/ml.
19218:* Sensitive to penicillin G concentration in medium of .8 units/ml.
19219:* Sensitive to penicillin G concentration in medium of 1.6 units/ml.
19220:* Sensitive to penicillin G concentration in medium of 3 units/ml.
19221:* Sensitive to penicillin G concentration in medium of 6 units/ml.
19222:* Sensitive to penicillin G concentration in medium of 12 units/ml.
19223:* Sensitive to penicillin G concentration in medium of 25 units/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19224:* Sensitive to penicillin G concentration in medium of 50 units/ml.
19225:* Sensitive to penicillin G concentration in medium of 100 units/ml.
19226:* Sensitive to penicillin G concentration in medium of 200 units/ml.
19227:* Sensitive to penicillin G concentration in medium of 400 units/ml.
19228:* Sensitive to penicillin G concentration in medium of 800 units/ml.
19229:* Sensitive to penicillin G concentration in medium of 1600 units/ml.

POLYMYXIN B (AEROSPORIN)
19230: Sensitive to polymyxin B (aerosporin) concentration (disc) 50 units.
19231: Sensitive to polymyxin B (aerosporin) concentration (disc) 300 units.

PURAMYCIN
19232: Sensitive to puramycin concentration (disc) 200 ugm.

STREPTOMYCIN OR DIHYDROSTREPTOMYCIN
19233: Sensitive to streptomycin concentration (disc) 2.0 ugm.
19234: Sensitive to streptomycin concentration (disc) 2.5 ugm.
19235: Sensitive to streptomycin concentration (disc) 10 ugm.
19236: Sensitive to streptomycin or dihydrostreptomycin at any concentration in medium of up to or greater than 1600 ugm/ml.
19237:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of .025 ugm/ml.
19238:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of .05 ugm/ml.
19239:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of .1 ugm/ml.
19240:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of .2 ugm/ml.
19241:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of .4 ugm/ml.
19242:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of .8 ugm/ml.
19243:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 1.6 ugm/ml.
19244:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 3 ugm/ml.
19245:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 6 ugm/ml.
19246:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 12 ugm/ml.
19247:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 25 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19248:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 50 ugm/ml.
19249:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 100 ugm/ml.
19250:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 200 ugm/ml.
19251:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 400 ugm/ml.
19252:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 800 ugm/ml.
19253:* Sensitive to streptomycin or dihydrostreptomycin concentration in medium of 1600 ugm/ml.

SULFISOXAZOLE (GANTRISIN)
19254: Sensitive to sulfisoxazole (gantrisin) concentration (disc) .1 mgm.
19255: Sensitive to sulfisoxazole (gantrisin) concentration (disc) .25 mgm.
19256: Sensitive to sulfisoxazole at any concentration in medium of up to or greater than 1600 ugm/ml.
19257:* Sensitive to sulfisoxazole concentration in medium of .025 ugm/ml.
19258:* Sensitive to sulfisoxazole concentration in medium of .05 ugm/ml.
19259:* Sensitive to sulfisoxazole concentration in medium of .1 ugm/ml.
19260:* Sensitive to sulfisoxazole concentration in medium of .2 ugm/ml.
19261:* Sensitive to sulfisoxazole concentration in medium of .4 ugm/ml.
19262:* Sensitive to sulfisoxazole concentration in medium of .8 ugm/ml.
19263:* Sensitive to sulfisoxazole concentration in medium of 1.6 ugm/ml.
19264:* Sensitive to sulfisoxazole concentration in medium of 3 ugm/ml.
19265:* Sensitive to sulfisoxazole concentration in medium of 6 ugm/ml.
19266:* Sensitive to sulfisoxazole concentration in medium of 12 ugm/ml.
19267:* Sensitive to sulfisoxazole concentration in medium of 16 ugm/ml.
19268:* Sensitive to sulfisoxazole concentration in medium of 50 ugm/ml.
19269:* Sensitive to sulfisoxazole concentration in medium of 100 ugm/ml.
19270:* Sensitive to sulfisoxazole concentration in medium of 200 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

19271:* Sensitive to sulfisoxazole concentration in medium of 400 ugm/ml.
19272:* Sensitive to sulfisoxazole concentration in medium of 800 ugm/ml.
19273:* Sensitive to sulfisoxazole concentration in medium of 1600 ugm/ml.

TETRACYCLINE (ACHROMYCIN)
19274: Sensitive to tetracycline (achromycin) concentration (disc) 5 mgm.
19275: Sensitive to tetracycline (achromycin) concentration (disc) 30 mgm.
19276: Sensitive to tetracycline (achromycin) at any concentration in medium up to or greater than 1600 ugm/ml.

19277:* Sensitive to tetracycline (achromycin) concentration in medium of .025 ugm/ml.
19278:* Sensitive to tetracycline (achromycin) concentration in medium of .05 ugm/ml.
19279:* Sensitive to tetracycline (achromycin) concentration in medium of .1 ugm/ml.
19280:* Sensitive to tetracycline (achromycin) concentration in medium of .2 ugm/ml.
19281:* Sensitive to tetracycline (achromycin) concentration in medium of .4 ugm/ml.
19282:* Sensitive to tetracycline (achromycin) concentration in medium of .8 ugm/ml.
19283:* Sensitive to tetracycline (achromycin) concentration in medium of 1.6 ugm/ml.
19284:* Sensitive to tetracycline (achromycin) concentration in medium of 3 ugm/ml.
19285:* Sensitive to tetracycline (achromycin) concentration in medium of 6 ugm/ml.
19286:* Sensitive to tetracycline (achromycin) concentration in medium of 12 ugm/ml.
19287:* Sensitive to tetracycline (achromycin) concentration in medium of 25 ugm/ml.
19288:* Sensitive to tetracycline (achromycin) concentration in medium of 50 ugm/ml.
19289:* Sensitive to tetracycline (achromycin) concentration in medium of 100 ugm/ml.
19290:* Sensitive to tetracycline (achromycin) concentration in medium of 200 ugm/ml.
19291:* Sensitive to tetracycline (achromycin) concentration in medium of 400 ugm/ml.
19292:* Sensitive to tetracycline (achromycin) concentration in medium of 800 ugm/ml.
19293:* Sensitive to tetracycline (achromycin) concentration in medium of 1600 ugm/ml.
SECTION 19: ANTIBIOTIC SENSITIVITY

TRIPLE SULFA (SULFADIAZINE/SULFAMETHAZINE/SULFAMERAZINE)
19294: Sensitive to triple sulfa (sulfadiazine/sulfamethazine/ sulfamerazine) concentration (disc) 1 mgm.

VANCOCYN (VANCOMYCIN)
19295: Sensitive to vancocyn (vancomycin) concentration (disc) 5.0 ugm.
19296: Sensitive to vancocyn (vancomycin) concentration (disc) 7.5 ugm.
19297: Sensitive to vancocyn (vancomycin) concentration (disc) 30.0 ugm.
99019: Antibiotic sensitivity: Comments.
SECTION 20: PIGMENTS

NOTE 1: For definition of colors use a standard reference such as Munsel, Color-harmony or Ridgeway standards.

NOTE 2: For colors of fruiting bodies, also see Section 7.

20001: Colonies are pure (paper) white on solid medium.
20002: Colonies are gray on solid medium.
20003: Colonies have a characteristic greenish hue as revealed by oblique light.
20004: Colonies fluoresce with Wood's light (long ultraviolet).
20005: Extracellular fluorescent pigment observed with Wood's light (long ultraviolet).
20006: Extracellular fluorescent pigment observed with short wavelength ultraviolet light (ca. 260 nm.).
20007: Colonies luminescent in the dark.
20008: Pigments produced in the light.
20009: Underside of colony pigmented.
20010:* Pigment on underside of colony changes color when the pH is lowered below pH 3.0.
20011:* Pigment on underside of colony changes color when the pH is raised above pH 12.0.
20012: Cells contain green photosynthetic pigments.
20013:* Cells contain bacteriochlorophyll 770 nm.
20014:* Cells contain bacteriochlorophyll 870 nm.
20015:* Cells contain Chlorobium chlorophyll 660.
20016:* Cells contain Chlorobium chlorophyll 650.
20017:* Cells contain chlorophyll a.
20018: Cells contain or produce pigments other than chlorophylls.
20019:** Diffusible (water-soluble) pigments are produced.
20020:** Diffusible blue pigments are produced.
20021:** Diffusible yellow pigments are produced.
20022:** Diffusible green pigments are produced.
20023:** Diffusible red pigments are produced.
20024:** Diffusible orange pigments are produced.
20025:** Diffusible violet (purple) pigments are produced.
20026:** Diffusible brown pigments are produced.
20027:** Diffusible black pigments are produced.
20028:** Pyocyanin is produced.
20029:** Indochrome is produced.
20030:** Fluorescein is produced.
20031:** Melanin is produced.
20032:** Iodinin is produced (also see Section 5).
20033:** Chlororaphin is produced.
20034:** Oxychlororaphin is produced.
20035:** Diffusible pigment changes color when pH is lowered
SECTION 20: PIGMENTS

below 3.0.
20036:** Diffusible pigment changes color when pH is raised above 12.0.

20037:* Non-diffusible pigments are produced.
20038:** Non-diffusible red pigments are produced.
20039:** Non-diffusible brown pigments are produced.
20040:** Non-diffusible green pigments are produced.
20041:** Non-diffusible purple pigments are produced.
20042:** Non-diffusible blue pigments are produced.
20043:** Non-diffusible golden (yellow) pigments are produced.
20044:** Non-diffusible orange pigments are produced.
20045:** Cells contain carotenoid pigments.
20046:** Cells contain spirilloxanthin (series A, B, C).
20047:** Cells contain xanthine.
20048:** Cells contain okenone.
20049:** Cells contain chlorobactene (A, B).
20050:** Cells contain tetrahydroxyspirilloxanthine.
20051:** Indigoidine is produced.
20052:** Violacein is produced.
20053:** Prodigiosin is produced.
20054:** Heme pigments are produced.
20055:** Heme pigments are coupled to a protein.
99020: Pigments: Comments.
SECTION 21: CELL-BOUND LIPOIDS

21001: Membranes contain lipid.
21002: A disaccharide residue is glycosidically linked to the 1-position of an alpha,beta-diglyceride.
21003: Cell contains alpha-glucosylglucosyl diglyceride.
21004: Cell contains beta-glucosylglucosyl diglyceride.
21005: Cell contains alpha-galactosylglucosyl diglyceride.
21006: Cell contains beta-galactosylglucosyl diglyceride.
21007: Cell contains alpha-mannosylmannosyl diglyceride.
21008: Phosphatidyl-glycerol with amino acid ester linkages present.
21009: Mycolic acids (C88 and higher) present.
21010: C-15 branched acids present.
21011: Cholesterol extractable from cells (also see Section 5).
21012: Choline bound with lipid-like substances in the cell.
21013: Ethanolamine bound with lipid-like substances in the cell.
99021: Cell-bound lipids: Comments.
SECTION 22: LYsis

22001: Majority of cells in a culture lyse spontaneously within two weeks.
22002: Cells lyse in distilled water.
22003: Magnesium ions protect against lysis in distilled water.
22004: Divalent cations protect against lysis in distilled water.
22005: Sodium ions protect against lysis in distilled water.
22006: Monovalent cations protect against lysis in distilled water.
22007: Cells are lysed by 10 mg. lysozyme per 2-3 grams wet weight of cells.
22008: Cells are lysed by 2% (final concentration) of sodium lauryl sulfate (sodium dodecyl sulfate).
22009: Cells are lysed by 10% bile.
22010: Cells are lysed by 40% bile.
22011: Cells are lysed by osmotic shock (reduction of at least 10-fold in tonicity).
22012: Cells are lysed by freezing and thawing.
22013: Cells are easily lysed by sonic vibration within 5 minutes.
22014: Cells are lysed by bacteriophage.
22015: Sphaeroplasts are formed in osmotically protective media, e.g., 20% sucrose.
22016: Incorporation of glycine (0.1M) in media results in enlarged cells and L forms.
22017: Majority of cells are lysed in 5% NaCl after 4 hours.
99022: Lysis: Comments.
SECTION 23: CELL WALL STRUCTURE

23001: Cell wall present.
23002: In electron micrographs of thin-sections of organisms the cell wall appears as a layer homogenous in density, 100-800 angstroms thick, extracellular to the plasma membrane.
23003: In electron micrographs of thin-sections of organisms the cell wall appears as a triple-layered structure, 60-100 angstroms thick (outer membrane) separated by one or more layers of variable electron density from the plasma membrane.
23004: As for 3 but showing in addition one or more layers of definite order or structure extracellular to the outer membrane.
23005: Electron micrographs of negatively stained, freeze-etched or shadowed organisms show a smooth surface structure.
23006: Electron micrographs of negatively stained, freeze-etched or shadowed organisms show a wrinkled surface structure.
23007: Electron micrographs of negatively stained, freeze-etched or shadowed organisms show a regular surface pattern of linear striations.
23008: Electron micrographs of negatively stained, freeze-etched or shadowed organisms show a surface polygonal array of spherical sub-units.
23009: Electron micrographs of negatively stained, freeze-etched or shadowed organisms show a surface criss-cross pattern of fibers, often in pairs.
23010: Cell wall contains peptidoglycan (mucoprotein).
23011: Peptidoglycan represents <10% of the mass of the cell wall.
23012: Peptidoglycan represents >10% of the mass of the cell wall.
23013: The back-bone structure of the cell wall peptidoglycan consists of alternating beta-1,4-linked N-acetylglucosamine and N-acetylmuramic acid residues.
23014: N-acetylmuramic acid residues in the peptidoglycan bear O-acetyl substituents.
23015: The carboxyl groups of the N-acetylmuramic acid residues are substituted with peptide sub-units of the sequence -L-Ala-D-Glu-(diamino)amino-D-Ala.
23016: The carboxyl groups of the N-acetylmuramic acid residues are substituted with peptide sub-units of the sequence -L-Ala-D-Glu-alpha-NH2 with the glutamic acid residue also linked in the gamma position with diamino amino-D-Ala acid sequence.
23017: The carboxyl groups of the N-acetyl muramic acid residues are substituted with peptide sub-units of the sequence -L-Ala-D-Glu linked in the alpha position of glutamic acid with glycine, and also in the gamma position of glutamic acid with a diamino amino D-Ala acid residue.
23018: The carboxyl groups of the N-acetylmuramic acid residues
SECTION 23: CELL WALL STRUCTURE

are substituted with peptide sub-units of the sequence
-Gly-D-Glu (with the gamma position of glutamic acid linked
to a HomoSer-D-Ala sequence).

23019: The carboxyl groups of the N-acetilmuramic acid residues
are substituted with peptide sub-units of the sequence
-L-Ser-D-Glu (the gamma position of glutamic acid being
linked with a diamino-D-Ala amino acid sequence).

23020: The carboxyl groups of the N-acetilmuramic acid residues
are substituted with peptide sub-units of the sequence
-L-Ala-threo-3-hydroxy-Glu (diamino-amino acid-D-Ala).

23021: The diamino-amino acid in the peptide sub-units is DL-DAP.

23022: The diamino-amino acid in the peptide sub-units is LL-DAP.

23023: The diamino-amino acid in the peptide sub-units is DD-DAP.

23024: The diamino-amino acid in the peptide sub-units is L-lysine.

23025: The diamino-amino acid in the peptide sub-units is
2,4-diamino-butyric acid.

23026: The diamino-amino acid in the peptide sub-units is
2,5-diamino-3-hydroxy-pimellic acid.

23027: The diamino-amino acid in the peptide sub-units is L-ornithine.

23028: The diamino-amino acid in the peptide sub-units is
hydroxylysine.

23029: The carboxyl groups of the N-acetilmuramic acid residues are
substituted with peptide sub-units of a sequence other than
that defined by characters 15-20.

23030: More than 50% of the peptide sub-units of the peptidoglycan
are cross-linked.

23031: Less than 50% of the peptide sub-units of the peptidoglycan
are cross-linked.

23032: Cross-linking bridges extend from an amino-group of the
diamino-amino acid of one peptide sub-unit to the C-terminal
D-Ala carboxyl of another peptide sub-unit.

23033: Cross-linking bridges extend from the alpha-carboxyl group
of the glutamic acid residue of one peptide sub-unit to the
C-terminal D-Ala carboxyl of another peptide sub-unit.

23034: Cross-linking bridges are direct and do not involve
additional amino acids.

23035: Cross-linking bridges are indirect and composed of short
peptides of glycine and/or other L-amino acids.

23036: Cross-linking bridges are indirect and composed of a single
D-amino acid.

23037: Cross-linking bridges are indirect and composed of diamino-
amino acid.

23038: Cross-linking bridges are indirect and composed of several
peptides, joined "head to tail," each having the same amino
acid sequence as the peptide sub-units.

23039: Cross-linking bridges are indirect and of a structure not
described by characters 23035 - 23038.
SECTION 23: CELL WALL STRUCTURE

23040: Teichoic acid is present in the cell wall.
23041:* Wall teichoic acid is a ribitol phosphate polymer.
23042:* Wall teichoic acid is a glycerol phosphate polymer.
23043:* Wall teichoic acid has glycosidic substituents.

23044: Glycosidic substituents of wall teichoic acid are hexoses.
23045: Glycosidic substituents of wall teichoic acid are hexosamines.
23046: Glycosidic substituents of wall teichoic acid are alpha in configuration.
23047: Glycosidic substituents of wall teichoic acid are beta in configuration.
23048:* Wall teichoic acid bears D-alanyl ester substituents.
23049:* Wall teichoic acid bears acyl substituents other than D-alanine.
23050:* Phosphodiester linkages of wall teichoic acid involve alditol primary hydroxyl groups.
23051:* Phosphodiester linkages of wall teichoic acid involve primary and secondary hydroxyl groups of alditol residues.
23052:* Wall teichoic acids are group precipitogens.
23053:* Serological activity of wall teichoic acid is specific to glycosidic substituents.
23054:* Serological activity of wall teichoic acid is specific to acyl substituents.
23055:* Serological activity of wall teichoic acid is specific to the alditol phosphate backbone.
23056:* Wall teichoic acid is implicated as a bacteriophage receptor.

23057: Membrane glycerol teichoic acids are present in organism.
23058:* Membrane teichoic acid is associated with lipid (lipoteichoic acid).
23059:* Membrane teichoic acid has glycosidic substituents.
23060:** Glycosidic substituents of membrane teichoic acid are hexoses.
23061:** Glycosidic substituents of membrane teichoic acid are hexosamines.
23062:** Glycosidic substituents of membrane teichoic acid are oligosaccharides.
23063:** Glycosidic substituents of membrane teichoic acid are alpha in configuration.
23064:** Glycosidic substituents of membrane teichoic acid are beta in configuration.
23065:* Membrane teichoic acids bear D-alanyl ester substituents.
23066:* Membrane teichoic acids bear acyl substituents other than D-alanine.
23067:* Substitution of membrane glycerol teichoic acid is qualitatively identical to wall teichoic acid.
23068:* Membrane teichoic acids are group precipitogens.
23069:* Serological specificity of membrane teichoic acid is
SECTION 23: CELL WALL STRUCTURE

Specific to its glycosidic substituents.

23070:* Serological specificity of membrane teichoic acid is specific to its acyl substituents.

23071:* Serological specificity of membrane teichoic acid is specific to its alditol phosphate back-bone.

23072: Cell wall contains polysaccharides.

23073:* Cell wall polysaccharide is group specific precipitinogen.

23074:* Cell wall polysaccharide is type specific precipitinogen.

23075:* Cell wall polysaccharide is implicated as a bacteriophage receptor.

23076:* Cell wall polysaccharide contains hexose residues.

23077:* Cell wall polysaccharide contains hexosamine residues.

23078:* Cell wall polysaccharide contains pentose residues.

23079:* Cell wall polysaccharide contains uronic acid residues.

23080:* Cell wall polysaccharide contains deoxysugar residues.

23081:* Cell wall polysaccharide contains alditol phosphate residues and is of the type - (sugar)x-alditol-P04 - 0.

23082:* Cell wall polysaccharide contains alditol phosphate residues and is of the type - (sugar-P04-alditol-P04)x - 0.

23083:* Cell wall polysaccharide bears alditol phosphate residues as side chain substituents.

23084:* Cell wall polysaccharide contains phosphodiester linkages between sugar residues.

23085:** Glycosidic linkages in cell wall polysaccharide are predominantly alpha in configuration.

23086:** Glycosidic linkages in cell wall polysaccharide are predominantly beta in configuration.

23087: Lipid present in cell wall (particularly phospholipid).

23088:* Total lipid of cell wall <3% dry weight.

23089:* Lipopolysaccharides present in cell wall.

23090:** Lipopolysaccharide can be extracted as an endotoxic complex with protein.

23091:** Polysaccharide moiety of lipopolysaccharide contains 2-keto-3-deoxyoctonic acid (KDO).

23092:** Polysaccharide of lipopolysaccharide contains heptose.

23093:** Polysaccharide of lipopolysaccharide contains hexoses.

23094:** Polysaccharide moiety of lipopolysaccharide contains 6-deoxyhexoses.

23095:** Polysaccharide moiety of lipopolysaccharide contains 3,6-dideoxyhexoses.

23096:** Polysaccharide moiety of lipopolysaccharide contains hexosamines.

23097:** Polysaccharide moiety of lipopolysaccharide contains 6-deoxyhexosamines.

23098:** Polysaccharide moiety of lipopolysaccharide contains dideoxyhexosamines.

23099:** Lipopolysaccharide shows R-antigen specificity (rough
SECTION 23: CELL WALL STRUCTURE

23100:** Lipopolysaccharide shows O-antigen specificity (smooth variant).

23101:** Lipid component of lipopolysaccharide <50% dry weight.

23102: Cell wall contains waxes (glycolipids to >5% of the dry weight).

23103: Cell wall contains lipoprotein.

23104: Cell wall contains protein not associated with lipid.

23105: * Cell wall protein is antigenic.

23106:* Cell wall protein shows type specific antigenicity.

23107:* Cell wall protein is associated with virulence.

23108:* Cell wall protein appears to have "structural" role.

23109:* Cell wall protein has enzymic activity.

23110: Cell walls contain autolysins.

23111:* Autolysin has endo-N-acetylmuramidase activity.

23112:* Autolysin has endo-N-acetylglucosaminidase activity.

23113:* Autolysin has N-acetylmuramyl-L-alanine amidase activity.

23114:* Autolysin has endopeptidase activity.

23115: Lytic enzymes convert whole organisms into protoplasts.

23116: Lytic enzymes convert whole organisms into sphaeroplasts.

23117: Cell wall synthesis is inhibited by penicillins.

23118: Cell wall synthesis is inhibited by cephalosporins.

23119: Cell wall synthesis is inhibited by vancomycin.

23120: Cell wall synthesis is inhibited by ristocetin.

23121: Cell wall synthesis is inhibited by bacitracin.

23122: Cell wall synthesis is inhibited by D-cycloserine or o-carbamyl-D-serine.

99023: Cell wall: Comments.
SECTION 24: METABOLIC REACTIONS

SYNTHESIS OF EXTRACELLULAR POLYSACCHARIDES
24001: Cellulose is produced.
24002: Extracellular dextrans are synthesized from sucrose.
24003: Extracellular levans are synthesized from sucrose.

DEGRADATION OF COMPLEX ORGANIC SUBSTANCES
24004: Agar is hydrolyzed (liquefied).
24005: Carrageenan is degraded.
24006: Carrot: sterile wedges are softened.
24007: Casein is hydrolyzed (peptonized).
24008: Collagen is degraded.
24009: Gelatin is hydrolyzed (liquefied).
24010: Keratin is degraded.
24011: Pectin is hydrolyzed.
24012: Potato: sterile wedges are softened.

GLUCOSE CATABOLISM
24013: D-Glucose is catabolized.
24014:* D-Glucose catabolized aerobically.
24015:* D-Glucose catabolized anaerobically.

FATTY ACIDS FROM GLUCOSE
24016:* Acetic acid is produced from glucose.
24017:* Acetic acid is produced from glucose without carbon dioxide production.
24018:* Butyric acid is produced from glucose.
24019:* Iso-Butyric acid is produced from glucose.
24020:* Caproic acid is produced from glucose.
24021:* Iso-Caproic acid is produced from glucose.
24022:* Caprylic acid is produced from glucose.
24023:* Formic acid is produced from glucose.
24024:* Oenanthic acid is produced from glucose.
24025:* Propionic acid is produced from glucose.
24026:* Valeric acid is produced from glucose.
24027:* Iso-Valeric acid is produced from glucose.

KETO- AND HYDROXY- ACIDS FROM GLUCOSE
24028:* Lactic acid (D-) is produced from glucose.
24029:* Lactic acid (L+) is produced from glucose.
24030:* Lactic acid (DL) is produced from glucose.
24031:* Gluconic acid is produced from glucose.
24032:* 2-Ketogluconic acid is produced from glucose.

DICARBOXYLIC ACID FROM GLUCOSE
24033:* Succinic acid is produced from glucose.

ALCOHOLS AND KETONES FROM GLUCOSE
24034:* Acetone is produced from glucose.
24035:* Acetyl methylcarbinol is produced from glucose.
24036:* 2,3-Butanediol is produced from glucose.
24037:* Butanol is produced from glucose.
SECTION 24: METABOLIC REACTIONS

24038:* Iso-Butanol is produced from glucose.
24039:* Ethanol is produced from glucose.
24040:* Glycerol is produced from glucose.
24041:* Hexanol is produced from glucose.
24042:* Pentanol is produced from glucose.
24043:* Propanol is produced from glucose.
24044:* Iso-Propanol is produced from glucose.

GASES FROM GLUCOSE
24045:* Carbon dioxide is produced from glucose.
24046:* Hydrogen gas is produced from glucose.

LACTIC ACID CATABOLISM
24047: Lactate catabolized.
24048:* Lactate catabolized aerobically.
24049:* Lactate catabolized anaerobically.
24050:* Acetic acid is produced from lactate.
24051:* Butyric acid is produced from lactate.
24052:* Caproic acid is produced from lactic acid.
24053:* Carbon dioxide is produced from lactate.
24054:* Hydrogen is produced from lactate.
24055:* Propionic acid is produced from lactate.
24056:* Succinic acid is produced from lactate.
24057:* Valeric acid is produced from lactic acid.

SPECIFIC CATABOLIC REACTIONS OF ORGANIC COMPOUNDS

ACIDS
24058: Acrylate reduction yields propionate.
24059: Alpha-crotonic acid utilized.
24060: Formate is decomposed to hydrogen and carbon dioxide.
24061: Glutaric acid salts utilized.
24062: Gluconate yields reducing compounds (i.e., containing carbonyl groups).
24063:* Gluconate yields 2-ketogluconate.
24064:* Gluconate yields 5-ketogluconate.
24065:* Gluconate yields 2,5-ketogluconate.
24066: Alpha-ketobutyrate yields glycine.
24067: Pyruvate is decomposed, yielding acetate, hydrogen and carbon dioxide.
24068: Succinate yields propionate.
24069: Succinate yields carbon dioxide.

ALCOHOLS (INCLUDING AROMATIC)
24070: Acetone is reduced to isopropyl alcohol.
24071: Catechol is cleaved by meta-cleavage.
24072: Catechol is cleaved by ortho-cleavage.
24073: Ethanol yields acetic acid.
24074: Ethanol is reduced to caproic acid.
24075: Glycerol yields dihydroxyacetone.
24076: Glycerol yields acrolein.
24077: Phenol is oxidized.
SECTION 24: METABOLIC REACTIONS

24078: Protocatechuic acid is cleaved by meta-cleavage.
24079: Protocatechuic acid is cleaved by ortho-cleavage.

AMINO ACIDS AND PEPTONES
24080: Acid is produced from carbohydrate-free media containing amino acids or peptones.
24081: Gas is produced from carbohydrate-free media containing amino acids or peptones.
24082: The Stickland reaction occurs in which mutual oxidation-reduction between two amino acids (one acting as a hydrogen donor and one acting as a hydrogen receptor) results in the formation of a keto acid, a fatty acid, and ammonia.

24083: Alanine yields acetate.
24084: Alanine yields propionate.
24085: Arginine yields citrulline.
24086: Aspartate yields acetate.
24087: Aspartate yields ethanol.
24088: Aspartate yields lactate.
24089: Citrulline yields ornithine.
24090: Glycine yields acetate.
24091: Glutamate yields acetate.
24092: Glutamate yields butyrate.
24093: Glutamate yields hydrogen.
24094: Histidine yields acetate.
24095: Histidine yields butyrate.
24096: Histidine yields formamide.
24097: Histidine yields formic acid.
24098: Histidine yields molecular hydrogen.
24099: Histidine yields lactate.
24100: Lysine yields acetate.
24101: Lysine yields butyrate.
24102: Serine yields acetate.
24103: Serine yields butyrate.
24104: Serine yields ethanol.
24105: Serine yields formate.
24106: Serine yields molecular hydrogen.
24107: Serine yields lactate.
24108: Serine yields propionate.
24109: Serine yields pyruvate.
24110: Serine yields valerate.
24111: Threonine yields butyrate.
24112: Threonine yields alpha-ketobutyrate.
24113: Threonine yields propionate.
24114: Tryptophan yields indole.
24115: Tryptophan yields skatol.
24116: Tryptophan yields methylindole.
24117: Tryptophan yields pyruvate.
24118: Tyrosine yields phenol.
SECTION 24: METABOLIC REACTIONS

24119: Tyrosine yields p-cresol.
24120: Tyrosine yields p-hydroxyphenylacetic acid.
24121: Tyrosine yields p-hydroxyphenyllactic acid.

CARBOHYDRATES
24122: D-Arabinose is oxidized to D-arabonic acid.
24123: L-Arabinose is oxidized to L-arabonic acid.
24124: D-Fructose is reduced to mannitol.
24125: Lactose is oxidized to 3-ketolactose.
24126: D-Ribose is oxidized to D-ribonic acid.
24127: D-Xylose is oxidized to D-xylonic acid.

MISCELLANEOUS
24128: Methane is produced.
24129: Trimethylamine oxide is reduced to trimethylamine.
24130: Uric acid salts utilized.
24131: Alkylamines are oxidized.
24132: Indole is oxidized to indigotin.

REACTIONS INVOLVING INORGANIC PRODUCTS OR SUBSTRATES

AMMONIA, NITRATE, NITRITE, NITROGEN
24133: Ammonium ion is oxidized.
24134: Ammonium thiocyanate serves as a sole carbon and nitrogen source for growth and is oxidized to ammonium sulfate and carbon dioxide.
24135: Ammonia is produced.
24136: Ammonia is produced from peptones.
24137: Nitrite is oxidized.
24138: Nitrate is reduced.
24139: Nitrate is reduced to nitrite.
24140: Nitrite is reduced to nitric oxide.
24141: Nitrite is reduced to ammonia.
24142: Nitrite is reduced to hydroxylamine.
24143: Molecular nitrogen is utilized.

SULFUR COMPOUNDS
24144: Hydrogen sulfide is oxidized.
24145: Thiosulfate is oxidized.
24146: Tetrathionate is oxidized.
24147: Triathionate is oxidized.
24148: Hydrogen sulfide is produced.
24149: Thiosulfate is reduced to hydrogen sulfide.
24150: Sulfate is reduced to hydrogen sulfide.
24151: Sulfite is reduced to sulfide.
24152: Sulfite is reduced to hydrogen sulfide.
24153: Elementary sulfur is reduced to hydrogen sulfide.
24154: Hydrogen sulfide is produced from cysteine.
24155: Hydrogen sulfide is produced from cystine.
24156: Hydrogen sulfide is produced from reduced glutathione.
24157: Hydrogen sulfide is produced from oxidized glutathione.
24158: Hydrogen sulfide is produced from methionine.
SECTION 24: METABOLIC REACTIONS

24159: Elementary sulfur is oxidized.
24160: Sulfite is oxidized.
24161: Tetrathionate is reduced.

OXYGEN, CARBON DIOXIDE, HYDROGEN, MISCELLANEOUS
24162: Molecular oxygen is utilized.
24163: Molecular oxygen is produced.
24164: Hydrogen peroxide is decomposed.
24165: Molecular hydrogen is oxidized.
24166: Molecular hydrogen is oxidized to hydrogen peroxide.
24167: Molecular hydrogen is oxidized to water.
24168: Molecular hydrogen is produced.
24169: Hydrogen gas is specifically produced from the nitrogenous constituents of peptones.
24170: Carbon dioxide is produced.
24171: Carbon monoxide is oxidized to carbon dioxide.
24172: Carbon dioxide is specifically produced from the nitrogenous constituents of peptones.
24173: Ferrous iron is oxidized.
24174: Manganese compounds are oxidized in the absence of citrate.
24175: Tellurite is reduced.
24176: Selenite is reduced.
24177: Methane is oxidized to carbon dioxide and water.
24178: Methanol is oxidized to carbon dioxide and water.

DYE REDUCTION AND SPECIFIC INDICATOR TESTS
24179: Benzylviologen is reduced.
24180: Litmus milk acid.
24181: Litmus milk coagulated.
24182: Litmus milk alkaline.
24183: Litmus milk peptonized.
24184: Litmus reduced.
24185: Methyl red test is positive.
24186: Methylene blue reduced.
24187: Resazurin is reduced to resorufin.
24188: Resorufin is reduced.
24189: One or more sulfonphthalein indicators reduced (bromthymol blue, phenol red, etc.).
24190: Tetrazolium dyes are reduced.
24191: Voges-Proskauer test positive (also see question 35).

TOXIN PRODUCTION AND HEMOLYSIS
24192: A neurotropic toxin is produced.
24193: A diffusible toxin (exotoxin) is produced.
24194: A toxin is liberated into the medium only if cell autolysis occurs.
24195: An enterotoxin is produced.
24196: A hemolytic toxin is produced.
24197: Cells are hemolytic.
24198:* Sheep blood hemolysis is alpha.
SECTION 24: METABOLIC REACTIONS

24199: Sheep blood hemolysis is beta.
24200: Ox blood hemolysis is alpha.
24201: Ox blood hemolysis is beta.
24202: Horse blood hemolysis is alpha.
24203: Horse blood hemolysis is beta.
24204: Human blood hemolysis is alpha.
24205: Human blood hemolysis is beta.

99024: Metabolic reactions: Comments.
SECTION 25: CARBOHYDRATE METABOLISM

25001: At least one carbohydrate is utilized (growth measurement).

MONOSACCHARIDES

TRIOSES
25002: * Dihydroxyacetone is utilized.
25003: * Glyceraldehyde is utilized.

TETROSES
25004: * L-Erythrulose is utilized.
25005: * D-Threose is utilized.

PENTOSES
25006: * D-Arabinose is utilized.
25007: * L-Arabinose is utilized.
25008: * D-Lyxose is utilized.
25009: * L-Lyxose is utilized.
25010: * D-Ribose is utilized.
25011: * D-Ribulose is utilized.
25012: * D-Xylose is utilized.
25013: * D-Xylulose is utilized.

METHYL PENTOSES
25014: * D-Fucose is utilized.
25015: * L-Fucose is utilized.
25016: * D-Rhamnose is utilized.
25017: * L-Rhamnose is utilized.

HEXOSES
25018: * D-Allose is utilized.
25019: * D-Fructose is utilized.
25020: * D-Galactose is utilized.
25021: * D-Glucose is utilized (also see Section 24).
25022: * D-Mannose is utilized.
25023: * L-Sorbose is utilized.

HEPTOSES
25024: * Alpha-D-Galactoheptose is utilized.
25025: * Beta-D-Galactoheptose is utilized.
25026: * Alpha-D-Glucoheptose is utilized.
25027: * Sedoheptulose is utilized.

GLYCOSIDES
25028: * Aesculin is utilized.
25029: * Amygdalin is utilized.
25030: * Arbutin is utilized.
25031: * Coniferin is utilized.
25032: * Methyl-D-Xyloside is utilized.
25033: * Alpha-Methyl-D-Glucoside is utilized.
25034: * Beta-Methyl-D-Glucoside is utilized.
25035: * Alpha-Methyl-D-Mannoside is utilized.
25036: * Salicin is utilized.

DISACCHARIDES
SECTION 25: CARBOHYDRATE METABOLISM

25037:* Cellbiose is utilized.
25038:* Lactose is utilized.
25039:* Maltose is utilized.
25040:* Melibiose is utilized.
25041:* Sucrose is utilized.
25042:* Trehalose is utilized.

TRI SACCHARIDES
25043:* D-Melezitose is utilized.
25044:* Raffinose is utilized.

POLYSACCHARIDES
PENTOSANS
25045:* Xylan is utilized.

HEXOSANS
25046:* Cellulose is utilized.
25047:* Chitin is utilized.
25048:* Dextran is utilized.
25049:* Dextrin is utilized.
25050:* Glycogen is utilized.
25051:* Inulin is utilized.
25052:* Starch is utilized.

OTHER POLYSACCHARIDES
25053:* Alginic Acid is utilized.
25054:* Bacterial Polysaccharide is utilized.
25055:* Gum Arabic is utilized.
25056:* Hemicellulose is utilized.
25057:* Lignocellulose is utilized.
25058:* Mannan is utilized.
25059: At least one carbohydrate is oxidized (manometric, polarographic, etc. measurement).

MONOSACCHARIDES
TRIOSES
25060:* Dihydroxyacetone is oxidized.
25061:* Glyceraldehyde is oxidized.

TETROSES
25062:* L-Erythrulose is oxidized.
25063:* D-Threose is oxidized.

PENTOSES
25064:* D-Arabinose is oxidized.
25065:* L-Arabinose is oxidized.
25066:* D-Lyxose is oxidized.
25067:* L-Lyxose is oxidized.
25068:* D-Ribose is oxidized.
25069:* D-Ribulose is oxidized.
25070:* D-Xylose is oxidized.
25071:* D-Xylulose is oxidized.

METHYL PENTOSES
25072:* D-Fucose is oxidized.
SECTION 25: CARBOHYDRATE METABOLISM

25073:* L-Fucose is oxidized.
25074:* D-Rhamnose is oxidized.
25075:* L-Rhamnose is oxidized.

HEXOSES
25076:* D-Allose is oxidized.
25077:* D-Fructose is oxidized.
25078:* D-Galactose is oxidized.
25079:* D-Glucose is oxidized (also see Section 24).
25080:* D-Mannose is oxidized.
25081:* L-Sorbose is oxidized.

HEPTOSES
25082:* Alpha-D-Galaheptose is oxidized.
25083:* Beta-D-Galaheptose is oxidized.
25084:* Alpha-D-Glucoheptose is oxidized.
25085:* Sedoheptulose is oxidized.

GLYCOSES
25086:* Aesculin is oxidized.
25087:* Amygdalin is oxidized.
25088:* Arbutin is oxidized.
25089:* Coniferin is oxidized.
25090:* Methyl-D-Xyloside is oxidized.
25091:* Alpha-Methyl-D-Glucoside is oxidized.
25092:* Beta-Methyl-D-Glucoside is oxidized.
25093:* Alpha-Methyl-D-Mannoside is oxidized.
25094:* Salicin is oxidized.

DISACCHARIDES
25095:* Cellobiose is oxidized.
25096:* Lactose is oxidized.
25097:* Maltose is oxidized.
25098:* Melibiose is oxidized.
25099:* Sucrose is oxidized.
25100:* Trehalose is oxidized.

TRISACCHARIDES
25101:* Melezitose is oxidized.
25102:* Raffinose is oxidized.

POLYSACCHARIDES
25103:* Xylan is oxidized.

HEXOSANS
25104:* Cellulose is oxidized.
25105:* Chitin is oxidized.
25106:* Dextran is oxidized.
25107:* Dextrin is oxidized.
25108:* Glycogen is oxidized.
25109:* Inulin is oxidized.
25110:* Starch is oxidized.

OTHER POLYSACCHARIDES
SECTION 25: CARBOHYDRATE METABOLISM

25111:* Alglnic Acid is oxidized.
25112:* Bacterial Polysaccharide is oxidized.
25113:* Gum Arabic is oxidized.
25114:* Hemicellulose is oxidized.
25115:* Lignocellulose is oxidized.
25116:* Mannan is oxidized.
25117: At least one carbohydrate is reduced (manometric, polarographic, etc. measurement).

MONOSACCHARIDES
TRIOSES
25118:* Dihydroxyacetone is reduced.
25119:* Glyceraldehyde is reduced.
TETROSES
25120:* L-Erythrulose is reduced.
25121:* D-Threose is reduced.
PENTOSES
25122:* D-Arabinose is reduced.
25123:* L-Arabinose is reduced.
25124:* D-Lylose is reduced.
25125:* L-Lylose is reduced.
25126:* D-Ribose is reduced.
25127:* D-Ribulose is reduced.
25128:* D-Xylose is reduced.
25129:* D-Xyulose is reduced.
METHYL PENTOSES
25130:* D-Fucose is reduced.
25131:* L-Fucose is reduced.
25132:* D-Rhamnose is reduced.
25133:* L-Rhamnose is reduced.
HEXOSES
25134:* D-Allose is reduced.
25135:* D-Fructose is reduced.
25136:* D-Galactose is reduced.
25137:* D-Glucose is reduced (also see Section 24).
25138:* D-Mannose is reduced.
25139:* L-Sorbose is reduced.
HEPTOSES
25140:* Alpha-D-Galaheptose is reduced.
25141:* Beta-D-Galaheptose is reduced.
25142:* Alpha-D-Glucoheptose is reduced.
25143:* Sedoheptulose is reduced.
GLYCOSIDES
25144:* Aesculin is reduced.
25145:* Amygdalin is reduced.
25146:* Arbutin is reduced.
25147:* Coniferin is reduced.
25148:* Methyl-D-Xyloside is reduced.
SECTION 25: CARBOHYDRATE METABOLISM

25149: * Alpha-Methyl-D-Glucoside is reduced.
25150: * Beta-Methyl-D-Glucoside is reduced.
25151: * Alpha-Methyl-D-Mannoside is reduced.
25152: * Salicin is reduced.

DISACCHARIDES
25153: * Cellobiose is reduced.
25154: * Lactose is reduced.
25155: * Maltose is reduced.
25156: * Melibiose is reduced.
25157: * Sucrose is reduced.
25158: * Trehalose is reduced.

TRISACCHARIDES
25159: * Melezitose is reduced.
25160: * Raffinose is reduced.

POLYSACCHARIDES

PENTOSANS
25161: * Xylan is reduced.

HEXOSANS
25162: * Cellulose is reduced.
25163: * Chitin is reduced.
25164: * Dextran is reduced.
25165: * Dextrin is reduced.
25166: * Glycogen is reduced.
25167: * Inulin is reduced.
25168: * Starch is reduced.

OTHER POLYSACCHARIDES
25169: * Alginate is reduced.
25170: * Bacterial Polysaccharide is reduced.
25171: * Gum Arabic is reduced.
25172: * Hemicellulose is reduced.
25173: * Lignocellulose is reduced.
25174: * Mannan is reduced.

25175: Acid is produced from at least one carbohydrate (indicator dye or pH meter).

MONOSACCHARIDES

TRIOSES
25176: * Acid produced from Dihydroxyacetone.
25177: * Acid produced from Glyceraldehyde.

TETROSES
25178: * Acid produced from L-Erythulose.
25179: * Acid produced from D-Threose.

PENTOSES
25180: * Acid produced from D-Arabinose.
25181: * Acid produced from L-Arabinose.
25182: * Acid produced from D-Lyxose.
25183: * Acid produced from L-Lyxose.
25184: * Acid produced from D-Ribose.
SECTION 25: CARBOHYDRATE METABOLISM

25185: Acid produced from D-Ribulose.
25186: Acid produced from D-Xylose.
25187: Acid produced from D-Xylulose.
METHYL PENTOSES
25188: Acid produced from D-Fucose.
25189: Acid produced from L-Fucose.
25190: Acid produced from D-Rhamnose.
25191: Acid produced from L-Rhamnose.
HEXOSES
25192: Acid produced from D-Allose.
25193: Acid produced from D-Fructose.
25194: Acid produced from D-Galactose.
25195: Acid produced from D-Glucose (also see Section 24).
25196: Acid produced from D-Mannose.
25197: Acid produced from L-Sorbose.
HEPTOSES
25198: Acid produced from Alpha-D-Galaheptose.
25199: Acid produced from Beta-D-Galaheptose.
25200: Acid produced from Alpha-D-Glucoheptose.
25201: Acid produced from Sedoheptulose.
GLYCOSIDES
25202: Acid produced from Aesculin.
25203: Acid produced from Amygdalin.
25204: Acid produced from Arbutin.
25205: Acid produced from Coniferin.
25206: Acid produced from Methyl-D-Xyloside.
25207: Acid produced from Alpha-Methyl-D-Glucoside.
25208: Acid produced from Beta-Methyl-D-Glucoside.
25209: Acid produced from Alpha-Methyl-D-Mannoside.
25210: Acid produced from Salicin.
DISACCHARIDES
25211: Acid produced from Cellobiose.
25212: Acid produced from Lactose.
25213: Acid produced from Maltose.
25214: Acid produced from Melibiose.
25215: Acid produced from Sucrose.
25216: Acid produced from Trehalose.
TRISACCHARIDES
25217: Acid produced from Melezitose.
25218: Acid produced from Raffinose.
POLYSACCHARIDES
PENTOSANS
25219: Acid produced from Xylan.
HEXOSANS
25220: Acid produced from Cellulose.
25221: Acid produced from Chitin.
25222: Acid produced from Dextran.
SECTION 25: CARBOHYDRATE METABOLISM

25223:* Acid produced from Dextrin.
25224:* Acid produced from Glycogen.
25225:* Acid produced from Inulin.
25226:* Acid produced from Starch.

OTHER POLYSACCHARIDES
25227:* Acid produced from Alginic Acid.
25228:* Acid produced from Bacterial Polysaccharide.
25229:* Acid produced from Gum Arabic.
25230:* Acid produced from Hemicellulose.
25231:* Acid produced from Lignocellulose.
25232:* Acid produced from Mannan.

25233: Gas produced from at least one carbohydrate.

MONOSACCHARIDES

TRIOSES
25234:* Gas produced from Dihydroxyacetone.
25235:* Gas produced from Glyceraldehyde.

TETROSES
25236:* Gas produced from L-Erythulose.
25237:* Gas produced from D-Threose.

PENTOSES
25238:* Gas produced from D-Arabinose.
25239:* Gas produced from L-Arabinose.
25240:* Gas produced from D-Lyxose.
25241:* Gas produced from L-Lyxose.
25242:* Gas produced from D-Ribose.
25243:* Gas produced from D-Ribulose.
25244:* Gas produced from D-Xylose.
25245:* Gas produced from D-Xylulose.

METHYL PENTOSES
25246:* Gas produced from D-Fucose.
25247:* Gas produced from L-Fucose.
25248:* Gas produced from D-Rhamnose.
25249:* Gas produced from L-Rhamnose.

HEXOSES
25250:* Gas produced from D-Allose.
25251:* Gas produced from D-Fructose.
25252:* Gas produced from D-Galactose.
25253:* Gas produced from D-Glucose (also see Section 24).
25254:* Gas produced from D-Mannose.
25255:* Gas produced from L-Sorbose.

HEPTOSES
25256:* Gas produced from Alpha-D-Galaheptose.
25257:* Gas produced from Beta-D-Galaheptose.
25258:* Gas produced from Alpha-D-Glucoheptose.
25259:* Gas produced from Sedoheptulose.

GLYCOSIDES
25260:* Gas produced from Aesculin.
SECTION 25: CARBOHYDRATE METABOLISM

25261:* Gas produced from Amygdalin.
25262:* Gas produced from Arbutin.
25263:* Gas produced from Coniferin.
25264:* Gas produced from Methyl-D-Xyloside.
25265:* Gas produced from Alpha-Methyl-D-Glucoside.
25266:* Gas produced from Beta-Methyl-D-Glucoside.
25267:* Gas produced from Alpha-Methyl-D-Mannoside.
25268:* Gas produced from Salicin.

DISACCHARIDES
25269:* Gas produced from Cellobiose.
25270:* Gas produced from Lactose.
25271:* Gas produced from Maltose.
25272:* Gas produced from Melibiose.
25273:* Gas produced from Sucrose.
25274:* Gas produced from Trehalose.

TRISACCHARIDES
25275:* Gas produced from Melezitose.
25276:* Gas produced from Raffinose.

POLYSACCHARIDES

PENTOSANS
25277:* Gas produced from Xylan.

HEXOSANS
25278:* Gas produced from Cellulose.
25279:* Gas produced from Chitin.
25280:* Gas produced from Dextran.
25281:* Gas produced from Dextrin.
25282:* Gas produced from Glycogen.
25283:* Gas produced from Inulin.
25284:* Gas produced from Starch.

OTHER POLYSACCHARIDES
25285:* Gas produced from Alginic Acid.
25286:* Gas produced from Bacterial Polysaccharide.
25287:* Gas produced from Gum Arabic.
25288:* Gas produced from Hemcellulose.
25289:* Gas produced from Lignocellulose.
25290:* Gas produced from Mannan.

25291: At least one carbohydrate can be used as sole source of carbon.

MONOSACCHARIDES

TRIOSES
25292:* Dihydroxyacetone can be used as the sole source of carbon.
25293:* Glyceraldehyde can be used as the sole source of carbon.

TETROSES
25294:* L-Erythulose can be used as the sole source of carbon.
25295:* D-Threose can be used as the sole source of carbon.

PENTOSES
25296:* D-Arabinose can be used as the sole source of carbon.
25297:* L-Arabinose can be used as the sole source of carbon.
SECTION 25: CARBOHYDRATE METABOLISM

25298:* D-Lylose can be used as the sole source of carbon.
25299:* L-Lylose can be used as the sole source of carbon.
25300:* D-Ribose can be used as the sole source of carbon.
25301:* D-Ribulose can be used as the sole source of carbon.
25302:* D-Xylose can be used as the sole source of carbon.
25303:* D-Xylulose can be used as the sole source of carbon.

METHYL PENTOSES
25304:* D-Fucose can be used as the sole source of carbon.
25305:* L-Fucose can be used as the sole source of carbon.
25306:* D-Rhamnose can be used as the sole source of carbon.
25307:* L-Rhamnose can be used as the sole source of carbon.

HEXOSES
25308:* D-Allose can be used as the sole source of carbon.
25309:* D-Fructose can be used as the sole source of carbon.
25310:* D-Galactose can be used as the sole source of carbon.
25311:* D-Glucose can be used as the sole source of carbon (also see Section 24).
25312:* D-Mannose can be used as the sole source of carbon.
25313:* L-Sorbose can be used as the sole source of carbon.

HEPTOSES
25314:* Alpha-D-Galaheptose can be used as the sole source of carbon.
25315:* Beta-D-Galaheptose can be used as the sole source of carbon.
25316:* Alpha-D-Glucoheptose can be used as the sole source of carbon.
25317:* Sedoheptulose can be used as the sole source of carbon.

GLYCOSEDES
25318:* Aesculin can be used as the sole source of carbon.
25319:* Amygdalin can be used as the sole source of carbon.
25320:* Arbutin can be used as the sole source of carbon.
25321:* Coniferin can be used as the sole source of carbon.
25322:* Methyl-D-Xyloside can be used as the sole source of carbon.
25323:* Alpha-Methyl-D-Glucoside can be used as the sole source of carbon.
25324:* Beta-Methyl-D-Glucoside can be used as the sole source of carbon.
25325:* Alpha-Methyl-D-Mannoside can be used as the sole source of carbon.
25326:* Salicin can be used as the sole source of carbon.

DISACCHARIDES
25327:* Cellulobiose can be used as the sole source of carbon.
25328:* Lactose can be used as the sole source of carbon.
25329:* Maltose can be used as the sole source of carbon.
25330:* Melibiose can be used as the sole source of carbon.
25331:* Sucrose can be used as the sole source of carbon.
25332:* Trehalose can be used as the sole source of carbon.
SECTION 25: CARBOHYDRATE METABOLISM

TRISACCHARIDES
25333:* Melezitose can be used as the sole source of carbon.
25334:* Raffinose can be used as the sole source of carbon.

POLYSACCHARIDES
25335:* Xylan can be used as the sole source of carbon.

HEXOSANS
25336:* Cellulose can be used as the sole source of carbon.
25337:* Chitin can be used as the sole source of carbon.
25338:* Dextran can be used as the sole source of carbon.
25339:* Dextrin can be used as the sole source of carbon.
25340:* Glycogen can be used as the sole source of carbon.
25341:* Inulin can be used as the sole source of carbon.
25342:* Starch can be used as the sole source of carbon.

OTHER POLYSACCHARIDES
25343:* Alginic Acid can be used as the sole source of carbon.
25344:* Bacterial Polysaccharide can be used as the sole source of carbon.
25345:* Gum Arabic can be used as the sole source of carbon.
25346:* Hemicellulose can be used as the sole source of carbon.
25347:* Lignocellulose can be used as the sole source of carbon.
25348:* Mannan can be used as the sole source of carbon.
25349: At least one polysaccharide can be hydrolyzed.

POLYSACCHARIDES

PENTOSANS
25350:* Xylan is hydrolyzed.

HEXOSANS
25351:* Cellulose is hydrolyzed.
25352:* Chitin is hydrolyzed.
25353:* Dextran is hydrolyzed.
25354:* Dextrin is hydrolyzed.
25355:* Glycogen is hydrolyzed.
25356:* Inulin is hydrolyzed.
25357:* Starch is hydrolyzed.

OTHER POLYSACCHARIDES
25358:* Alginic Acid is hydrolyzed.
25359:* Bacterial Polysaccharide is hydrolyzed.
25360:* Gum Arabic is hydrolyzed.
25361:* Hemicellulose is hydrolyzed.
25362:* Lignocellulose is hydrolyzed.
25363:* Mannan is hydrolyzed.

99025: Carbohydrate metabolism: Comments.
SECTION 26: ALCOHOL METABOLISM

26001: At least one alcohol is utilized (growth measurement).

ALIPHATIC ALCOHOLS

26002:* Allyl Alcohol is utilized.
26003:* 1-Butanol is utilized.
26004:* 2-Butanol is utilized.
26005:* Ethanol is utilized.
26006:* Geraniol (3,7-dimethyl-2,6-octadiene-1-ol) is utilized.
26007:* 1-Hexanol is utilized.
26008:* Methanol is utilized.
26009:* 3-Methyl-1-butanol is utilized.
26010:* 2-Methyl-1-Propanol is utilized.
26011:* 2-Methyl-2-propanol is utilized.
26012:* 1-Octanol is utilized.
26013:* 1-Pentanol is utilized.
26014:* 1-Propanol is utilized.
26015:* 2-Propanol is utilized.

MONOHYDROXY ALCOHOLS

26016:* 2-Amino-2-Ethyl-1,3-Propanediol is utilized.
26017:* 1,4-Butanediol is utilized.
26018:* DL-1,3-Butanediol is utilized.
26019:* D(-) 2,3-Butanediol is utilized.
26020:* Meso-2,3-Butanediol is utilized.
26021:* L(+) 2,3-Butanediol is utilized.
26022:* 2-Butene-1,4-diol is utilized.
26023:* 1,4-Butynediol is utilized.
26024:* Diethylene glycol is utilized.
26025:* Dipropylene Glycol is utilized.
26026:* 1,2-Ethanediol is utilized.
26027:* 1,7-Heptanediol is utilized.
26028:* 1,6-Hexanediol is utilized.
26029:* 2,5-Hexanediol is utilized.
26030:* D(+)-3,4-Hexanediol is utilized.
26031:* Meso-3,4-Hexanediol is utilized.
26032:* 2-Nitro-2-Ethyl-1,3-Propanediol is utilized.
26033:* 1,3-Pentanediol is utilized.
26034:* 1,5-Pentanediol is utilized.
26035:* Polyethylene Glycol (-200) is utilized.
26036:* Polyethylene Glycol (-300) is utilized.
26037:* Polyethylene Glycol (-400) is utilized.
26038:* Polyethylene Glycol (-1500) is utilized.
26039:* D(-) 1,2-Propanediol is utilized.
26040:* 1,3-Propanediol is utilized.
26041:* Triethylene Glycol is utilized.
26042:* Triethylene Glycol is utilized.
SECTION 26: ALCOHOL METABOLISM

TRIHYDRIC ALCOHOLS
26043:* 1,2,4-Butanetriol is utilized.
26044:* 1,2,6-Hexanetriol is utilized.
26045:* 1,2,3-Propanetriol (Glycerol) is utilized.

TETRAHYDRIC ALCOHOLS
26046:* Erythritol is utilized.
26047:* Meso-Erythritol is utilized.
26048:* Pentaerythritol is utilized.

PENTAHYDRIC ALCOHOLS
26049:* Adonitol is utilized.
26050:* Iso-adonitol is utilized.
26051:* Meso-Arabitol is utilized.
26052:* D-Arabitol is utilized.
26053:* L-Arabitol is utilized.
26054:* Meso-Ribitol is utilized.
26055:* Meso-Xyilitol is utilized.

HEXAHYDRIC ALCOHOLS
26056:* Meso-Al1litol is utilized.
26057:* Dulcitol is utilized.
26058:* L-Fucitol is utilized.
26059:* Meso-Galactitol is utilized.
26060:* D-Gluclitol is utilized.
26061:* L-Gluclitol is utilized.
26062:* D-Iditol is utilized.
26063:* L-Iditol is utilized.
26064:* Lactositol is utilized.
26065:* D-Mannitol is utilized.
26066:* L-Mannitol is utilized.
26067:* L-Rhamnitol is utilized.
26068:* D-Sorbitol is utilized.
26069:* L-Sorbitol is utilized.

POLYHYDRIC ALCOHOLS
26070:* D-Glycero-D-Galactoheptitol is utilized.
26071:* Meso-Glycero-Guloheptitol is utilized.
26072:* Perseitol is utilized.
26073:* Polygalitol is utilized.
26074:* Primulitol is utilized.

ALCOHOLS DERIVED FROM CYCLIC PARAFFINS
26075:* Cyclohexanol is utilized.
26076:* Cycloheptanol is utilized.
26077:* Cyclooctanol is utilized.
26078:* Cyclopentanol is utilized.
26079:* Meso-Insitol is utilized.
26080:* Iso-Insitol is utilized.
26081:* Phenylethanediol is utilized.
26082:* Pinitol is utilized.
26083:* Quercitol is utilized.
SECTION 26: ALCOHOL METABOLISM

AROMATIC ALCOHOLS
MONOHYDRIC ALCOHOLS
26084:* Anisyl Alcohol is utilized.
26085:* Benzyl Alcohol is utilized.
26086:* Cinnamyl Alcohol is utilized.
26087:* Coniferyl Alcohol is utilized.
26088:* M-Cresol is utilized.
26089:* Phenol is utilized.

DIHYDRIC ALCOHOLS
26090:* Aesculetin is utilized.
26091:* Catechol is utilized.
26092:* Resorcinol is utilized.
26093:* Saligenin is utilized.

ALCOHOLS WITH ADDITIONAL ETHER-LINKED GROUPS
26094:* 2(2-Butoxy-Ethoxy) Ethanol is utilized.
26095:* Diethylene Glycol Monoethyl Ether is utilized.
26096:* 2-Ethoxy Ethanol is utilized.
26097:* 2(2-Ethoxy-Ethoxy) Ethanol is utilized.
26098:* 2(2-Methoxy-Ethoxy) Ethanol is utilized.
26099:* Ethylene Glycol Monoethyl Ether is utilized.

KETOALCOHOLS
26100:* Acetoin is utilized.
26101:* D(-) Ethylpropionyl Carbinol is utilized.
26102:* L(+) Ethylpropionyl Carbinol is utilized.

26103: At least one alcohol is oxidized (manometric, polarographic, etc., measurement).

ALIPHATIC ALCOHOLS
MONOHYDRIC ALCOHOLS
26104:* Allyl Alcohol is oxidized.
26105:* 1-Butanol is oxidized.
26106:* 2-Butanol is oxidized.
26107:* Ethanol is oxidized.
26108:* Geraniol (3,7-dimethyl-2,6-octadiene-1-ol) is oxidized.
26109:* 1-Hexanol is oxidized.
26110:* Methanol is oxidized.
26111:* 3-Methyl-1-butanol is oxidized.
26112:* 2-Methyl-1-Propanol is oxidized.
26113:* 2-Methyl-2-Propanol is oxidized.
26114:* 1-Octanol is oxidized.
26115:* 1-Pentanol is oxidized.
26116:* 1-Propanol is oxidized.
26117:* 2-Propanol is oxidized.

DIHYDRIC ALCOHOLS
26118:* 2-Amino-2-Ethyl-1,3-Propanediol is oxidized.
26119:* 1,4-Butanediol is oxidized.
26120:* DL-1,3-Butanediol is oxidized.
26121:* DC-3,2-Butanediol is oxidized.
26122:* Meso-2,3-Butanediol is oxidized.
26123:* L(+)-2,3-Butanediol is oxidized.
26124:* 2-Butene-1,4-diol is oxidized.
SECTION 26: ALCOHOL METABOLISM

26125: * 1,4-Butylenediol is oxidized.
26126: * Dioxyethylene glycol is oxidized.
26127: * Dipropylene glycol is oxidized.
26128: * 1,2-Ethanediol is oxidized.
26129: * 1,7-Heptanediol is oxidized.
26130: * 1,6-Hexanediol is oxidized.
26131: * 2,5-Hexanediol is oxidized.
26132: * D(+)-3,4-Hexanediol is oxidized.
26133: * Meso-3,4-Hexanediol is oxidized.
26134: * 2-Nitro-2-Ethyl-1,3-Propanediol is oxidized.
26135: * 1,3-Pentanediol is oxidized.
26136: * 1,5-Pentanediol is oxidized.
26137: * Polyethylene glycol (-200) is oxidized.
26138: * Polyethylene glycol (-300) is oxidized.
26139: * Polyethylene glycol (-400) is oxidized.
26140: * Polyethylene glycol (-1500) is oxidized.
26141: * D(-)-1,2-Propanediol is oxidized.
26142: * 1,3-Propanediol is oxidized.
26143: * Thiadiethylene glycol is oxidized.
26144: * Triethylene glycol is oxidized.

TRIHYDRIC ALCOHOLS
26145: * 1,2,4-Butanetriol is oxidized.
26146: * 1,2,6-Hexanetriol is oxidized.
26147: * 1,2,3-Propanetriol (Glycerol) is oxidized.

TETRAHYDRIC ALCOHOLS
26148: * Erythritol is oxidized.
26149: * Meso-Erythritol is oxidized.
26150: * Pentaerythritol is oxidized.

PENTAHYDRIC ALCOHOLS
26151: * Adonitol is oxidized.
26152: * ISO-adonitol is oxidized.
26153: * Meso-Arabitol is oxidized.
26154: * D-Arabitol is oxidized.
26155: * L-Arabitol is oxidized.
26156: * Meso-Ribitol is oxidized.
26157: * Meso-Xylitol is oxidized.

HEXAHYDRIC ALCOHOLS
26158: * Meso-Allitol is oxidized.
26159: * Dulcitol is oxidized.
26160: * L-Fucitol is oxidized.
26161: * Meso-Galactitol is oxidized.
26162: * D-Glucitol is oxidized.
26163: * L-Glucitol is oxidized.
26164: * D-Iditol is oxidized.
SECTION 26: ALCOHOL METABOLISM

26165: * L-iditol is oxidized.
26166: * Lactositol is oxidized.
26167: * L-Mannitol is oxidized.
26168: * L-Mannitol is oxidized.
26169: * L-Rhamnitol is oxidized.
26170: * L-Sorbitol is oxidized.
26171: * L-Sorbitol is oxidized.

POLYHYDRIC ALCOHOLS
26172: * D-Glycero-D-Galactoheptitol is oxidized.
26173: * Meso-Glycero-Guloheptitol is oxidized.
26174: * Parasitol is oxidized.
26175: * Polygalitol is oxidized.
26176: * Primullitol is oxidized.

ALCOHOLS DERIVED FROM CYCLIC PARAFFINS
26177: * Cyclohexanol is oxidized.
26178: * Cycloheptanol is oxidized.
26179: * Cyclooctanol is oxidized.
26180: * Cyclopentanol is oxidized.
26181: * Meso-Inositol is oxidized.
26182: * Iso-Inositol is oxidized.
26183: * Phenylethanol is oxidized.
26184: * Pinitol is oxidized.
26185: * Quercitol is oxidized.

AROMATIC ALCOHOLS

MONOHYDRIC ALCOHOLS
26186: * Anisyl Alcohol is oxidized.
26187: * Benzyl Alcohol is oxidized.
26188: * Cinnamyl Alcohol is oxidized.
26189: * Coniferyl Alcohol is oxidized.
26190: * M-Cresol is oxidized.
26191: * Phenol is oxidized.

DIHYDRIC ALCOHOLS
26192: * Aesculetin is oxidized.
26193: * Catechol is oxidized.
26194: * Resorcinol is oxidized.
26195: * Saligenin is oxidized.

ALCOHOLS WITH ADDITIONAL ETHER-LINKED GROUPS
26196: * 2(2-Butoxy-Ethoxy) Ethanol is oxidized.
26197: * Diethylene Glycol Monoethyl Ether is oxidized.
26198: * 2-Ethoxy Ethanol is oxidized.
26199: * 2(2-Ethoxy-Ethoxy) Ethanol is oxidized.
26200: * 2(2-Methoxy-Ethoxy) Ethanol is oxidized.
26201: * Ethylene Glycol Monoethyl Ether is oxidized.

KETOALCOHOLS
26202: * Acetoin is oxidized.
26203: * D(-) Ethylpropanoyl Carbinol is oxidized.
26204: * L(+)Ethylpropanoyl Carbinol is oxidized.
SECTION 26: ALCOHOL METABOLISM

26205: At least one alcohol is reduced (manometric, polarographic, etc., measurement).

ALIPHATIC ALCOHOLS

MONOHYDRIC ALCOHOLS

26206: * Allyl Alcohol is reduced.

26207: * 1-Butanol is reduced.

26208: * 2-Butanol is reduced.

26209: * Ethanol is reduced.

26210: * Geraniol (3,7-dimethyl-2,6-octadiene-1-ol) is reduced.

26211: * 1-Hexanol is reduced.

26212: * Methanol is reduced.

26213: * 3-Methyl-1-butanol is reduced.

26214: * 2-Methyl-1-propanol is reduced.

26215: * 2-Methyl-2-propanol is reduced.

26216: * 1-Octanol is reduced.

26217: * 1-Pentanol is reduced.

26218: * 1-Propanol is reduced.

26219: * 2-Propanol is reduced.

DIHYDRIC ALCOHOLS

26220: * 2-Amino-2-Ethyl-1,3-Propanediol is reduced.

26221: * 1,4-Butanediol is reduced.

26222: * DL-1,3-Butanediol is reduced.

26223: * D(-)2,3-Butanediol is reduced.

26224: * Meso-2,3-Butanediol is reduced.

26225: * L(+)-2,3-Butanediol is reduced.

26226: * 2-Butene-1,4-diol is reduced.

26227: * 1,4-Butynediol is reduced.

26228: * Diethylene glycol is reduced.

26229: * Dipropylene Glycol is reduced.

26230: * 1,2-Ethanediol is reduced.

26231: * 1,7-Heptanediol is reduced.

26232: * 1,6-Hexanediol is reduced.

26233: * 2,5-Hexanediol is reduced.

26234: * D(+)-3,4-Hexanediol is reduced.

26235: * Meso-3,4-Hexanediol is reduced.

26236: * 2-Nitro-2-Ethyl-1,3-Propanediol is reduced.

26237: * 1,3-Pentanediol is reduced.

26238: * 1,5-Pentanediol is reduced.

26239: * Polyethylene Glycol (-200) is reduced.

26240: * Polyethylene Glycol (-300) is reduced.

26241: * Polyethylene Glycol (-400) is reduced.

26242: * Polyethylene Glycol (-1500) is reduced.

26243: * D(-)-1,2-Propanediol is reduced.

26244: * 1,3-Propanediol is reduced.

26245: * Thiodiethylene Glycol is reduced.

26246: * Triethylene Glycol is reduced.
SECTION 26: ALCOHOL METABOLISM

TRIHYDRIC ALCOHOLS

26247:* 1,2,4-Butanetriol is reduced.
26248:* 1,2,6-Hexanetriol is reduced.
26249:* 1,2,3-Propanetriol (Glycerol) is reduced.

TETRAHYDRIC ALCOHOLS

26250:* Erythritol is reduced.
26251:* Meso-Erythritol is reduced.
26252:* Pentaerythritol is reduced.

PENTAHYDRIC ALCOHOLS

26253:* Adonitol is reduced.
26254:* Iso-adonitol is reduced.
26255:* Meso-Arabinol is reduced.
26256:* D-Arabinol is reduced.
26257:* L-Arabinol is reduced.
26258:* Meso-Ribitol is reduced.
26259:* Meso-Xylitol is reduced.

HEXAHYDRIC ALCOHOLS

26260:* Meso-Allitol is reduced.
26261:* Dulcitol is reduced.
26262:* L-Fucitol is reduced.
26263:* Meso-Galactitol is reduced.
26264:* D-Glucitol is reduced.
26265:* L-Glucitol is reduced.
26266:* D-Iclitol is reduced.
26267:* L-Iclitol is reduced.
26268:* Lactositol is reduced.
26269:* D-Mannitol is reduced.
26270:* L-Mannitol is reduced.
26271:* L-Rhamnitol is reduced.
26272:* D-Sorbitol is reduced.
26273:* L-Sorbitol is reduced.

POLYHYDRIC ALCOHOLS

26274:* D-Glycero-D-Galactoheptitol is reduced.
26275:* Meso-Glycero-Guloheptitol is reduced.
26276:* Perseltol is reduced.
26277:* Polygalitol is reduced.
26278:* Primulitol is reduced.

ALCOHOLS DERIVED FROM CYCLIC PARAFFINS

26279:* Cyclohexanol is reduced.
26280:* Cycloheptanol is reduced.
26281:* Cyclooctanol is reduced.
26282:* Cyclopentanol is reduced.
26283:* Meso-Inositol is reduced.
26284:* Iso-Inositol is reduced.
26285:* Phenylethanediol is reduced.
26286:* Pinitol is reduced.
26287:* Quercitol is reduced.
SECTION 26: ALCOHOL METABOLISM

AROMATIC ALCOHOLS
MONOHYDRIC ALCOHOLS
26288:* Anisyl Alcohol is reduced.
26289:* Benzyl Alcohol is reduced.
26290:* Cinnamyl Alcohol is reduced.
26291:* Coniferyl Alcohol is reduced.
26292:* M-Cresol is reduced.
26293:* Phenol is reduced.

DIHYDRIC ALCOHOLS
26294:* Aesculetin is reduced.
26295:* Catechol is reduced.
26296:* Resorcinol is reduced.
26297:* Saligenin is reduced.

ALCOHOLS WITH ADDITIONAL ETHER-LINKED GROUPS
26298:* 2(2-Butoxy-Ethoxy) Ethanol is reduced.
26299:* Diethylene Glycol Monoethyl Ether is reduced.
26300:* 2-Ethoxy Ethanol is reduced.
26301:* 2(2-Ethoxy-Ethoxy) Ethanol is reduced.
26302:* 2(2-Methoxy-Ethoxy) Ethanol is reduced.
26303:* Ethylene Glycol Monoethyl Ether is reduced.

KETOALCOHOLS
26304:* Acetoin is reduced.
26305:* D(-) Ethylpropionyl Carbinol is reduced.
26306:* L(+) Ethylpropionyl Carbinol is reduced.
26307: Acid is produced from at least one alcohol (indicator dye or pH

ALIPHATIC ALCOHOLS
MONOHYDRIC ALCOHOLS
26308:* Acid is produced from Allyl Alcohol.
26309:* Acid is produced from 1-Butanol.
26310:* Acid is produced from 2-Butanol.
26311:* Acid is produced from Ethanol.
26312:* Acid is produced from Geraniol
(3,7-dimethyl-2,6-octadiene-1-ol).
26313:* Acid is produced from 1-Hexanol.
26314:* Acid is produced from Methanol.
26315:* Acid is produced from 3-Methyl-1-butanol.
26316:* Acid is produced from 2-Methyl-1-Propanol.
26317:* Acid is produced from 2-Methyl-2-Propanol.
26318:* Acid is produced from 1-Octanol.
26319:* Acid is produced from 1-Pentanol.
26320:* Acid is produced from 1-Propanol.
26321:* Acid is produced from 2-Propanol.

DIHYDRIC ALCOHOLS
26322:* Acid is produced from 2-Amino-2-Ethyl-1,3-Propanediol.
26323:* Acid is produced from 1,4-Butanediol.
26324:* Acid is produced from DL-1,3-Butanediol.
26325:* Acid is produced from D(-)2,3-Butanediol.
SECTION 26: ALCOHOL METABOLISM

26326:* Acid is produced from Meso-2,3-Butanediol.
26327:* Acid is produced from L(+)2,3-Butanediol.
26328:* Acid is produced from 2-Butene-1,4-diol.
26329:* Acid is produced from 1,4-Butynediol.
26330:* Acid is produced from Diethylene glycol.
26331:* Acid is produced from Dipropylene Glycol.
26332:* Acid is produced from 1,2-Ethanediol.
26333:* Acid is produced from 1,7-Heptanediol.
26334:* Acid is produced from 1,6-Hexanediol.
26335:* Acid is produced from 2,5-Hexanediol.
26336:* Acid is produced from D(+)-3,4-Hexanediol.
26337:* Acid is produced from Meso-3,4-Hexanediol.
26338:* Acid is produced from 2-Nitro-2-Ethyl-1,3-Propanediol.
26339:* Acid is produced from 1,3-Pentanediol.
26340:* Acid is produced from 1,5-Pentanediol.
26341:* Acid is produced from Polyethylene Glycol (-200).
26342:* Acid is produced from Polyethylene Glycol (-300).
26343:* Acid is produced from Polyethylene Glycol (-400).
26344:* Acid is produced from Polyethylene Glycol (-1500).
26345:* Acid is produced from D(-)-1,2-Propanediol.
26346:* Acid is produced from 1,3-Propanediol.
26347:* Acid is produced from Triethylene Glycol.
26348:* Acid is produced from Triethylene Glycol.

TRIHYDRIC ALCOHOLS
26349:* Acid is produced from 1,2,4-Butanetriol.
26350:* Acid is produced from 1,2,6-Hexanetriol.
26351:* Acid is produced from 1,2,3-Propanetriol (Glycerol).

TETRAHYDRIC ALCOHOLS
26352:* Acid is produced from Erythritol.
26353:* Acid is produced from Meso-erythritol.
26354:* Acid is produced from Pentaerythritol.

PENTHYDRIC ALCOHOLS
26355:* Acid is produced from Adonitol.
26356:* Acid is produced from Iso-adonitol.
26357:* Acid is produced from Meso-Arabitol.
26358:* Acid is produced from D-Arabitol.
26359:* Acid is produced from L-Arabitol.
26360:* Acid is produced from Meso-Ribitol.
26361:* Acid is produced from Meso-Xylitol.

HEXAHYDRIC ALCOHOLS
26362:* Acid is produced from Meso-Allitol.
26363:* Acid is produced from Dulcitol.
26364:* Acid is produced from L-Fucitol.
26365:* Acid is produced from Meso-Galactitol.
26366:* Acid is produced from D-Glucitol.
26367:* Acid is produced from L-Glucitol.
26368:* Acid is produced from D-Iditol.
SECTION 26: ALCOHOL METABOLISM

26369:* Acid is produced from L-Iditol.
26370:* Acid is produced from Lactositol.
26371:* Acid is produced from D-Mannitol.
26372:* Acid is produced from L-Mannitol.
26373:* Acid is produced from L-Rhamnitol.
26374:* Acid is produced from D-Sorbitol.
26375:* Acid is produced from L-Sorbitol.

POLYHYDRIC ALCOHOLS

26376:* Acid is produced from D-Glycero-D-Galactoheptitol.
26377:* Acid is produced from Meso-Glycero-Guloheptitol.
26378:* Acid is produced from Perseitol.
26379:* Acid is produced from Polygallitol.
26380:* Acid is produced from Primulitol.

ALCOHOLS DERIVED FROM CYCLIC PARAFFINS

26381:* Acid is produced from Cyclohexanol.
26382:* Acid is produced from Cyclohexanitol.
26383:* Acid is produced from Cyclooctanol.
26384:* Acid is produced from Cyclopentanol.
26385:* Acid is produced from Meso-Inositol.
26386:* Acid is produced from Iso-Inositol.
26387:* Acid is produced from Phenylethanediol.
26388:* Acid is produced from Pinitol.
26389:* Acid is produced from Quercitol.

AROMATIC ALCOHOLS

MONOHYDRIC ALCOHOLS

26390:* Acid is produced from Anisyl Alcohol.
26391:* Acid is produced from Benzyl Alcohol.
26392:* Acid is produced from Cinnamyl Alcohol.
26393:* Acid is produced from Coniferyl Alcohol.
26394:* Acid is produced from M-Cresol.
26395:* Acid is produced from Phenol.

DIHYDRIC ALCOHOLS

26396:* Acid is produced from Aesculetin.
26397:* Acid is produced from Catechol.
26398:* Acid is produced from Resorcinol.
26399:* Acid is produced from Saligenin.

ALCOHOLS WITH ADDITIONAL ETHER-LINKED GROUPS

26400:* Acid is produced from 2(2-Butoxy-Ethoxy) Ethanol.
26401:* Acid is produced from Diethylene Glycol Monoethyl Ether.
26402:* Acid is produced from 2-Ethoxy Ethanol.
26403:* Acid is produced from 2(2-Ethoxy-Ethoxy) Ethanol.
26404:* Acid is produced from 2(2-Methoxy-Ethoxy) Ethanol.
26405:* Acid is produced from Ethylene Glycol Monoethyl Ether.

KETOALCOHOLS

26406:* Acid is produced from Acetoin.
26407:* Acid is produced from D(-) Ethylpropionyl Carbinol.
26408:* Acid is produced from L(+) Ethylpropionyl Carbinol.
SECTION 26: ALCOHOL METABOLISM

26409: Gas is produced from at least one Alcohol.

ALIPHATIC ALCOHOLS

MONOHYDRIC ALCOHOLS

26410:* Gas is produced from Allyl Alcohol.
26411:* Gas is produced from 1-Butanol.
26412:* Gas is produced from 2-Butanol.
26413:* Gas is produced from Ethanol.
26414:* Gas is produced from Geraniol (3,7-dimethyl-2,6-octadiene-1-ol).
26415:* Gas is produced from 1-Hexanol.
26416:* Gas is produced from Methanol.
26417:* Gas is produced from 3-Methyl-1-butanol.
26418:* Gas is produced from 2-Methyl-1-Propanol.
26419:* Gas is produced from 2-Methyl-2-propanol.
26420:* Gas is produced from 1-Octanol.
26421:* Gas is produced from 1-Pentanol.
26422:* Gas is produced from 1-Propanol.
26423:* Gas is produced from 2-Propanol.

DIHYDRIC ALCOHOLS

26424:* Gas is produced from 2-Amino-2-Ethyl-1,3-Propanediol.
26425:* Gas is produced from 1,4-Butanediol.
26426:* Gas is produced from DL-1,3-Butanediol.
26427:* Gas is produced from D(-)2,3-Butanediol.
26428:* Gas is produced from Meso-2,3-Butanediol.
26429:* Gas is produced from D(+)-2,3-Butanediol.
26430:* Gas is produced from 2-Butene-1,4-diol.
26431:* Gas is produced from 1,4-Butynediol.
26432:* Gas is produced from Diethylene glycol.
26433:* Gas is produced from Dipropylene Glycol.
26434:* Gas is produced from 1,2-Ethanediol.
26435:* Gas is produced from 1,7-Heptanediol.
26436:* Gas is produced from 1,6-Hexanediol.
26437:* Gas is produced from 2,3-Hexanediol.
26438:* Gas is produced from D(+)-3,4-Hexanediol.
26439:* Gas is produced from Meso-3,4-Hexanediol.
26440:* Gas is produced from 2-Nitro-2-Ethyl-1,3-Propanediol.
26441:* Gas is produced from 1,3-Pentanediol.
26442:* Gas is produced from 1,5-Pentanediol.
26443:* Gas is produced from Polyethylene Glycol (-200).
26444:* Gas is produced from Polyethylene Glycol (-300).
26445:* Gas is produced from Polyethylene Glycol (-400).
26446:* Gas is produced from Polyethylene Glycol (-1500).
26447:* Gas is produced from D(-)-1,2-Propanediol.
26448:* Gas is produced from 1,3-Propanediol.
26449:* Gas is produced from Thiodilethylene Glycol.
26450:* Gas is produced from Triethylene Glycol.

TRIHYDRIC ALCOHOLS

(3,7-dimethyl-2,6-octadiene-1-ol).
SECTION 26: ALCOHOL METABOLISM

26451:* Gas is produced from 1,2,4-Butanetriol.
26452:* Gas is produced from 1,2,6-Hexanetriol.
26453:* Gas is produced from 1,2,3-Propanetriol (Glycerol).

TETRAHYDRIC ALCOHOLS

26454:* Gas is produced from Erythritol.
26455:* Gas is produced from Meso-Erythritol.
26456:* Gas is produced from Pentaerythritol.

PENTAHYDRIC ALCOHOLS

26457:* Gas is produced from Adonitol.
26458:* Gas is produced from Iso-adonitol.
26459:* Gas is produced from Meso-Arabinitol.
26460:* Gas is produced from D-Arabinitol.
26461:* Gas is produced from L-Arabinitol.
26462:* Gas is produced from Meso-Ribitol.
26463:* Gas is produced from Meso-Xyloitol.

HEXAHYDRIC ALCOHOLS

26464:* Gas is produced from Meso-Alloitol.
26465:* Gas is produced from Dulcitol.
26466:* Gas is produced from L-Fucitol.
26467:* Gas is produced from Meso-Galactitol.
26468:* Gas is produced from D-Glucitol.
26469:* Gas is produced from L-Glucitol.
26470:* Gas is produced from D-iditol.
26471:* Gas is produced from L-iditol.
26472:* Gas is produced from Lactositol.
26473:* Gas is produced from D-Mannitol.
26474:* Gas is produced from L-Mannitol.
26475:* Gas is produced from L-Rhamnitol.
26476:* Gas is produced from D-Sorbitol.
26477:* Gas is produced from L-Sorbitol.

POLYHYDRIC ALCOHOLS

26478:* Gas is produced from D-Glycero-D-Galactoheptitol.
26479:* Gas is produced from Meso-Glycero-Guloheptitol.
26480:* Gas is produced from Perseitol.
26481:* Gas is produced from Polygalitol.
26482:* Gas is produced from Primulitol.

ALCOHOLS DERIVED FROM CYCLIC PARAFFINS

26483:* Gas is produced from Cyclohexanol.
26484:* Gas is produced from Cycloheptanol.
26485:* Gas is produced from Cyclooctanol.
26486:* Gas is produced from Cyclopentanol.
26487:* Gas is produced from Meso-Inositol.
26488:* Gas is produced from Iso-Inositol.
26489:* Gas is produced from Phenylethanediol.
26490:* Gas is produced from Pinitol.
26491:* Gas is produced from Quercitol.

AROMATIC ALCOHOLS
SECTION 26: ALCOHOL METABOLISM

MONOHYDRIC ALCOHOLS
26492:* Gas is produced from Anisyl Alcohol.
26493:* Gas is produced from Benzyl Alcohol.
26494:* Gas is produced from Cinnamyl Alcohol.
26495:* Gas is produced from Coniferyl Alcohol.
26496:* Gas is produced from m-Cresol.
26497:* Gas is produced from Phenol.

DIHYDRIC ALCOHOLS
26498:* Gas is produced from Aesculetin.
26499:* Gas is produced from Catechol.
26500:* Gas is produced from Resorcinol.
26501:* Gas is produced from Saligenin.

ALCOHOLS WITH ADDITIONAL ETHER-LINKED GROUPS
26502:* Gas is produced from 2(2-Butoxy-Ethoxy) Ethanol.
26503:* Gas is produced from Diethylene Glycol Monoethyl Ether.
26504:* Gas is produced from 2-Ethoxy Ethanol.
26505:* Gas is produced from 2(2-Ethoxy-Ethoxy) Ethanol.
26506:* Gas is produced from 2-Methoxy-Ethanol.
26507:* Gas is produced from Ethylene Glycol Monoethyl Ether.

KETOALCOHOLS
26508:* Gas is produced from Acetoin.
26509:* Gas is produced from D(-) Ethylpropionyl Carbinol.
26510:* Gas is produced from L(+)Ethylpropionyl Carbinol.

26511: At least one alcohol can be used as the sole source of carbon growth measurement.

ALIPHATIC ALCOHOLS

MONOHYDRIC ALCOHOLS
26512:* Allyl Alcohol can be used as the sole source of carbon.
26513:* 1-Butanol can be used as the sole source of carbon.
26514:* 2-Butanol can be used as the sole source of carbon.
26515:* Ethanol can be used as the sole source of carbon.
26516:* Geraniol(3,7-dimethyl-2,6-octadiene-1-ol) can be used as the sole source of carbon.
26517:* 1-Hexanol can be used as the sole source of carbon.
26518:* Methanol can be used as the sole source of carbon.
26519:* 3-Methyl-1-butanol can be used as the sole source of carbon.
26520:* 2-Methyl-1-Propanol can be used as the sole source of carbon.
26521:* 2-Methyl-2-propanol can be used as the sole source of carbon.
26522:* 1-Octanol can be used as the sole source of carbon.
26523:* 1-Pentanol can be used as the sole source of carbon.
26524:* 1-Propanol can be used as the sole source of carbon.
26525:* 2-Propanol can be used as the sole source of carbon.

DIHYDRIC ALCOHOLS
26526:* 2-Amino-2-Ethyl-1,3-Propanediol can be used as the sole
SECTION 26: ALCOHOL METABOLISM

source of carbon.

1,4-Butanediol can be used as the sole source of carbon.

DL-1,3-Butanediol can be used as the sole source of carbon.

D(-)2,3-Butanediol can be used as the sole source of carbon.

Meso-1,3-Butanediol can be used as the sole source of carbon.

L(+)2,3-Butanediol can be used as the sole source of carbon.

2-Butene-1,4-diol can be used as the sole source of carbon.

1,4-Butynediol can be used as the sole source of carbon.

Diethylene glycol can be used as the sole source of carbon.

Dipropylene Glycol can be used as the sole source of carbon.

2,3-Butanediol can be used as the sole source of carbon.

Meso-2,3-Butanediol can be used as the sole source of carbon.

L(-)2,3-Butanediol can be used as the sole source of carbon.

2-Butene-1,4-diol can be used as the sole source of carbon.

1,4-Butynediol can be used as the sole source of carbon.

Diethylene glycol can be used as the sole source of carbon.

Dipropylene Glycol can be used as the sole source of carbon.

1,2-Ethanediol can be used as the sole source of carbon.

1,7-Heptanediol can be used as the sole source of carbon.

1,6-Hexanediol can be used as the sole source of carbon.

2,5-Hexanediol can be used as the sole source of carbon.

D(+)-3,4-Hexanediol can be used as the sole source of carbon.

D(-)-3,4-Hexanediol can be used as the sole source of carbon.

2,3,4,5-Tetrahydrofuran can be used as the sole source of carbon.

1,2-Propanediol can be used as the sole source of carbon.

1,3-Propanediol can be used as the sole source of carbon.

Polyethylene Glycol (-200) can be used as the sole source of carbon.

Polyethylene Glycol (-300) can be used as the sole source of carbon.

Polyethylene Glycol (-400) can be used as the sole source of carbon.

Polyethylene Glycol (-1500) can be used as the sole source of carbon.

1,3-Propanediol can be used as the sole source of carbon.

Thiodiethylene Glycol can be used as the sole source of carbon.

Trilethylene Glycol can be used as the sole source of carbon.

TRIHYDRIC ALCOHOLS

1,2,4-Butanetriol can be used as the sole source of carbon.

1,2,6-Hexanetriol can be used as the sole source of carbon.

1,2,3-Propanetriol (Glycerol) can be used as the sole source of carbon.

TETRAHYDRIC ALCOHOLS
SECTION 26: ALCOHOL METABOLISM

26556:* Erythritol can be used as the sole source of carbon.
26557:* Meso-Erythritol can be used as the sole source of carbon.
26558:* Pentaerythritol can be used as the sole source of carbon.

PENTAHYDRIC ALCOHOLS
26559:* Adonitol can be used as the sole source of carbon.
26560:* Iso-adonitol can be used as the sole source of carbon.
26561:* Meso-Arabitol can be used as the sole source of carbon.
26562:* D-Arabitol can be used as the sole source of carbon.
26563:* L-Arabitol can be used as the sole source of carbon.
26564:* Meso-Ribitol can be used as the sole source of carbon.
26565:* Meso-Xylitol can be used as the sole source of carbon.

HEXAHYDRIC ALCOHOLS
26566:* Meso-Allitol can be used as the sole source of carbon.
26567:* Dulcitol can be used as the sole source of carbon.
26568:* L-Fucitol can be used as the sole source of carbon.
26569:* Meso-Galactitol can be used as the sole source of carbon.
26570:* D-Glucitol can be used as the sole source of carbon.
26571:* L-Glucitol can be used as the sole source of carbon.
26572:* D-Iditol can be used as the sole source of carbon.
26573:* L-Iditol can be used as the sole source of carbon.
26574:* Lactositol can be used as the sole source of carbon.
26575:* D-Mannitol can be used as the sole source of carbon.
26576:* L-Mannitol can be used as the sole source of carbon.
26577:* L-Rhamnitol can be used as the sole source of carbon.
26578:* D-Sorbitol can be used as the sole source of carbon.
26579:* L-Sorbitol can be used as the sole source of carbon.

POLYHYDRIC ALCOHOLS
26580:* D-Glycerol-D-Galactoheptitol can be used as the sole source of carbon.
26581:* Meso-Glycerol-Guloheptitol can be used as the sole source of carbon.
26582:* Perselitol can be used as the sole source of carbon.
26583:* Polygalitol can be used as the sole source of carbon.
26584:* Primulitol can be used as the sole source of carbon.

ALCOHOLS DERIVED FROM CYCLIC PARAFFINS
26585:* Cyclohexanol can be used as the sole source of carbon.
26586:* Cycloheptanol can be used as the sole source of carbon.
26587:* Cyclooctanol can be used as the sole source of carbon.
26588:* Cyclopentanol can be used as the sole source of carbon.
26589:* Meso-Insositol can be used as the sole source of carbon.
26590:* Iso-Insositol can be used as the sole source of carbon.
26591:* Phenylethanediol can be used as the sole source of carbon.
26592:* Pinitol can be used as the sole source of carbon.
26593:* Quercitol can be used as the sole source of carbon.

AROMATIC ALCOHOLS

MONOHYDRIC ALCOHOLS
26594:* Anisyl Alcohol can be used as the sole source of carbon.
SECTION 26: ALCOHOL METABOLISM

26595:* Benzyl Alcohol can be used as the sole source of carbon.
26596:* Cinnamyl Alcohol can be used as the sole source of carbon.
26597:* Coniferyl Alcohol can be used as the sole source of carbon.
26598:* M-Cresol can be used as the sole source of carbon.
26599:* Phenol can be used as the sole source of carbon.

DIHYDRIC ALCOHOLS
26600:* Aesculetin can be used as the sole source of carbon.
26601:* Catechol can be used as the sole source of carbon.
26602:* Resorcinol can be used as the sole source of carbon.
26603:* Salligenin can be used as the sole source of carbon.

ALCOHOLS WITH ADDITIONAL ETHER-LINKED GROUPS
26604:* 2(2-Butoxy-Ethoxy) Ethanol can be used as the sole source of carbon.
26605:* Diethylene Glycol Monoethyl Ether can be used as the sole source of carbon.
26606:* 2-Ethoxy Ethanol can be used as the sole source of carbon.
26607:* 2(2-Ethoxy-Ethoxy) Ethanol can be used as the sole source of carbon.
26608:* 2(2-Methoxy-Ethoxy) Ethanol can be used as the sole source of carbon.
26609:* Ethylene Glycol Monoethyl Ether can be used as the sole source of carbon.

KETOALCOHOLS
26610:* Acetoin can be used as the sole source of carbon.
26611:* D(-) Ethylpropionyl Carbinol can be used as the sole source of carbon.
26612:* L(+)Ethylpropionyl Carbinol can be used as the sole source of carbon.

99026: Alcohol metabolism: Comments.
SECTION 27: ALDEHYDE METABOLISM

27001: At least one aldehyde is utilized (growth measurement).
- Acetaldehyde is utilized.
- N-Butyraldehyde is utilized.
- Formaldehyde is utilized.
- Hydroxypyruvic aldehyde is utilized.
- Proponaldehyde is utilized.
- Pyruvaldehyde is utilized.

27008: At least one aldehyde is oxidized (manometric, polarographic, etc. measurement).
- Acetaldehyde is oxidized.
- N-Butyraldehyde is oxidized.
- Formaldehyde is oxidized.
- Hydroxypyruvic Aldehyde is oxidized.
- Proponaldehyde is oxidized.
- Pyruvaldehyde is oxidized.

27013: At least one aldehyde is reduced (manometric, polarographic, etc. measurement).
- Acetaldehyde is reduced.
- N-Butyraldehyde is reduced.
- Formaldehyde is reduced.
- Hydroxypyruvic Aldehyde is reduced.
- Proponaldehyde is reduced.
- Pyruvaldehyde is reduced.

27020: Acid produced from at least one aldehyde (Indicator dye or pH meter).
- Acid produced from Acetaldehyde.
- Acid produced from N-Butyraldehyde.
- Acid produced from Formaldehyde.
- Acid produced from Hydroxypyruvic Aldehyde.
- Acid produced from Proponaldehyde.
- Acid produced from Pyruvaldehyde.

27027: Gas produced from at least one aldehyde.
- Gas produced from Acetaldehyde.
- Gas produced from N-Butyraldehyde.
- Gas produced from Formaldehyde.
- Gas produced from Hydroxypyruvic Aldehyde.
- Gas produced from Proponaldehyde.
- Gas produced from Pyruvaldehyde.

27034: At least one aldehyde can be used as the sole source of carbon.
- Acetaldehyde can be used as the sole source of carbon.
- N-Butyraldehyde can be used as the sole source of carbon.
- Formaldehyde can be used as the sole source of carbon.
- Hydroxypyruvic Aldehyde can be used as the sole source of carbon.
- Proponaldehyde can be used as the sole source of carbon.
SECTION 27: ALDEHYDE METABOLISM

Pyruvaldehyde can be used as the sole source of carbon.

Aldehyde metabolism: Comments.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

NOTE: The term "acid" covers acidic ions and salts.

28001: At least one acid or ester is utilized (growth measurement).

SATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS
28002:* Acetic acid is utilized.
28003:* Butyric acid is utilized.
28004:* Caproic acid is utilized.
28005:* Caprylic acid is utilized.
28006:* Formic acid is utilized.
28007:* Isobutyric acid is utilized.
28008:* Isovaleric acid is utilized.
28009:* Lauric acid is utilized.
28010:* 10-Methylhexadecanoic acid is utilized.
28011:* Palmitic acid is utilized.
28012:* Pelargonic acid is utilized.
28013:* Proplionic acid is utilized.
28014:* Tridecanoic acid is utilized.
28015:* Undecanoic acid is utilized.
28016:* Valeric acid is utilized.

ESTER
28017:* Methyl formate is utilized.

DICARBOXYLIC ACIDS
28018:* Adipic acid is utilized.
28019:* Azelaic acid is utilized.
28020:* Elcosanedioic acid is utilized.
28021:* Glutaric acid is utilized.
28022:* Malonic acid is utilized.
28023:* Oxalic acid is utilized.
28024:* Pimelic acid is utilized.
28025:* Sebacic acid is utilized.
28026:* Suberic acid is utilized.
28027:* Succinic acid is utilized.

UNSATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS
28028:* Erucic acid is utilized.
28029:* Linoleic acid is utilized.
28030:* Linolenic acid is utilized.
28031:* cis-8-Octadecenoic acid is utilized.
28032:* Trans-8-Octadecenoic acid is utilized.
28033:* cis-10-Octadecenoic acid is utilized.
28034:* 8-Octadecynoic acid is utilized.
28035:* 9-Octadecynoic (Stearolic) acid is utilized.
28036:* 10-Octadecynoic acid is utilized.
28037:* Oleic acid is utilized.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28038:* Petroselaidic acid is utilized.
28039:* Petrosekenic acid is utilized.

HYDROXYMONOCARBOXYLIC ACID
28040:* Ricinoleic acid is utilized.

ESTERS
28041:* Methyl arachidonate is utilized.
28042:* Ethyl oleate is utilized.
28043:* Methyl oleate is utilized.

DICARBOXYLIC ACIDS
28044:* Citraconic acid is utilized.
28045:* Fumaric acid is utilized.
28046:* Itacondic acid is utilized.
28047:* Maleic acid is utilized.
28048:* Mesoconic acid is utilized.

TRICARBOXYLIC ACIDS
28049:* Aconitic acid is utilized.
28050:* cis-aconitic acid is utilized.

HYDROXY-ACIDS

MONOCARBOXYLIC ACIDS
28051:* Glyceric acid is utilized.
28052:* DL-Glyceric acid is utilized.
28053:* Glycollic acid is utilized.
28054:* Beta-hydroxybutyric acid is utilized.
28055:* Poly-beta-hydroxybutyric acid is utilized.
28056:* D-Lactic acid is utilized.
28057:* DL-Lactic acid is utilized.
28058:* L-Lactic acid is utilized.

DICARBOXYLIC ACIDS
28059:* D-Malic acid is utilized.
28060:* L-Malic acid is utilized.
28061:* Mucic acid is utilized.
28062:* Oxaloacetic acid is utilized.
28063:* D(-) Tartaric acid is utilized.
28064:* L(+) Tartaric acid is utilized.
28065:* Meso-Tartaric acid is utilized.

TRICARBOXYLIC ACIDS
28066:* Citric acid is utilized.
28067:* Isocitric acid is utilized.

KETO-ACIDS

MONOCARBOXYLIC ACIDS
28068:* 2-Ketogluconic acid is utilized.
28069:* Levulinic acid is utilized.
28070:* Beta-oxobutyrlc (Acetoacetic) acid is utilized.
28071:* Pyruvic acid is utilized.

DICARBOXYLIC ACID
28072:* Alpha-ketoglutaric acid is utilized.

TRICARBOXYLIC ACIDS
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28073:* Oxalosuccinic acid is utilized.

CYCLIC ACIDS

MONOCARBOXYLIC ACID
28074:* Shikimic acid is utilized.

DICARBOXYLIC ACIDS
28075:* Phthalic acid is utilized.
28076:* Isophthalic acid is utilized.
28077:* Terephthalic acid is utilized.

AROMATIC ACIDS
28078:* Benzoic acid is utilized.
28079:* Meta-Hydroxybenzoic acid is utilized.
28080:* Para-Hydroxybenzoic acid is utilized.
28081:* Benzoylformic acid is utilized.
28082:* 2-Chlorophenoxyacetic acid is utilized.
28083:* 4(2,4-Dichlorophenoxy)butyric acid is utilized.
28084:* Mandelic acid is utilized.
28085:* D-Mandelic acid is utilized.
28086:* L-Mandelic acid is utilized.
28087:* Phenylacetic acid is utilized.
28088:* Beta-phenylpropionic acid is utilized.
28089:* Quinic acid is utilized.
28090:* Salicylic acid is utilized.
28091:* Cinnamic acid is utilized.

ACIDS WITH OTHER GROUPS ATTACHED
28092:* 2,2-Dichloropropionic acid is utilized.
28093:* 2-Ethoxy Ethyl Acetic acid is utilized.
28094:* Ethoxyacetic acid is utilized.

MIXTURE
28095:* Valerianic acid is utilized.

SUGAR-DERIVED ACIDS
28096:* Arabonic acid is utilized.
28097:* Ascorbic acid is utilized.
28098:* Galactonic acid is utilized.
28099:* Galacturonic acid is utilized.
28100:* Gluconic acid is utilized.
28101:* D-Gluconic acid is utilized.
28102:* Glucuronic acid is utilized.
28103:* Alpha-methyl glucuronic acid is utilized.
28104:* Hydroxymethyl glutaric acid is utilized.
28106:* Pectin is utilized.
28107:* Saccharic acid acid is utilized.

28108: At least one acid or ester can be used as the sole source of carbon.

SATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS
28109:* Acetic acid can be used as the sole source of carbon.
28110:* Butyric acid can be used as the sole source of carbon.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

Caproic acid can be used as the sole source of carbon.
Caprylic acid can be used as the sole source of carbon.
Formic acid can be used as the sole source of carbon.
Isobutyric acid can be used as the sole source of carbon.
Isovaleric acid can be used as the sole source of carbon.
Lauric acid can be used as the sole source of carbon.
10-Methylexadecanoic acid can be used as the sole source of carbon.
Palmitic acid can be used as the sole source of carbon.
Pelargonic acid can be used as the sole source of carbon.
Propionic acid can be used as the sole source of carbon.
Tridecanoic acid can be used as the sole source of carbon.
Valeric acid can be used as the sole source of carbon.
Methyl Formate can be used as the sole source of carbon.
Adipic acid can be used as the sole source of carbon.
Azelaic acid can be used as the sole source of carbon.
Eicosanediol acid can be used as the sole source of carbon.
Glutaric acid can be used as the sole source of carbon.
Malonic acid can be used as the sole source of carbon.
Pimelic acid can be used as the sole source of carbon.
Sebacic acid can be used as the sole source of carbon.
Suberic acid can be used as the sole source of carbon.
Succinic acid can be used as the sole source of carbon.
Eruccic acid can be used as the sole source of carbon.
Linolenic acid can be used as the sole source of carbon.
Cla-8-Octadecenoic acid can be used as the sole source of carbon.
Trans-8-Octadecenoic acid can be used as the sole source of carbon.
Cla-10-Octadecenoic acid can be used as the sole source of carbon.
8-Octadecynoic acid can be used as the sole source of carbon.
9-Octadecynoic (Stearolic) acid can be used as the sole source of carbon.
10-Octadeyynoic acid can be used as the sole source of carbon.
Oleic acid can be used as the sole source of carbon.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

**HYDROXYMONOCARBOXYLIC ACID**
28145:* Petroselaidic acid can be used as the sole source of carbon.
28146:* Petroselenic acid can be used as the sole source of carbon.

**ESTERS**
28147:* Ricinoleic acid can be used as the sole source of carbon.
28148:* Methyl arachidonate can be used as the sole source of carbon.
28149:* Ethyl oleate can be used as the sole source of carbon.
28150:* Methyl oleate can be used as the sole source of carbon.

**DICARBOXYLIC ACIDS**
28151:* Citraconic acid can be used as the sole source of carbon.
28152:* Fumaric acid can be used as the sole source of carbon.
28153:* Itaconic acid can be used as the sole source of carbon.
28154:* Maleic acid can be used as the sole source of carbon.
28155:* Mesoaconic acid can be used as the sole source of carbon.

**TRICARBOXYLIC ACIDS**
28156:* Aconitic acid can be used as the sole source of carbon.
28157:* Cit-Aconitic acid can be used as the sole source of carbon.

**HYDROXY-ACIDS**
**MONOCARBOXYLIC ACIDS**
28158:* Glyceric acid can be used as the sole source of carbon.
28159:* DL-Glyceric acid can be used as the sole source of carbon.
28160:* Glycollic acid can be used as the sole source of carbon.
28161:* Beta-hydroxybutyric acid can be used as the sole source of carbon.
28162:* Poly-beta-hydroxybutyric acid can be used as the sole source of carbon.
28163:* D-Lactic acid can be used as the sole source of carbon.
28164:* DL-Lactic acid can be used as the sole source of carbon.
28165:* L-Lactic acid can be used as the sole source of carbon.

**DICARBOXYLIC ACIDS**
28166:* D-Malic acid can be used as the sole source of carbon.
28167:* L-Malic acid can be used as the sole source of carbon.
28168:* Mucic acid can be used as the sole source of carbon.
28169:* Oxaloacetic acid can be used as the sole source of carbon.
28170:* D(-) Tartaric acid can be used as the sole source of carbon.
28171:* L(+) Tartaric acid can be used as the sole source of carbon.
28172:* Meso-Tartaric acid can be used as the sole source of carbon.

**TRICARBOXYLIC ACIDS**
28173:* Citric acid can be used as the sole source of carbon.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28174: Isocitric acid can be used as the sole source of carbon.

KETO-ACIDS

MONOCARBOXYLIC ACIDS
28175: 2-Ketogluconic acid can be used as the sole source of carbon.
28176: Levulinic acid can be used as the sole source of carbon.
28177: Beta-oxobutyric (Acetoacetic) acid can be used as the sole source of carbon.
28178: Pyruvic acid can be used as the sole source of carbon.

DICARBOXYLIC ACID
28179: Alpha-ketoglutaric acid can be used as the sole source of carbon.

TRICARBOXYLIC ACIDS
28180: Oxaloacetic acid can be used as the sole source of carbon.

CYCLIC ACIDS

MONOCARBOXYLIC ACID
28181: Shikimic acid can be used as the sole source of carbon.

DICARBOXYLIC ACIDS
28182: Phthalic acid can be used as the sole source of carbon.
28183: Isophthalic acid can be used as the sole source of carbon.
28184: Terephthalic acid can be used as the sole source of carbon.

AROMATIC ACIDS
28185: Benzoic acid can be used as the sole source of carbon.
28186: Meta-Hydroxybenzoic acid can be used as the sole source of carbon.
28187: Para-Hydroxybenzoic acid can be used as the sole source of carbon.
28188: Benzoylformic acid can be used as the sole source of carbon.
28189: 2-Chlorophenoxyacetic acid can be used as the sole source of carbon.
28190: 4(2,4 Dichlorophenoxy) Butyric acid can be used as the sole source of carbon.
28191: Mandelic acid can be used as the sole source of carbon.
28192: D-Mandelic acid can be used as the sole source of carbon.
28193: L-Mandelic acid can be used as the sole source of carbon.
28194: Phenylacetic acid can be used as the sole source of carbon.
28195: Beta-phenylpropionic acid can be used as the sole source of carbon.
28196: Quinic acid can be used as the sole source of carbon.
28197: Salicylic acid can be used as the sole source of carbon.
28198: Cinnamic acid can be used as the sole source of carbon.

ACIDS WITH OTHER GROUPS ATTACHED
28199: 2,2-Dichloropropionic acid can be used as the sole source of carbon.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28200:* 2-Ethoxy Ethyl Acetic acid can be used as the sole source of carbon.
28201:* Ethoxyacetic acid can be used as the sole source of carbon.

MIXTURE
28202:* Valerlanic acid can be used as the sole source of carbon.

SUGAR-DERIVED ACIDS
28203:* Arabinonic acid can be used as the sole source of carbon.
28204:* Ascorbic acid can be used as the sole source of carbon.
28205:* Galactonic acid can be used as the sole source of carbon.
28206:* Galacturonic acid can be used as the sole source of carbon.
28207:* Gluconic acid can be used as the sole source of carbon.
28208:* D-Gluconic acid can be used as the sole source of carbon.
28209:* Glucuronic acid can be used as the sole source of carbon.
28210:* Alpha-methyl glucuronic acid can be used as the sole source of carbon.
28211:* Hydroxymethyl glutaric acid can be used as the sole source of carbon.
28212:* Pectin can be used as the sole source of carbon.
28213:* Saccharic acid can be used as the sole source of carbon.
28215:* At least one acid or ester is oxidized (manometric, polarographic, etc. measurement).

SATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS
28216:* Acetic acid is oxidized.
28217:* Butyric acid is oxidized.
28218:* Caproic acid is oxidized.
28219:* Caprylic acid is oxidized.
28220:* Formic acid is oxidized.
28221:* Isovaleric acid is oxidized.
28222:* Isovaleric acid is oxidized.
28223:* Lauric acid is oxidized.
28224:* 10-Methylhexadecanoic acid is oxidized.
28225:* Palmitic acid is oxidized.
28226:* Pelargonic acid is oxidized.
28227:* Proplionic acid is oxidized.
28228:* Tridecanoic acid is oxidized.
28229:* Undecanoic acid is oxidized.
28230:* Valeric acid is oxidized.

ESTER
28231:* Methyl Formate is oxidized.

DICARBOXYLIC ACIDS
28232:* Adipic acid is oxidized.
28233:* Azelaic acid is oxidized.
28234:* Elcosanedioic acid is oxidized.
28235:* Glutaric acid is oxidized.
28236:* Malonic acid is oxidized.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28237:* Oxalic acid is oxidized.
28238:* Pimelic acid is oxidized.
28239:* Sebacic acid is oxidized.
28240:* Suberic acid is oxidized.
28241:* Succinic acid is oxidized.

UNSATURATED FATTY ACIDS

28242:* Erucic acid is oxidized.
28243:* Linoleic acid is oxidized.
28244:* Linolenic acid is oxidized.
28245:* Cis-8-Octadecenoic acid is oxidized.
28246:* Trans-8-Octadecenoic acid is oxidized.
28247:* Cis-10-Octadecenoic acid is oxidized.
28248:* 8-Octadecynoic acid is oxidized.
28249:* 9-Octadecynoic (Stearolic) acid is oxidized.
28250:* 10-Octadecynoic acid is oxidized.
28251:* Oleic acid is oxidized.
28252:* Petroselaidic acid is oxidized.
28253:* Petroselenic acid is oxidized.

HYDROXY-MONOCARBOXYLIC ACID
28254:* Ricinoleic acid is oxidized.

ESTERS
28255:* Methyl arachidonate is oxidized.
28256:* Ethyl oleate is oxidized.
28257:* Methyl oleate is oxidized.

DICARBOXYLIC ACIDS
28258:* Citraconic acid is oxidized.
28259:* Fumaric acid is oxidized.
28260:* Itaconic acid is oxidized.
28261:* Maleic acid is oxidized.
28262:* Mesaconic acid is oxidized.

TRICARBOXYLIC ACIDS
28263:* Aconitic acid is oxidized.
28264:* Cis-Aconitic acid is oxidized.

HYDROXY-ACIDS

MONOCARBOXYLIC ACIDS
28265:* Glyceric acid is oxidized.
28266:* DL-Glyceric acid is oxidized.
28267:* Glycollic acid is oxidized.
28268:* Beta-hydroxybutyric acid is oxidized.
28269:* Poly-beta-hydroxybutyric acid is oxidized.
28270:* D-Lactic acid is oxidized.
28271:* DL-Lactic acid is oxidized.
28272:* L-Lactic acid is oxidized.

DICARBOXYLIC ACIDS
## SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28275</td>
<td>Mucic acid is oxidized.</td>
</tr>
<tr>
<td>28273</td>
<td>D-Malic acid is oxidized.</td>
</tr>
<tr>
<td>28274</td>
<td>L-Malic acid is oxidized.</td>
</tr>
<tr>
<td>28276</td>
<td>Oxaloacetic acid is oxidized.</td>
</tr>
<tr>
<td>28277</td>
<td>D(-) Tartaric acid is oxidized.</td>
</tr>
<tr>
<td>28278</td>
<td>L(+) Tartaric acid is oxidized.</td>
</tr>
<tr>
<td>28279</td>
<td>Meso-Tartaric acid is oxidized.</td>
</tr>
</tbody>
</table>

**TRICARBOXYLIC ACIDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28280</td>
<td>Citric acid is oxidized.</td>
</tr>
<tr>
<td>28281</td>
<td>Isocitric acid is oxidized.</td>
</tr>
</tbody>
</table>

**KETO-ACIDS**

**MONOCARBOXYLIC ACIDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28282</td>
<td>2-Ketogluconic acid is oxidized.</td>
</tr>
<tr>
<td>28283</td>
<td>Levulinic acid is oxidized.</td>
</tr>
<tr>
<td>28284</td>
<td>Beta-oxobutyric (Acetoacetic) acid is oxidized.</td>
</tr>
<tr>
<td>28285</td>
<td>Pyruvic acid is oxidized.</td>
</tr>
</tbody>
</table>

**DICARBOXYLIC ACID**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28286</td>
<td>Alpha-ketoglutaric acid is oxidized.</td>
</tr>
</tbody>
</table>

**TRICARBOXYLIC ACIDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28287</td>
<td>Oxalosuccinic acid is oxidized.</td>
</tr>
</tbody>
</table>

**CYCLIC ACIDS**

**MONOCARBOXYLIC ACIDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28288</td>
<td>Shikimic acid is oxidized.</td>
</tr>
</tbody>
</table>

**DICARBOXYLIC ACIDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28289</td>
<td>Phthalic acid is oxidized.</td>
</tr>
<tr>
<td>28290</td>
<td>Isophthalic acid is oxidized.</td>
</tr>
<tr>
<td>28291</td>
<td>Terephthalic acid is oxidized.</td>
</tr>
</tbody>
</table>

**AROMATIC ACIDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28292</td>
<td>Benzoic acid is oxidized.</td>
</tr>
<tr>
<td>28293</td>
<td>Meta-Hydroxybenzoic acid is oxidized.</td>
</tr>
<tr>
<td>28294</td>
<td>Para-Hydroxybenzoic acid is oxidized.</td>
</tr>
<tr>
<td>28295</td>
<td>Benzoylformic acid is oxidized.</td>
</tr>
<tr>
<td>28296</td>
<td>2-Chlorophenoxyacetic acid is oxidized.</td>
</tr>
<tr>
<td>28297</td>
<td>4(2,4 Dichlorophenoxy) Butyric acid is oxidized.</td>
</tr>
<tr>
<td>28298</td>
<td>Mandelic acid is oxidized.</td>
</tr>
<tr>
<td>28299</td>
<td>D-Mandellic acid is oxidized.</td>
</tr>
<tr>
<td>28300</td>
<td>L-Mandellic acid is oxidized.</td>
</tr>
<tr>
<td>28301</td>
<td>Phenylacetic acid is oxidized.</td>
</tr>
<tr>
<td>28302</td>
<td>Beta-phenylpropionic acid is oxidized.</td>
</tr>
<tr>
<td>28303</td>
<td>Quinic acid is oxidized.</td>
</tr>
<tr>
<td>28304</td>
<td>Salicylic acid is oxidized.</td>
</tr>
<tr>
<td>28305</td>
<td>Cinnamic acid is oxidized.</td>
</tr>
</tbody>
</table>

**ACIDS WITH OTHER GROUPS ATTACHED**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28306</td>
<td>2,2, Dichloropropionic acid is oxidized.</td>
</tr>
<tr>
<td>28307</td>
<td>2-Ethoxy Ethyl Acetic acid is oxidized.</td>
</tr>
<tr>
<td>28308</td>
<td>Ethoxyacetic acid is oxidized.</td>
</tr>
</tbody>
</table>

**MIXTURE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28309</td>
<td>Valerianic acid is oxidized.</td>
</tr>
</tbody>
</table>

**SUGAR-DERIVED ACIDS**
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28310:* Arabonic acid is oxidized.
28311:* Ascorbic acid is oxidized.
28312:* Galactonic acid is oxidized.
28313:* Galacturonic acid is oxidized.
28314:* Gluconic acid is oxidized.
28315:* D-Gluconic acid is oxidized.
28316:* Glucuronic acid is oxidized.
28317:* Alpha-methyl glucuronic acid is oxidized.
28318:* Hydroxymethyl glutaric acid is oxidized.
28320:* Pectin is oxidized.
28321:* Saccharic acid is oxidized.
28322: At least one acid or ester is reduced (manometric, polarographic, etc. measurement).

SATURATED FATTY ACIDS

28323:* Acetic acid is reduced.
28324:* Butyric acid is reduced.
28325:* Caproic acid is reduced.
28326:* Caprylic acid is reduced.
28327:* Formic acid is reduced.
28328:* Isobutyric acid is reduced.
28329:* Isovaleric acid is reduced.
28330:* Lauric acid is reduced.
28331:* 10-Methylohexadecanoic acid is reduced.
28332:* Palmitic acid is reduced.
28333:* Pelargonic acid is reduced.
28334:* Propionic acid is reduced.
28335:* Tridecanoic acid is reduced.
28336:* Undecanoic acid is reduced.
28337:* Valeric acid is reduced.

ESTER

28338:* Methyl Formate is reduced.

DICARBOXYLIC ACIDS

28339:* Adipic acid is reduced.
28340:* Azelaic acid is reduced.
28341:* Eicosanediolic acid is reduced.
28342:* Glutaric acid is reduced.
28343:* Malonic acid is reduced.
28344:* Oxalic acid is reduced.
28345:* Pimelic acid is reduced.
28346:* Sebacic acid is reduced.
28347:* Suberic acid is reduced.
28348:* Succinic acid is reduced.

UNSATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS

28349:* Erucic acid is reduced.
28350:* Linoleic acid is reduced.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28351:* Linolenic acid is reduced.
28352:* Cis-8-Octadecenoic acid is reduced.
28353:* Trans-8-Octadecenoic acid is reduced.
28354:* Cis-10-Octadecenoic acid is reduced.
28355:* 8-Octadecenoic acid is reduced.
28356:* 9-Octadecenoic (Stearolic) acid is reduced.
28357:* 10-Octadecenoic acid is reduced.
28358:* Oleic acid is reduced.
28359:* Petroselaidic acid is reduced.
28360:* Petroselenenic acid is reduced.

HYDROXYMONOCARBOXYLIC ACID
28361:* Ricinoleic acid is reduced.

ESTERS
28362:* Methyl arachidonate is reduced.
28363:* Ethyl oleate is reduced.
28364:* Methyl oleate is reduced.

DICARBOXYLIC ACIDS
28365:* Citraconic acid is reduced.
28366:* Fumaric acid is reduced.
28367:* Itaconic acid is reduced.
28368:* Maleic acid is reduced.
28369:* Mesoaconic acid is reduced.

TRICARBOXYLIC ACIDS
28370:* Aconitic acid is reduced.
28371:* Cis-Aconitic acid is reduced.

HYDROXY-ACIDS

MONOCARBOXYLIC ACIDS
28372:* Glyceric acid is reduced.
28373:* DL-Glyceric acid is reduced.
28374:* Glycollic acid is reduced.
28375:* Beta-hydroxybutyric acid is reduced.
28376:* Poly-beta-hydroxybutyric acid is reduced.
28377:* DL-Lactic acid is reduced.
28378:* DL-Lactic acid is reduced.
28379:* L-Lactic acid is reduced.

DICARBOXYLIC ACIDS
28380:* D-Malic acid is reduced.
28381:* L-Malic acid is reduced.
28382:* Mucic acid is reduced.
28383:* Oxaloacetic acid is reduced.
28384:* D(-) Tartaric acid is reduced.
28385:* L(+) Tartaric acid is reduced.
28386:* Meso-Tartaric acid is reduced.

TRICARBOXYLIC ACIDS
28387:* Citric acid is reduced.
28388:* Isocitric acid is reduced.

KETO-ACIDS
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

MONOCARBOXYLIC ACIDS
28389:* 2-Ketogluconic acid is reduced.
28390:* Levulinic acid is reduced.
28391:* Beta-oxobutyric (Acetoacetic) acid is reduced.
28392:* Pyruvic acid is reduced.

DICARBOXYLIC ACID
28393:* Alpha-ketoglutaric acid is reduced.

TRICARBOXYLIC ACIDS
28394:* Oxalosuccinic acid is reduced.

CYCLIC ACIDS
MONOCARBOXYLIC ACID
28395:* Shikimic acid is reduced.

DICARBOXYLIC ACIDS
28396:* Phthalic acid is reduced.
28397:* Isophthalic acid is reduced.
28398:* Terephthalic acid is reduced.

AROMATIC ACIDS
28399:* Benzoic acid is reduced.
28400:* Meta-Hydroxybenzolic acid is reduced.
28401:* Para-Hydroxybenzolic acid is reduced.
28402:* Benzoylformic acid is reduced.
28403:* 2-Chlorophenoxyacetic acid is reduced.
28404:* 4(2,4 Dichlorophenoxy) Butyric acid is reduced.
28405:* Mandelic acid is reduced.
28406:* D-Mandelic acid is reduced.
28407:* L-Mandelic acid is reduced.
28408:* Phenylacetic acid is reduced.
28409:* Beta-phenylpropionic acid is reduced.
28410:* Quinic acid is reduced.
28411:* Salicylic acid is reduced.
28412:* Cinnamic acid is reduced.

ACIDS WITH OTHER GROUPS ATTACHED
28413:* 2,2,Dichloropropionic acid is reduced.
28414:* 2-Ethoxy Ethyl Acetic acid is reduced.
28415:* Ethoxyacetic acid is reduced.

MIXTURE
28416:* Valerianic acid is reduced.

SUGAR-DERIVED ACIDS
28417:* Arabonic acid is reduced.
28418:* Ascorbic acid is reduced.
28419:* Galactonic acid is reduced.
28420:* Galacturonic acid is reduced.
28421:* Gluconic acid is reduced.
28422:* D-Gluconic acid is reduced.
28423:* Glucuronic acid is reduced.
28424:* Alpha-methyl glucuronic acid is reduced.
28425:* Hydroxymethyl glutaric acid is reduced.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28427:* Pectin is reduced.
28428:* Saccharic acid is reduced.
28429: Gas is produced from at least one acid or ester.

SATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS
28430:* Gas is produced from Acetic acid.
28431:* Gas is produced from Butyric acid.
28432:* Gas is produced from Caproic acid.
28433:* Gas is produced from Caprylic acid.
28434:* Gas is produced from Formic acid.
28435:* Gas is produced from Isobutyric acid.
28436:* Gas is produced from Isovaleric acid.
28437:* Gas is produced from Lauric acid.
28438:* Gas is produced from 10-Methylhexadecanoic acid.
28439:* Gas is produced from Palmitic acid.
28440:* Gas is produced from Palmaric acid.
28441:* Gas is produced from Propionic acid.
28442:* Gas is produced from Tridecanoic acid.
28443:* Gas is produced from Undecanoic acid.
28444:* Gas is produced from Valeric acid.

ESTER
28445:* Gas is produced from Methyl Formate.

DICARBOXYLIC ACIDS
28446:* Gas is produced from Adipic acid.
28447:* Gas is produced from Azelaic acid.
28448:* Gas is produced from Elcosanedioic acid.
28449:* Gas is produced from Glutaric acid.
28450:* Gas is produced from Malonic acid.
28451:* Gas is produced from Oxalic acid.
28452:* Gas is produced from Pimelic acid.
28453:* Gas is produced from Sebacic acid.
28454:* Gas is produced from Suberic acid.
28455:* Gas is produced from Succinic acid.

UNSATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS
28456:* Gas is produced from Erucic acid.
28457:* Gas is produced from Linoleic acid.
28458:* Gas is produced from Linolenic acid.
28459:* Gas is produced from Cis-8-Octadecenoic acid.
28460:* Gas is produced from Trans-8-Octadecenoic acid.
28461:* Gas is produced from Cis-10-Octadecenoic acid.
28462:* Gas is produced from 8-Octadecynoic acid.
28463:* Gas is produced from 9-Octadecynoic (Stearolic) acid.
28464:* Gas is produced from 10-Octadecynoic acid.
28465:* Gas is produced from Oleic acid.
28466:* Gas is produced from Petroselaidic acid.
28467:* Gas is produced from Petroselenic acid.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

HYDROXYMONOCARBOXYLIC ACID
28468:* Gas is produced from Ricinoleic acid.

ESTERS
28469:* Gas is produced from Methyl arachidonate.
28470:* Gas is produced from Ethyl oleate.
28471:* Gas is produced from Methyl oleate.

DICARBOXYLIC ACIDS
28472:* Gas is produced from Citraconic acid.
28473:* Gas is produced from Fumaric acid.
28474:* Gas is produced from Itaconic acid.
28475:* Gas is produced from Maleic acid.
28476:* Gas is produced from Mesoaconitic acid.

TRICARBOXYLIC ACIDS
28477:* Gas is produced from Aconitic acid.
28478:* Gas is produced from Cls-Aconitic acid.

HYDROXY-ACIDS

MONOCARBOXYLIC ACIDS
28479:* Gas is produced from Glyceric acid.
28480:* Gas is produced from DL-Glyceric acid.
28481:* Gas is produced from Glycollic acid.
28482:* Gas is produced from Beta-hydroxybutyric acid.
28483:* Gas is produced from Poly-beta-hydroxybutyric acid.
28484:* Gas is produced from D-Lactic acid.
28485:* Gas is produced from DL-Lactic acid.
28486:* Gas is produced from L-Lactic acid.

DICARBOXYLIC ACIDS
28487:* Gas is produced from D-Malic acid.
28488:* Gas is produced from L-Malic acid.
28489:* Gas is produced from Mucic acid.
28490:* Gas is produced from Oxaloacetic acid.
28491:* Gas is produced from D(-) Tartaric acid.
28492:* Gas is produced from L(+) Tartaric acid.
28493:* Gas is produced from Meso-Tartaric acid.

TRICARBOXYLIC ACIDS
28494:* Gas is produced from Citric acid.
28495:* Gas is produced from Isocitric acid.

KETO-ACIDS

MONOCARBOXYLIC ACIDS
28496:* Gas is produced from 2-Ketogluconic acid.
28497:* Gas is produced from Levulinic acid.
28498:* Gas is produced from Beta-oxobutyric (Acetoacetic) acid.
28499:* Gas is produced from Pyruvic acid.

DICARBOXYLIC ACID
28500:* Gas is produced from Alpha-ketoglutaric acid.

TRICARBOXYLIC ACIDS
28501:* Gas is produced from Oxalosuccinic acid.

CYCLIC ACIDS
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

MONOCARBOXYLIC ACID
28502: Gas is produced from Shikimic acid.

DICARBOXYLIC ACIDS
28503: Gas is produced from Phthalic acid.
28504: Gas is produced from Isophthalic acid.
28505: Gas is produced from Terephthalic acid.

AROMATIC ACIDS
28506: Gas is produced from Benzoic acid.
28507: Gas is produced from Meta-Hydroxybenzoic acid.
28508: Gas is produced from Para-Hydroxybenzoic acid.
28509: Gas is produced from Benzoylformic acid.
28510: Gas is produced from 2-Chlorophenoxyacetic acid.
28511: Gas is produced from 4(2,4 Dichlorophenoxy) Butyric acid.
28512: Gas is produced from Mandelic acid.
28513: Gas is produced from D-Mandelic acid.
28514: Gas is produced from L-Mandelic acid.
28515: Gas is produced from Phenylacetic acid.
28516: Gas is produced from Beta-phenylpropionic acid.
28517: Gas is produced from Quinic acid.
28518: Gas is produced from Salicylic acid.
28519: Gas is produced from Cinnamic acid.

ACIDS WITH OTHER GROUPS ATTACHED
28520: Gas is produced from 2,2-Dichloropropionic acid.
28521: Gas is produced from 2-Ethoxy Ethyl Acetic acid.
28522: Gas is produced from Ethoxyacetic acid.

MIXTURE
28523: Gas is produced from Valerianic acid.

SUGAR-DERIVED ACIDS
28524: Gas is produced from Arabonic acid.
28525: Gas is produced from Ascorbic acid.
28526: Gas is produced from Galactonic acid.
28527: Gas is produced from Galacturonic acid.
28528: Gas is produced from Gluconic acid.
28529: Gas is produced from D-Gluconic acid.
28530: Gas is produced from Glucuronic acid.
28531: Gas is produced from Alpha-methyl glucurononic acid.
28532: Gas is produced from Hydroxymethyl glutaric acid.
28534: Gas is produced from Pectin.
28535: Gas is produced from Saccharic acid.

28536: At least one acid is decarboxylated.

SATURATED FATTY ACIDS
MONOCARBOXYLIC ACIDS
28537: Acetic acid is decarboxylated.
28538: Butyric acid is decarboxylated.
28539: Caproic acid is decarboxylated.
28540: Caprylic acid is decarboxylated.
28541: Formic acid is decarboxylated.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28542:* Isobutyric acid is decarboxylated.
28543:* Isovaleric acid is decarboxylated.
28544:* Lauric acid is decarboxylated.
28545:* 10-Methylhexadecanoic acid is decarboxylated.
28546:* Palmitic acid is decarboxylated.
28547:* Pelargonic acid is decarboxylated.
28548:* Propionic acid is decarboxylated.
28549:* Tridecanoic acid is decarboxylated.
28550:* Undecanoic acid is decarboxylated.
28551:* Valeric acid is decarboxylated.

DICARBOXYLIC ACIDS

28552:* Adipic acid is decarboxylated.
28553:* Azelaic acid is decarboxylated.
28554:* Eicosanedioic acid is decarboxylated.
28555:* Glutaric acid is decarboxylated.
28556:* Malonic acid is decarboxylated.
28557:* Oxallic acid is decarboxylated.
28558:* Pimelic acid is decarboxylated.
28559:* Sebacic acid is decarboxylated.
28560:* Suberic acid is decarboxylated.
28561:* Succinic acid is decarboxylated.

UNSATURATED FATTY ACIDS

MONOCARBOXYLIC ACIDS

28562:* Erucic acid is decarboxylated.
28563:* Linoleic acid is decarboxylated.
28564:* Linolenic acid is decarboxylated.
28565:* cis-8-Octadecenoic acid is decarboxylated.
28566:* trans-8-Octadecenoic acid is decarboxylated.
28567:* cis-10-Octadecenoic acid is decarboxylated.
28568:* 8-Octadecynoic acid is decarboxylated.
28569:* 9-Octadecynoic (Stearolic) acid is decarboxylated.
28570:* 10-Octadecynoic acid is decarboxylated.
28571:* Oleic acid is decarboxylated.
28572:* Petroselaidic acid is decarboxylated.
28573:* Petroselenic acid is decarboxylated.

HYDROXYMONOCARBOXYLIC ACID

28574:* Ricinoleic acid is decarboxylated.

DICARBOXYLIC ACIDS

28575:* Citraconic acid is decarboxylated.
28576:* Fumaric acid is decarboxylated.
28577:* Itaconic acid is decarboxylated.
28578:* Maleic acid is decarboxylated.
28579:* Mesaconic acid is decarboxylated.

TRICARBOXYLIC ACIDS

28580:* Aconitic acid is decarboxylated.
28581:* cis-aconitic acid is decarboxylated.

HYDROXY-ACIDS
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

MONOCARBOXYLIC ACIDS
28582:* Glyceric acid is decarboxylated.
28583:* DL-Glyceric acid is decarboxylated.
28584:* Glycollic acid is decarboxylated.
28585:* Beta-hydroxybutyric acid is decarboxylated.
28586:* Poly-beta-hydroxybutyric acid is decarboxylated.
28587:* DL-Lactic acid is decarboxylated.
28588:* DL-Lactic acid is decarboxylated.
28589:* L-Lactic acid is decarboxylated.
28590:* D-Malic acid is decarboxylated.
28591:* L-Malic acid is decarboxylated.
28592:* Mucic acid is decarboxylated.
28593:* Oxaloacetic acid is decarboxylated.
28594:* D(-) Tartaric acid is decarboxylated.
28595:* L(+) Tartaric acid is decarboxylated.
28596:* Meso-Tartaric acid is decarboxylated.

DICARBOXYLIC ACIDS
28597:* Citric acid is decarboxylated.
28598:* Isocitric acid is decarboxylated.

KETO-ACIDS

MONOCARBOXYLIC ACIDS
28609:* 2-Ketogluconic acid is decarboxylated.
28610:* Levulinic acid is decarboxylated.
28611:* Beta-oxobutyric (Acetoacetic) acid is decarboxylated.
28612:* Pyruvic acid is decarboxylated.

DICARBOXYLIC ACIDS
28613:* Alpha-Ketoglutaric acid is decarboxylated.

TRICARBOXYLIC ACIDS

CYCLIC ACIDS

MONOCARBOXYLIC ACID
28614:* Shikimic acid is decarboxylated.

DICARBOXYLIC ACIDS
28615:* Phthalic acid is decarboxylated.
28616:* Isophthalic acid is decarboxylated.
28617:* Terephthalic acid is decarboxylated.

AROMATIC ACIDS
28618:* Benzonic acid is decarboxylated.
28619:* Meta-Hydroxybenzoic acid is decarboxylated.
28620:* Para-Hydroxybenzoic acid is decarboxylated.
28621:* Benzoylformic acid is decarboxylated.
28622:* 2-Chlorophenoxyacetic acid is decarboxylated.
28623:* 4(2,4-Dichlorophenoxy)butyric acid is decarboxylated.
28624:* Mandelic acid is decarboxylated.
28625:* D-Mandelic acid is decarboxylated.
28626:* L-Mandelic acid is decarboxylated.
SECTION 28: CARBOXYLIC ACID OR ESTER METABOLISM

28618: * Phenylacetic acid is decarboxylated.
28619: * Beta-phenylpropionic acid is decarboxylated.
28620: * Quinic acid is decarboxylated.
28621: * Salicylic acid is decarboxylated.
28622: * Cinnamic acid is decarboxylated.

ACIDS WITH OTHER GROUPS ATTACHED
28623: * 2,2-Dichloropropionic acid is decarboxylated.
28624: * 2-Ethoxy Ethyl Acetic acid is decarboxylated.
28625: * Ethoxyacetic acid is decarboxylated.

MIXTURE
28626: * Valerianic acid is decarboxylated.

SUGAR-DERIVED ACIDS
28627: * Arabonic acid is decarboxylated.
28628: * Ascorbic acid is decarboxylated.
28629: * Galactonic acid is decarboxylated.
28630: * Galacturonic acid is decarboxylated.
28631: * Gluconic acid is decarboxylated.
28632: * D-Gluconic acid is decarboxylated.
28633: * Glucuronic acid is decarboxylated.
28634: * Alpha-methyl glucuronic acid is decarboxylated.
28635: * Hydroxymethyl glutaric acid is decarboxylated.
28637: * Pectin is decarboxylated.
28638: * Saccharic acid acid is decarboxylated.

28639: At least one ester is hydrolyzed.

ESTERS
28640: * Methyl formate is hydrolyzed.
28641: * Methyl arachidonate is hydrolyzed.
28642: * Ethyl oleate is hydrolyzed.
28643: * Methyl oleate is hydrolyzed.

99028: Acid or ester metabolism: Comments.
SECTION 29: AMINO ACID METABOLISM

29001: At least one amino acid is utilized (resulting in growth or manometric, polarographic, etc. measurement).
29002: * D-Alanine is utilized.
29003: * L-Alanine is utilized.
29004: * Beta-Alanine is utilized.
29005: * Meta-Aminobenzoic Acid is utilized.
29006: * Para-Aminobenzoic Acid is utilized.
29007: * DL-alpha-Aminobutyric Acid is utilized.
29008: * Gamma-Aminobutyric Acid is utilized.
29009: * Gamma-Aminocapronic Acid is utilized.
29010: * DL-alpha-Aminovaleric Acid is utilized.
29011: * Delta-Aminovaleric Acid is utilized.
29012: * Anthranilic Acid is utilized.
29013: * L-Arginine is utilized.
29014: * DL-Arginine is utilized.
29015: * L-Asparagine is utilized.
29016: * L-Aspartic Acid is utilized.
29017: * Betaine is utilized.
29018: * DL-Citrulline is utilized.
29019: * Creatine is utilized.
29020: * L-Cysteine is utilized.
29021: * L-Cystine is utilized.
29022: * D-Glutamic Acid is utilized.
29023: * L-Glutamic Acid is utilized.
29024: * Glycine is utilized.
29025: * Hippurate is utilized.
29026: * L-Histidine is utilized.
29027: * Kynurenic Acid is utilized.
29028: * L-Kynurenine is utilized.
29029: * D-Leucine is utilized.
29030: * L-Leucine is utilized.
29031: * D-iso-Leucine is utilized.
29032: * L-iso-Leucine is utilized.
29033: * DL-Norleucine is utilized.
29034: * D-lysine is utilized.
29035: * L-Lysine is utilized.
29036: * L-Methionine is utilized.
29037: * L-Ornithine is utilized.
29038: * D-Phenylalanine is utilized.
29039: * L-Phenylalanine is utilized.
29040: * D-Proline is utilized.
29041: * L-Proline is utilized.
29042: * Sarcosine is utilized.
29043: * D-Serine is utilized.
29044: * L-Serine is utilized.
SECTION 29: AMINO ACID METABOLISM

L-Threonine is utilized.
D-Tryptophan is utilized.
L-Tryptophan is utilized.
D-Tyrosine is utilized.
L-Tyrosine is utilized.
D-Valine is utilized.
L-Valine is utilized.

At least one amino acid is required for growth.
D-Alanine is required for growth.
L-Alanine is required for growth.
Beta-Alanine is required for growth.
Meta-Aminobenzoic Acid is required for growth.
Para-Aminobenzoic Acid is required for growth.
Delta-alpha-Aminobutyric Acid is required for growth.
Gamma-Aminobutyric Acid is required for growth.
Gamma-Aminocapronic Acid is required for growth.
DL-alpha-Aminovaleric Acid is required for growth.
Delta-Aminovaleric Acid is required for growth.
AnthraniIic Acid is required for growth.
L-Arginine is required for growth.
D-Arginine is required for growth.
L-Asparagine is required for growth.
L-Aspartic Acid is required for growth.
BetaAlanine is required for growth.
DL-Citrulline is required for growth.
Creatine is required for growth.
L-Cysteine is required for growth.
L-Cystine is required for growth.
D-Glutamic Acid is required for growth.
L-Glutamic Acid is required for growth.
Glycine is required for growth.
Hippurate is required for growth.
L-Histidine is required for growth.
Kynurenine Acid is required for growth.
L-Kynurenine is required for growth.
D-Leucine is required for growth.
L-Leucine is required for growth.
D-Iso-Leucine is required for growth.
L-Iso-Leucine is required for growth.
DL-Norleucine is required for growth.
D-Lysine is required for growth.
L-Lysine is required for growth.
L-Methionine is required for growth.
L-Ornithine is required for growth.
D-Phenylalanine is required for growth.
L-Phenylalanine is required for growth.
D-Proline is required for growth.
SECTION 29: AMINO ACID METABOLISM

29092: * L-Proline is required for growth.
29093: * Sarcosine is required for growth.
29094: * D-Serine is required for growth.
29095: * L-Serine is required for growth.
29096: * L-Threonine is required for growth.
29097: * D-Tryptophan is required for growth.
29098: * L-Tryptophan is required for growth.
29099: * Tyrosine is required for growth.
29100: * L-Tyrosine is required for growth.
29101: * D-Valine is required for growth.
29102: * L-Valine is required for growth.
29103: At least one amino acid can be used as the sole source of carbon (growth measurement).
29104: * D-Alanine can be used as the sole source of carbon.
29105: * L-Alanine can be used as the sole source of carbon.
29106: * Beta-Alanine can be used as the sole source of carbon.
29107: * Meta-Aminobenzoic Acid can be used as the sole source of carbon.
29108: * Para-Aminobenzoic Acid can be used as the sole source of carbon.
29109: * DL-alpha-Aminobutyric Acid can be used as the sole source of carbon.
29110: * Gamma-Aminobutyric Acid can be used as the sole source of carbon.
29111: * Gamma-Aminocapronic Acid can be used as the sole source of carbon.
29112: * DL-alpha-Aminovaleric Acid can be used as the sole source of carbon.
29113: * Delta-Aminovaleric Acid can be used as the sole source of carbon.
29114: * Anthranilic Acid can be used as the sole source of carbon.
29115: * L-Arginine can be used as the sole source of carbon.
29116: * DL-Arginine can be used as the sole source of carbon.
29117: * L-Asparagine can be used as the sole source of carbon.
29118: * L-Aspartic Acid can be used as the sole source of carbon.
29119: * Betaine can be used as the sole source of carbon.
29120: * DL-Citrulline can be used as the sole source of carbon.
29121: * Creatine can be used as the sole source of carbon.
29122: * L-Cysteine can be used as the sole source of carbon.
29123: * L-Cystine can be used as the sole source of carbon.
29124: * D-Glutamic Acid can be used as the sole source of carbon.
29125: * L-Glutamic Acid can be used as the sole source of carbon.
29126: * Glycine can be used as the sole source of carbon.
29127: * Hippurate can be used as the sole source of carbon.
29128: * L-Histidine can be used as the sole source of carbon.
29129: * Kynurenic Acid can be used as the sole source of carbon.
29130: * L-Kynurenine can be used as the sole source of carbon.
SECTION 29: AMINO ACID METABOLISM

29131: * D-Leucine can be used as the sole source of carbon.
29132: * L-Leucine can be used as the sole source of carbon.
29133: * D-Iso-Leucine can be used as the sole source of carbon.
29134: * L-Iso-Leucine can be used as the sole source of carbon.
29135: * DL-Norleucine can be used as the sole source of carbon.
29136: * D-Lysine can be used as the sole source of carbon.
29137: * L-Lysine can be used as the sole source of carbon.
29138: * L-Methionine can be used as the sole source of carbon.
29139: * L-Ornithine can be used as the sole source of carbon.
29140: * D-Phenylalanine can be used as the sole source of carbon.
29141: * L-Phenylalanine can be used as the sole source of carbon.
29142: * D-Proline can be used as the sole source of carbon.
29143: * L-Proline can be used as the sole source of carbon.
29144: * Sarcosine can be used as the sole source of carbon.
29145: * L-Threonine can be used as the sole source of carbon.
29146: * L-Threonine can be used as the sole source of carbon.
29147: * D-Valine can be used as the sole source of carbon.
29148: * L-Valine can be used as the sole source of carbon.
29149: * L-Tryptophan can be used as the sole source of carbon.
29150: * L-Tryptophan can be used as the sole source of carbon.
29151: * Tyrosine can be used as the sole source of carbon.
29152: * L-Tyrosine can be used as the sole source of carbon.
29153: * L-Tyrosine can be used as the sole source of carbon.
29154: * At least one amino acid can be used as the sole source of nitrogen (growth measurement).
29155: * D-Alanine can be used as the sole source of nitrogen.
29156: * L-Alanine can be used as the sole source of nitrogen.
29157: * Beta-Alanine can be used as the sole source of nitrogen.
29158: * Meta-Aminobenzoic Acid can be used as the sole source of nitrogen.
29159: * Para-Aminobenzoic Acid can be used as the sole source of nitrogen.
29160: * DL-alpha-Aminobutyric Acid can be used as the sole source of nitrogen.
29161: * Gamma-Aminobutyric Acid can be used as the sole source of nitrogen.
29162: * Gamma-Aminocappronic Acid can be used as the sole source of nitrogen.
29163: * DL-alpha-Aminovaleric Acid can be used as the sole source of nitrogen.
29164: * Delta-Aminovaleric Acid can be used as the sole source of nitrogen.
29165: * Anthranilic Acid can be used as the sole source of nitrogen.
29166: * L-Arginine can be used as the sole source of nitrogen.
29167: * DL-Arginine can be used as the sole source of nitrogen.
29168: * L-Asparagine can be used as the sole source of nitrogen.
SECTION 29: AMINO ACID METABOLISM

L-Aspartic Acid can be used as the sole source of nitrogen.
DL-Citrulline can be used as the sole source of nitrogen.
Creatine can be used as the sole source of nitrogen.
L-Cystine can be used as the sole source of nitrogen.
DL-Glutamic Acid can be used as the sole source of nitrogen.
L-Glutamic Acid can be used as the sole source of nitrogen.
Glycine can be used as the sole source of nitrogen.
Hippurate can be used as the sole source of nitrogen.
L-Histidine can be used as the sole source of nitrogen.
Kynurenine can be used as the sole source of nitrogen.
L-Kynurenine can be used as the sole source of nitrogen.
D-Leucine can be used as the sole source of nitrogen.
L-Leucine can be used as the sole source of nitrogen.
D-Isoleucine can be used as the sole source of nitrogen.
L-Isoleucine can be used as the sole source of nitrogen.
DL-Norleucine can be used as the sole source of nitrogen.
D-Lysine can be used as the sole source of nitrogen.
L-Lysine can be used as the sole source of nitrogen.
L-Methionine can be used as the sole source of nitrogen.
L-Ornithine can be used as the sole source of nitrogen.
D-Phenylalanine can be used as the sole source of nitrogen.
L-Phenylalanine can be used as the sole source of nitrogen.
D-Proline can be used as the sole source of nitrogen.
L-Proline can be used as the sole source of nitrogen.
Sarcosine can be used as the sole source of nitrogen.
D-Serine can be used as the sole source of nitrogen.
L-Serine can be used as the sole source of nitrogen.
L-Threonine can be used as the sole source of nitrogen.
D-Tryptophan can be used as the sole source of nitrogen.
L-Tryptophan can be used as the sole source of nitrogen.
Tyrosine can be used as the sole source of nitrogen.
L-Tyrosine can be used as the sole source of nitrogen.
D-Valine can be used as the sole source of nitrogen.
L-Valine can be used as the sole source of nitrogen.

At least one amino acid can be used as the sole source of carbon and nitrogen (growth measurement).

D-Alanine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Alanine can be used as the sole source of carbon and nitrogen (growth measurement).
Beta-Alanine can be used as the sole source of carbon and nitrogen (growth measurement).
Meta-Aminobenzoic Acid can be used as the sole source of carbon and nitrogen (growth measurement).
Para-Aminobenzoic Acid can be used as the sole source of carbon and nitrogen (growth measurement).
SECTION 29: AMINO ACID METABOLISM

of carbon and nitrogen (growth measurement).

29211:* DL-alpha-Aminobutyric Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29212:* Gamma-Aminobutyric Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29213:* Gamma-Aminocapronic Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29214:* DL-alpha-Aminovaleric Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29215:* Delta-Aminovaleric Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29216:* Anthranilic Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29217:* L-Arginine can be used as the sole source of carbon and nitrogen (growth measurement).

29218:* DL-Arginine can be used as the sole source of carbon and nitrogen (growth measurement).

29219:* L-Asparagine can be used as the sole source of carbon and nitrogen (growth measurement).

29220:* L-Aspartic Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29221:* Betaine can be used as the sole source of carbon and nitrogen (growth measurement).

29222:* DL-Cltrulline can be used as the sole source of carbon and nitrogen (growth measurement).

29223:* Creatine can be used as the sole source of carbon and nitrogen (growth measurement).

29224:* L-Cysteine can be used as the sole source of carbon and nitrogen (growth measurement).

29225:* L-Cystine can be used as the sole source of carbon and nitrogen (growth measurement).

29226:* D-Glutamic Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29227:* L-Glutamic Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29228:* Glycine can be used as the sole source of carbon and nitrogen (growth measurement).

29229:* Hippurate can be used as the sole source of carbon and nitrogen (growth measurement).

29230:* L-Histidine can be used as the sole source of carbon and nitrogen (growth measurement).

29231:* Kynurenic Acid can be used as the sole source of carbon and nitrogen (growth measurement).

29232:* L-Kynurenine can be used as the sole source of carbon and nitrogen (growth measurement).

29233:* D-Leucine can be used as the sole source of carbon and nitrogen (growth measurement).
SECTION 29: AMINO ACID METABOLISM

L-Leucine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Iso-Leucine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Iso-Leucine can be used as the sole source of carbon and nitrogen (growth measurement).
DL-Norleucine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Lysine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Lysine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Methionine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Ornithine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Phenylalanine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Phenylalanine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Proline can be used as the sole source of carbon and nitrogen (growth measurement).
L-Proline can be used as the sole source of carbon and nitrogen (growth measurement).
Sarcosine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Serine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Serine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Threonine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Tryptophan can be used as the sole source of carbon and nitrogen (growth measurement).
L-Tryptophan can be used as the sole source of carbon and nitrogen (growth measurement).
Tyrosine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Tyrosine can be used as the sole source of carbon and nitrogen (growth measurement).
D-Valine can be used as the sole source of carbon and nitrogen (growth measurement).
L-Valine can be used as the sole source of carbon and nitrogen (growth measurement).

At least one amino acid is deaminated.

D-Alanine is deaminated.
L-Alanine is deaminated.
SECTION 29: AMINO ACID METABOLISM

29259: * Beta-Alanine is deaminated.
29260: * Meta-Aminobenzoic Acid is deaminated.
29261: * Para-Aminobenzoic Acid is deaminated.
29262: * DL-alpha-Aminobutyric Acid is deaminated.
29263: * Gamma-Aminobutyric Acid is deaminated.
29264: * Gamma-Aminocapronic Acid is deaminated.
29265: * DL-alpha-Aminovaleric Acid is deaminated.
29266: * Delta-Aminovaleric Acid is deaminated.
29267: * Anthranilic Acid is deaminated.
29268: * L-Arginine is deaminated.
29269: * DL-Arginine is deaminated.
29270: * L-Asparagine is deaminated.
29271: * L-Aspartic Acid is deaminated.
29272: * Betaine is deaminated.
29273: * DL-Citrulline is deaminated.
29274: * Creatine is deaminated.
29275: * L-Cysteine is deaminated.
29276: * L-Cystine is deaminated.
29277: * D-Glutamic Acid is deaminated.
29278: * L-Glutamic Acid is deaminated.
29279: * Glycine is deaminated.
29280: * Hippurate is deaminated.
29281: * L-Histidine is deaminated.
29282: * Kynurenlic Acid is deaminated.
29283: * L-Kynurenine is deaminated.
29284: * D-Leucine is deaminated.
29285: * L-Leucine is deaminated.
29286: * D-Iso-Leucine is deaminated.
29287: * L-Iso-Leucine is deaminated.
29288: * DL-Norleucine is deaminated.
29289: * D-Lysine is deaminated.
29290: * L-Lysine is deaminated.
29291: * L-Methionine is deaminated.
29292: * L-Ornithine is deaminated.
29293: * D-Phenylalanine is deaminated.
29294: * L-Phenylalanine is deaminated.
29295: * D-Proline is deaminated.
29296: * L-Proline is deaminated.
29297: * Sarcosine is deaminated.
29298: * D-Serine is deaminated.
29299: * L-Serine is deaminated.
29300: * L-Threonine is deaminated.
29301: * D-Tryptophan is deaminated.
29302: * L-Tryptophan is deaminated.
29303: * Tyrosine is deaminated.
29304: * L-Tyrosine is deaminated.
29305: * D-Valine is deaminated.
SECTION 29: AMINO ACID METABOLISM

29306:* L-Valine is deaminated.
29307: At least one amino acid is decarboxylated.
29308:* D-Alanine is decarboxylated.
29309:* L-Alanine is decarboxylated.
29310:* Beta-Alanine is decarboxylated.
29311:* Meta-Aminobenzolic Acid is decarboxylated.
29312:* Para-Aminobenzolic Acid is decarboxylated.
29313:* DL-alpha-Aminobutyric Acid is decarboxylated.
29314:* Gamma-Aminobutyric Acid is decarboxylated.
29315:* Gamma-Aminocapronic Acid is decarboxylated.
29316:* DL-alpha-Aminovaleric Acid is decarboxylated.
29317:* Delta-Aminovaleric Acid is decarboxylated.
29318:* Anthranilic Acid is decarboxylated.
29319:* L-Arginine is decarboxylated.
29320:* DL-Arginine is decarboxylated.
29321:* L-Asparagine is decarboxylated.
29322:* L-Aspartic Acid is decarboxylated.
29323:* Betaaline is decarboxylated.
29324:* DL-Citrulline is decarboxylated.
29325:* Creatine is decarboxylated.
29326:* L-Cysteine is decarboxylated.
29327:* L-Cystine is decarboxylated.
29328:* D-Glutamic Acid is decarboxylated.
29329:* L-Glutamic Acid is decarboxylated.
29330:* Glycine is decarboxylated.
29331:* Hippurate is decarboxylated.
29332:* L-Histidine is decarboxylated.
29333:* Kynurenic Acid is decarboxylated.
29334:* L-Kynurenine is decarboxylated.
29335:* D-Leucine is decarboxylated.
29336:* L-Leucine is decarboxylated.
29337:* D-Iso-Leucine is decarboxylated.
29338:* L-Iso-Leucine is decarboxylated.
29339:* DL-Norleucine is decarboxylated.
29340:* D-Lysine is decarboxylated.
29341:* L-Lysine is decarboxylated.
29342:* L-Methionine is decarboxylated.
29343:* L-Ornithine is decarboxylated.
29344:* D-Phenylalanine is decarboxylated.
29345:* L-Phenylalanine is decarboxylated.
29346:* D-Proline is decarboxylated.
29347:* L-Proline is decarboxylated.
29348:* Sarcosine is decarboxylated.
29349:* D-Serine is decarboxylated.
29350:* L-Serine is decarboxylated.
29351:* L-Threonine is decarboxylated.
29352:* D-Tryptophan is decarboxylated.
SECTION 29: AMINO ACID METABOLISM

L-Tryptophan is decarboxylated.
Tyrosine is decarboxylated.
L-Tyrosine is decarboxylated.
D-Valine is decarboxylated.
L-Valine is decarboxylated.

At least one amino acid is oxidized (manometric, polarographic, etc. measurement).
D-Alanine is oxidized.
L-Alanine is oxidized.
Beta-Alanine is oxidized.
Meta-Aminobenzoic Acid is oxidized.
Para-Aminobenzoic Acid is oxidized.
DL-alpha-Aminobutyric Acid is oxidized.
Gamma-Aminobutyric Acid is oxidized.
Gamma-Aminocaproic Acid is oxidized.
L-Arginine is oxidized.
DL-Arginine is oxidized.
L-Asparagine is oxidized.
L-Aspartic Acid is oxidized.
Betaline is oxidized.
DL-Citrulline is oxidized.
Creatine is oxidized.
L-Cysteine is oxidized.
L-Cystine is oxidized.
D-Glutamic Acid is oxidized.
L-Glutamic Acid is oxidized.
Glycine is oxidized.
Hippurate is oxidized.
L-Histidine is oxidized.
Kynurenic Acid is oxidized.
L-Kynurenine is oxidized.
D-Leucine is oxidized.
L-Leucine is oxidized.
D-Iso-Leucine is oxidized.
L-Iso-Leucine is oxidized.
DL-Isoreucine is oxidized.
D-Lysine is oxidized.
L-Lysine is oxidized.
L-Methionine is oxidized.
L-Ornithine is oxidized.
D-Phenylalanine is oxidized.
L-Phenylalanine is oxidized.
D-Proline is oxidized.
L-Proline is oxidized.
SECTION 29: AMINO ACID METABOLISM

29399:* Sarcosine is oxidized.
29400:* D-Serine is oxidized.
29401:* L-Serine is oxidized.
29402:* L-Threonine is oxidized.
29403:* D-Tryptophan is oxidized.
29404:* L-Tryptophan is oxidized.
29405:* Tyrosine is oxidized.
29406:* L-Tyrosine is oxidized.
29407:* D-Valine is oxidized.
29408:* L-Valine is oxidized.

29409: At least one amino acid is reduced (manometric, polarographic, etc., measurement).

29410:* D-Alanine is reduced.
29411:* L-Alanine is reduced.
29412:* Beta-Alanine is reduced.
29413:* Meta-Aminobenzoic Acid is reduced.
29414:* Para-Aminobenzoic Acid is reduced.
29415:* DL-alpha-Aminobutyric Acid is reduced.
29416:* Gamma-Aminobutyric Acid is reduced.
29417:* Gamma-Aminocapronic Acid is reduced.
29418:* DL-alpha-Aminovaleric Acid is reduced.
29419:* Delta-Aminovaleric Acid is reduced.
29420:* Anthranilic Acid is reduced.
29421:* L-Arginine is reduced.
29422:* DL-Arginine is reduced.
29423:* L-Asparagine is reduced.
29424:* L-Aspartic Acid is reduced.
29425:* Betaine is reduced.
29426:* DL-Citrulline is reduced.
29427:* Creatine is reduced.
29428:* L-Cysteine is reduced.
29429:* L-Cystine is reduced.
29430:* D-Glutamic Acid is reduced.
29431:* L-Glutamic Acid is reduced.
29432:* Glycine is reduced.
29433:* Hippurate is reduced.
29434:* L-Histidine is reduced.
29435:* Kynurenic Acid is reduced.
29436:* L-Kynurenine is reduced.
29437:* D-Leucine is reduced.
29438:* L-Leucine is reduced.
29439:* D-Iso-Leucine is reduced.
29440:* L-Iso-Leucine is reduced.
29441:* DL-Norleucine is reduced.
29442:* D-Lysine is reduced.
29443:* L-Lysine is reduced.
29444:* L-Methionine is reduced.
SECTION 29: AMINO ACID METABOLISM

29445:* L-Ornithine is reduced.
29446:* D-Phenylalanine is reduced.
29447:* L-Phenylalanine is reduced.
29448:* D-Proline is reduced.
29449:* L-Proline is reduced.
29450:* Sarcosine is reduced.
29451:* D-Serine is reduced.
29452:* L-Serine is reduced.
29453:* L-Threonine is reduced.
29454:* D-Tryptophan is reduced.
29455:* L-Tryptophan is reduced.
29456:* Tyrosine is reduced.
29457:* L-Tyrosine is reduced.
29458:* D-Valine is reduced.
29459:* L-Valine is reduced.
29460: Gas is produced from at least one amino acid.
29461:* Gas is produced from D-Alanine.
29462:* Gas is produced from L-Alanine.
29463:* Gas is produced from Beta-Alanine.
29464:* Gas is produced from Meta-Aminobenzoic Acid.
29465:* Gas is produced from Para-Aminobenzoic Acid.
29466:* Gas is produced from DL-alpha-Aminobutyric Acid.
29467:* Gas is produced from Gamma-Aminobutyric Acid.
29468:* Gas is produced from Gamma-Aminocaproic Acid.
29469:* Gas is produced from DL-alpha-Aminovaleric Acid.
29470:* Gas is produced from Delta-Aminovaleric Acid.
29471:* Gas is produced from Anthranilic Acid.
29472:* Gas is produced from L-Arginine.
29473:* Gas is produced from DL-Arginine.
29474:* Gas is produced from L-Asparagine.
29475:* Gas is produced from L-Aspartic Acid.
29476:* Gas is produced from Betaine.
29477:* Gas is produced from DL-Citrulline.
29478:* Gas is produced from Creatine.
29479:* Gas is produced from L-Cysteine.
29480:* Gas is produced from L-Cystine.
29481:* Gas is produced from D-Glutamic Acid.
29482:* Gas is produced from L-Glutamic Acid.
29483:* Gas is produced from Glycine.
29484:* Gas is produced from Hippurate.
29485:* Gas is produced from L-Histidine.
29486:* Gas is produced from Kynurenic Acid.
29487:* Gas is produced from L-Kynurenine.
29488:* Gas is produced from D-Leucine.
29489:* Gas is produced from L-Leucine.
29490:* Gas is produced from D-iso-Leucine.
29491:* Gas is produced from L-iso-Leucine.
SECTION 29: AMINO ACID METABOLISM

29492: * Gas is produced from DL-Norleucine.
29493: * Gas is produced from D-Lysine.
29494: * Gas is produced from L-Lysine.
29495: * Gas is produced from L-Methionine.
29496: * Gas is produced from L-Ornithine.
29497: * Gas is produced from D-Phenylalanine.
29498: * Gas is produced from L-Phenylalanine.
29499: * Gas is produced from D-Proline.
29500: * Gas is produced from L-Proline.
29501: * Gas is produced from Sarcosine.
29502: * Gas is produced from D-Serine.
29503: * Gas is produced from L-Serine.
29504: * Gas is produced from L-Threonine.
29505: * Gas is produced from D-Tryptophan.
29506: * Gas is produced from L-Tryptophan.
29507: * Gas is produced from Tyrosine.
29508: * Gas is produced from L-Tyrosine.
29509: * Gas is produced from D-Valine.
29510: * Gas is produced from L-Valine.

99029: Amino acid metabolism: Comments.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

30001: At least one amine (or amide or lactam) is utilized (resulting in growth or manometric, polarographic, etc. measurement).

AMINES
30002:* Allylamine is utilized.
30003:* Alpha-Amylamine is utilized.
30004:* Iso-Amylamine is utilized.
30005:* Benzylamine is utilized.
30006:* Butylamine is utilized.
30007:* Iso-Butylamine is utilized.
30008:* Di-Iso-Butylamine is utilized.
30009:* Cadaverine is utilized.
30010:* Ethylamine is utilized.
30011:* Di-Ethylamine is utilized.
30012:* Ethanolamine is utilized.
30013:* Galactosamine is utilized.
30014:* Glucosamine is utilized.
30015:* Histamine is utilized.
30016:* Methylamine is utilized.
30017:* Tri-Methylamine is utilized.
30018:* Beta-methylbutylamine is utilized.
30019:* Beta-phenylamine is utilized.
30020:* Phenylethylamine is utilized.
30021:* Propylamine is utilized.
30022:* Di-Propylamine is utilized.
30023:* Iso-Propylamine is utilized.
30024:* Tri-Propylamine is utilized.
30025:* Putrescine is utilized.
30026:* Spermine is utilized.
30027:* Spermidine is utilized.
30028:* Tryptamine is utilized.
30029:* Tyramine is utilized.

AMIDES
30030:* Acetamide is utilized.
30031:* Allantoin is utilized.
30032:* Benzamide is utilized.
30033:* Caproamide is utilized.
30034:* Malonamide is utilized.
30035:* Nicotinamide is utilized.
30036:* Iso-Nicotinamide is utilized.
30037:* Proplonamide is utilized.
30038:* Pyrazinamide is utilized.
30039:* Salicylamide is utilized.
30040:* Succinamide is utilized.

LACTAMS
30041:* Gamma-Butyrolactam is utilized.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

At least one amine (or amide or lactam) is required for growth.

**AMINES**
- Epsilon-Caprolactam is utilized.
- Pyroglutamic Acid is utilized.
- Delta-Valerolactam is utilized.

**AMIDES**
- Allylamine is required for growth.
- Alpha-Amylamine is required for growth.
- Iso-Amylamine is required for growth.
- Benzylamine is required for growth.
- Butylamine is required for growth.
- Iso-Butylamine is required for growth.
- Di-Iso-Butylamine is required for growth.
- Cadaverine is required for growth.
- Ethylamine is required for growth.
- Di-Ethylamine is required for growth.
- Ethanolamine is required for growth.
- Galactosamine is required for growth.
- Glucosamine is required for growth.
- Histamine is required for growth.
- Methylamine is required for growth.
- Tri-Methylamine is required for growth.
- Beta-methylbutylamine is required for growth.
- Beta-phenylamine is required for growth.
- Phenylethylamine is required for growth.
- Propylamine is required for growth.
- Di-Propylamine is required for growth.
- Iso-Propylamine is required for growth.
- Tri-Propylamine is required for growth.
- Putrescine is required for growth.
- Spermine is required for growth.
- Spermidine is required for growth.
- Tryptamine is required for growth.
- Tyramine is required for growth.

**LACTAMS**
- Allantoin is required for growth.
- Acetamide is required for growth.
- Benzamide is required for growth.
- Caproamide is required for growth.
- Malonamide is required for growth.
- Nicotinamide is required for growth.
- Iso-Nicotinamide is required for growth.
- Proponamide is required for growth.
- Pyrazinamide is required for growth.
- Salicylamide is required for growth.
- Succinamide is required for growth.
- Gamma-Butyrolactam is required for growth.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

30086:* Epsilon-Caprolactam is required for growth.
30087:* Pyroglutamic Acid is required for growth.
30088:* Delta-Valerolactam is required for growth.
30089: At least one amine (or amide or lactam) can be used as the sole source of carbon (growth measurement).

AMINES
30090:* Allylamine can be used as the sole source of carbon.
30091:* Alpha-Amylamine can be used as the sole source of carbon.
30092:* Iso-Amylamine can be used as the sole source of carbon.
30093:* Benzylamine can be used as the sole source of carbon.
30094:* Butylamine can be used as the sole source of carbon.
30095:* Iso-Butylamine can be used as the sole source of carbon.
30096:* Di-Iso-Butylamine can be used as the sole source of carbon.
30097:* Cadaverine can be used as the sole source of carbon.
30098:* Ethylamine can be used as the sole source of carbon.
30099:* Di-Ethylamine can be used as the sole source of carbon.
30100:* Ethanolamine can be used as the sole source of carbon.
30101:* Galactosamine can be used as the sole source of carbon.
30102:* Glucosamine can be used as the sole source of carbon.
30103:* Histamine can be used as the sole source of carbon.
30104:* Methylamine can be used as the sole source of carbon.
30105:* Tri-Methylamine can be used as the sole source of carbon.
30106:* Beta-methylbutylamine can be used as the sole source of carbon.
30107:* Beta-phenylamine can be used as the sole source of carbon.
30108:* Phenylethylamine can be used as the sole source of carbon.
30109:* Propylamine can be used as the sole source of carbon.
30110:* Di-Propylamine can be used as the sole source of carbon.
30111:* Iso-Propylamine can be used as the sole source of carbon.
30112:* Tri-Propylamine can be used as the sole source of carbon.
30113:* Putrescine can be used as the sole source of carbon.
30114:* Spermine can be used as the sole source of carbon.
30115:* Spermidine can be used as the sole source of carbon.
30116:* Tryptamine can be used as the sole source of carbon.
30117:* Tyramine can be used as the sole source of carbon.

AMIDES
30118:* Allantoin can be used as the sole source of carbon.
30119:* Acetamide can be used as the sole source of carbon.
30120:* Benzamide can be used as the sole source of carbon.
30121:* Caproamide can be used as the sole source of carbon.
30122:* Malonamide can be used as the sole source of carbon.
30123:* Nicotinamide can be used as the sole source of carbon.
30124:* Iso-Nicotinamide can be used as the sole source of carbon.
30125:* Propionamide can be used as the sole source of carbon.
30126:* Pyrazinamide can be used as the sole source of carbon.
30127:* Salicylamide can be used as the sole source of carbon.
30128:* Succinamide can be used as the sole source of carbon.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

LACTAMS

Gamma-Butyrolactam can be used as the sole source of carbon.
Epsilon-Caprolactam can be used as the sole source of carbon.
Pyroglutamic Acid can be used as the sole source of carbon.
Delta-Valerolactam can be used as the sole source of carbon.

At least one amine (or amide or lactam) can be used as the sole source of nitrogen (growth measurement).

AMINES

Allylamine can be used as the sole source of nitrogen.
Alpha-Amylamine can be used as the sole source of nitrogen.
Iso-Amylamine can be used as the sole source of nitrogen.
Butylamine can be used as the sole source of nitrogen.
Iso-Butylamine can be used as the sole source of nitrogen.
Di-Iso-Butylamine can be used as the sole source of nitrogen.
Cadaverine can be used as the sole source of nitrogen.
Di-Ethylamine can be used as the sole source of nitrogen.
Ethanolamine can be used as the sole source of nitrogen.
Galactosamine can be used as the sole source of nitrogen.
Histamine can be used as the sole source of nitrogen.
Tri-Methylamine can be used as the sole source of nitrogen.
Beta-methylbutyramine can be used as the sole source of nitrogen.

AMIDES

Allantoin can be used as the sole source of nitrogen.
Acetamide can be used as the sole source of nitrogen.
Benzamide can be used as the sole source of nitrogen.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

30165:* Caproamide can be used as the sole source of nitrogen.
30166:* Malonamide can be used as the sole source of nitrogen.
30167:* Nicotinamide can be used as the sole source of nitrogen.
30168:* Iso-Nicotinamide can be used as the sole source of nitrogen.
30169:* Propionamide can be used as the sole source of nitrogen.
30170:* Pyrazinamide can be used as the sole source of nitrogen.
30171:* Salicylamide can be used as the sole source of nitrogen.
30172:* Succinamide can be used as the sole source of nitrogen.

LACTAMS
30173:* Gamma-Butyrolactam can be used as the sole source of nitrogen.
30174:* Epsilon-Caprolactam can be used as the sole source of nitrogen.
30175:* Pyroglutamic Acid can be used as the sole source of nitrogen.
30176:* Delta-Valerolactam can be used as the sole source of nitrogen.
30177: At least one amine (or amide or lactam) can be used as the sole source of carbon and nitrogen (growth measurement).

AMINES
30178:* Allylamine can be used as the sole source of carbon and nitrogen.
30179:* Alpha-Amylamine can be used as the sole source of carbon and nitrogen.
30180:* Iso-Amylamine can be used as the sole source of carbon and nitrogen.
30181:* Benzylamine can be used as the sole source of carbon and nitrogen.
30182:* Butylamine can be used as the sole source of carbon and nitrogen.
30183:* Iso-Butylamine can be used as the sole source of carbon and nitrogen.
30184:* Di-Iso-Butylamine can be used as the sole source of carbon and nitrogen.
30185:* Cadaverine can be used as the sole source of carbon and nitrogen.
30186:* Ethylamine can be used as the sole source of carbon and nitrogen.
30187:* Di-Ethylamine can be used as the sole source of carbon and nitrogen.
30188:* Ethanolamine can be used as the sole source of carbon and nitrogen.
30189:* Galactosamine can be used as the sole source of carbon and nitrogen.
30190:* Glucosamine can be used as the sole source of carbon and nitrogen.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

Histamine can be used as the sole source of carbon and nitrogen.
Methylamine can be used as the sole source of carbon and nitrogen.
Tri-Methylamine can be used as the sole source of carbon and nitrogen.
Beta-methylbutylamine can be used as the sole source of carbon and nitrogen.
Beta-phenylamine can be used as the sole source of carbon and nitrogen.
Phenylethylamine can be used as the sole source of carbon and nitrogen.
Propylamine can be used as the sole source of carbon and nitrogen.
Di-Propylamine can be used as the sole source of carbon and nitrogen.
Iso-Propylamine can be used as the sole source of carbon and nitrogen.
Tri-Propylamine can be used as the sole source of carbon and nitrogen.
Putrescine can be used as the sole source of carbon and nitrogen.
Spermine can be used as the sole source of carbon and nitrogen.
Spermidine can be used as the sole source of carbon and nitrogen.
Tryptamine can be used as the sole source of carbon and nitrogen.
Tyramine can be used as the sole source of carbon and nitrogen.

AMIDES

Allantoin can be used as the sole source of carbon and nitrogen.
Acetamide can be used as the sole source of carbon and nitrogen.
Benzamide can be used as the sole source of carbon and nitrogen.
Caproamide can be used as the sole source of carbon and nitrogen.
Malonamide can be used as the sole source of carbon and nitrogen.
Nicotinamide can be used as the sole source of carbon and nitrogen.
Iso-Nicotinamide can be used as the sole source of carbon and nitrogen.
Propionamide can be used as the sole source of carbon and nitrogen.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

nitrogen.

30214:* Pyrazinamide can be used as the sole source of carbon and nitrogen.
30215:* Salicylamide can be used as the sole source of carbon and nitrogen.
30216:* Succinamidine can be used as the sole source of carbon and nitrogen.

LACTAMS

30217:* Gamma-Butyrolactam can be used as the sole source of carbon and nitrogen.
30218:* Epsilon-Caprolactam can be used as the sole source of carbon and nitrogen.
30219:* Pyroglutamic Acid can be used as the sole source of carbon and nitrogen.
30220:* Delta-Valerolactam can be used as the sole source of carbon and nitrogen.
30221: At least one amine (or amide or lactam) is deaminated.

AMINES

30222:* Allylamine is deaminated.
30223:* Alpha-Amylamine is deaminated.
30224:* Iso-Amylamine is deaminated.
30225:* Benzylamine is deaminated.
30226:* Butylamine is deaminated.
30227:* Iso-Butylamine is deaminated.
30228:* Di-Iso-Butylamine is deaminated.
30229:* Cadaverine is deaminated.
30230:* Ethylamine is deaminated.
30231:* Di-Ethylamine is deaminated.
30232:* Ethanolamine is deaminated.
30233:* Galactosamine is deaminated.
30234:* Glucosamine is deaminated.
30235:* Histamine is deaminated.
30236:* Methylamine is deaminated.
30237:* Tri-Methylamine is deaminated.
30238:* Beta-methylbutylamine is deaminated.
30239:* Beta-phenylamine is deaminated.
30240:* Phenylethylamine is deaminated.
30241:* Propylamine is deaminated.
30242:* Di-Propylamine is deaminated.
30243:* Iso-Propylamine is deaminated.
30244:* Tri-Propylamine is deaminated.
30245:* Putrescine is deaminated.
30246:* Spermine is deaminated.
30247:* Spermidine is deaminated.
30248:* Tryptamine is deaminated.
30249:* Tyramine is deaminated.

AMIDES

30250:* Allantoic acid is deaminated.
30251:* Arginine is deaminated.
30252:* Histidylglycine is deaminated.
30253:* Histidine is deaminated.
30254:* L-Histidylglycine is deaminated.
30255:* L-Phenylalanine is deaminated.
30256:* Phenylalanine is deaminated.
30257:* Phenylpyruvic acid is deaminated.
30258:* Phospho-lysine is deaminated.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

30250:* Acetamide is deaminated.
30251:* Allantoin is deaminated.
30252:* Benzamide is deaminated.
30253:* Caproamide is deaminated.
30254:* Malonamide is deaminated.
30255:* Nicotinamide is deaminated.
30256:* Iso-Nicotinamide is deaminated.
30257:* Proponamide is deaminated.
30258:* Pyrazinamide is deaminated.
30259:* Salicylamide is deaminated.
30260:* Succinamide is deaminated.

LACTAMS
30261:* Gamma-Butyrolactam is deaminated.
30262:* Epsilon-Caprolactam is deaminated.
30263:* Pyroglutamic Acid is deaminated.
30264:* Delta-Valerolactam is deaminated.
30265: At least one amine (or amide or lactam) is oxidized
(emanometric, polarographic, etc. measurement).

AMINES
30266:* Allylamine is oxidized.
30267:* Alpha-Amylamine is oxidized.
30268:* Iso-Amylamine is oxidized.
30269:* Benzylamine is oxidized.
30270:* Butylamine is oxidized.
30271:* Iso-Butylamine is oxidized.
30272:* Di-Iso-Butylamine is oxidized.
30273:* Cadaverine is oxidized.
30274:* Ethylamine is oxidized.
30275:* Di-Ethylamine is oxidized.
30276:* Ethanolamine is oxidized.
30277:* Galactosamine is oxidized.
30278:* Glucosamine is oxidized.
30279:* Histamine is oxidized.
30280:* Methylamine is oxidized.
30281:* Tri-Methylamine is oxidized.
30282:* Beta-methylbutylamine is oxidized.
30283:* Beta-phenylamine is oxidized.
30284:* Phenylethylamine is oxidized.
30285:* Propylamine is oxidized.
30286:* Di-Propylamine is oxidized.
30287:* Iso-Propylamine is oxidized.
30288:* Tri-Propylamine is oxidized.
30289:* Putrescine is oxidized.
30290:* Spermine is oxidized.
30291:* Spermidine is oxidized.
30292:* Tryptamine is oxidized.
30293:* Tyramine is oxidized.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

AMIDES
30294:* Acetamide is oxidized.
30295:* Allantoin is oxidized.
30296:* Benzamide is oxidized.
30297:* Caproamide is oxidized.
30298:* Malonamide is oxidized.
30299:* Nicotinamide is oxidized.
30300:* Iso-Nicotinamide is oxidized.
30301:* Propionamide is oxidized.
30302:* Pyrazinamide is oxidized.
30303:* Salicylamide is oxidized.
30304:* Succinamide is oxidized.

LACTAMS
30305:* Gamma-Butyrolactam is oxidized.
30306:* Epsilon-Caprolactam is oxidized.
30307:* Pyroglutamic Acid is oxidized.
30308:* Delta-Valerolactam is oxidized.

30309: At least one amine (or amide or lactam) is reduced (manometric, polarographic, etc. measurement).

AMINES
30310:* Allylamine is reduced.
30311:* Alpha-Amylamine is reduced.
30312:* Iso-Amylamine is reduced.
30313:* Benzylamine is reduced.
30314:* Butylamine is reduced.
30315:* Iso-Butylamine is reduced.
30316:* Di-Iso-Butylamine is reduced.
30317:* Cadaverine is reduced.
30318:* Ethylamine is reduced.
30319:* Di-Ethylamine is reduced.
30320:* Ethanolamine is reduced.
30321:* Galactosamine is reduced.
30322:* Glucosamine is reduced.
30323:* Histamine is reduced.
30324:* Methylamine is reduced.
30325:* Tri-Methylamine is reduced.
30326:* Beta-methylbutylamine is reduced.
30327:* Beta-phenylamine is reduced.
30328:* Phenylethylamine is reduced.
30329:* Propylamine is reduced.
30330:* Di-Propylamine is reduced.
30331:* Iso-Propylamine is reduced.
30332:* Tri-Propylamine is reduced.
30333:* Putrescine is reduced.
30334:* Spermine is reduced.
30335:* Spermidine is reduced.
30336:* Tryptamine is reduced.
SECTION 30: AMINE, AMIDE AND LACTAM METABOLISM

Tyramine is reduced.
Acetamide is reduced.
Allantoin is reduced.
Benzamide is reduced.
Caproamide is reduced.
Malonamide is reduced.
Nicotinamide is reduced.
Iso-Nicotinamide is reduced.
Propionamide is reduced.
Salicylamide is reduced.
Succinamide is reduced.

Gamma-Butyrolactam is reduced.
Epsilon-Caprolactam is reduced.
Pyroglutamic Acid is reduced.
Delta-Valerolactam is reduced.

Amine, amide and lactam metabolism: Comments.
HYDROCARBONS

31001: At least one hydrocarbon can be used as the sole source of carbon.

HYDROCARBONS - ALKANES (UNBRANCHED)

31002:* N-Butane can be used as the sole source of carbon.
31003:* N-Decane can be used as the sole source of carbon.
31004:* N-Docosane can be used as the sole source of carbon.
31005:* N-Dodecane can be used as the sole source of carbon.
31006:* N-Eicosane can be used as the sole source of carbon.
31007:* Ethane can be used as the sole source of carbon.
31008:* N-Heptadecane can be used as the sole source of carbon.
31009:* N-Heptane can be used as the sole source of carbon.
31010:* N-Hexadecane can be used as the sole source of carbon.
31011:* N-Hexane can be used as the sole source of carbon.
31012:* Methane can be used as the sole source of carbon.
31013:* N-Nonadecane can be used as the sole source of carbon.
31014:* N-Nonane can be used as the sole source of carbon.
31015:* N-Octadecane can be used as the sole source of carbon.
31016:* N-Octane can be used as the sole source of carbon.
31017:* N-Pentadecane can be used as the sole source of carbon.
31018:* N-Pentane can be used as the sole source of carbon.
31019:* N-Propane can be used as the sole source of carbon.
31020:* N-Tetradecane can be used as the sole source of carbon.
31021:* N-Tridecane can be used as the sole source of carbon.
31022:* N-Undecane can be used as the sole source of carbon.

HYDROCARBONS - ALKANES (BRANCHED)

31023:* Dimethyl Octane can be used as the sole source of carbon.
31024:* 3-Ethyl Tetradecane can be used as the sole source of carbon.
31025:* 2-Methyl Heptane can be used as the sole source of carbon.
31026:* 3-Methyl Heptane can be used as the sole source of carbon.
31027:* 4-Methyl Heptane can be used as the sole source of carbon.
31028:* 2-Methyl Hexane can be used as the sole source of carbon.
31029:* 3-Methyl Hexane can be used as the sole source of carbon.
31030:* 2-Methyl Pentadecane can be used as the sole source of carbon.
31031:* 3-Methyl Pentadecane can be used as the sole source of carbon.
31032:* 4-Methyl Pentadecane can be used as the sole source of carbon.
31033:* 5-Methyl Pentadecane can be used as the sole source of carbon.
31034:* 6-Methyl Pentadecane can be used as the sole source of carbon.
31035:* 7-Methyl Pentadecane can be used as the sole source of carbon.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31036:* 8-Methyl Pentadecane can be used as the sole source of carbon.

HYDROCARBONS - CYCLIC ALKANES
31037:* N-Butylcyclohexane can be used as the sole source of carbon.
31038:* Cyclohexane can be used as the sole source of carbon.
31039:* Cis-Decalin can be used as the sole source of carbon.
31040:* Dimethylcyclohexane can be used as the sole source of carbon.

HYDROCARBONS - ALKENES (UNBRANCHED)
31041:* 1,11-Dodecadiene can be used as the sole source of carbon.
31042:* 1-Dodecene can be used as the sole source of carbon.
31043:* Ethylene can be used as the sole source of carbon.
31044:* 1-Heptene can be used as the sole source of carbon.
31045:* 1-Hexadecene (hexadecylene) can be used as the sole source of carbon.
31046:* 1-Octadecene can be used as the sole source of carbon.
31047:* 1-Octene (n-caprylene) can be used as the sole source of carbon.
31048:* Propylene can be used as the sole source of carbon.

HYDROCARBONS - CYCLIC ALKENES
31049:* Pinene can be used as the sole source of carbon.

HYDROCARBONS -ALKYNES
31050:* Acetylene can be used as the sole source of carbon.

HYDROCARBONS - DERIVATIVES
31051:* 1,2-Epoxyoctane can be used as the sole source of carbon.
31052:* Propylene oxide can be used as the sole source of carbon.

HYDROCARBONS - MIXTURES
31053:* Asphalt can be used as the sole source of carbon.
31054:* Gasoline can be used as the sole source of carbon.
31055:* Kerosine can be used as the sole source of carbon.
31056:* Paraffin Oil can be used as the sole source of carbon.
31057:* Paraffin Wax can be used as the sole source of carbon.
31058:* Petroleum can be used as the sole source of carbon.

HYDROCARBONS - AROMATIC
31059:* Anthracene can be used as the sole source of carbon.
31060:* Benzene can be used as the sole source of carbon.
31061:* N-Butylbenzene can be used as the sole source of carbon.
31062:* P-Cymene can be used as the sole source of carbon.
31063:* N-Dodecylbenzene can be used as the sole source of carbon.
31064:* Ethylbenzene can be used as the sole source of carbon.
31065:* Mesitylene can be used as the sole source of carbon.
31066:* 2-Methylnaphthalene can be used as the sole source of carbon.
31067:* 1-Methylnaphthalene can be used as the sole source of carbon.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31069:* 3-Methylphenanthrene can be used as the sole source of carbon.
31070:* 9-Methylphenanthrene can be used as the sole source of carbon.
31071:* Naphthalene can be used as the sole source of carbon.
31072:* 1-(Alpha-Naphthyl)Hendecane can be used as the sole source of carbon.
31073:* Phenanthrene can be used as the sole source of carbon.
31074:* Omega-Phenyldodecane can be used as the sole source of carbon.
31075:* Omega-Phenylundecane can be used as the sole source of carbon.
31076:* 3-Phenyleicosane can be used as the sole source of carbon.
31077:* Omega-Phenylloctadecane can be used as the sole source of carbon.
31078:* Pseudocumene can be used as the sole source of carbon.
31079:* Pyrogallol can be used as the sole source of carbon.
31080:* Toluene can be used as the sole source of carbon.
31081:* Xylene can be used as the sole source of carbon.

HYDROCARBONS - AROMATIC DERIVATIVES

31082:* Cumyl Hydroperoxide can be used as the sole source of carbon.

KETONES

31083: At least one ketone can be used as the sole source of carbon.

KETONES OF ALKANES (UNBRANCHED)

31084:* Acetone can be used as the sole source of carbon.
31085:* 2-Butanone can be used as the sole source of carbon.
31086:* Dihydroxyacetone can be used as the sole source of carbon.
31087:* 2-Octadecanone can be used as the sole source of carbon.
31088:* 2-Pentanone can be used as the sole source of carbon.
31089:* 2-Tridecanone can be used as the sole source of carbon.

KETONES OF CYCLIC ALKANES

31090:* Camphor can be used as the sole source of carbon.
31091:* Cyclohexane-1,2-dione can be used as the sole source of carbon.
31092:* Cyclohexane-1,3-dione can be used as the sole source of carbon.
31093:* Cyclohexanone can be used as the sole source of carbon.
31094:* Cyclooctanone can be used as the sole source of carbon.
31095:* Cyclopentnone can be used as the sole source of carbon.

KETONES OF AROMATIC HYDROCARBONS

31096:* Coumarin can be used as the sole source of carbon.
31097:* 1,2-Naphthoquinone can be used as the sole source of carbon.
31098:* 2-Naphthoquinone can be used as the sole source of carbon.

HYDROCARBONS

31099: At least one hydrocarbon is utilized (growth measurement).
## SECTION 31: HYDROCARBON OR KETONE METABOLISM

### HYDROCARBONS - ALKANES (UNBRANCHED)

1. **31100:** N-Butane is utilized.
2. **31101:** N-Decane is utilized.
3. **31102:** N-Docosane is utilized.
4. **31103:** N-Dodecane is utilized.
5. **31104:** N-Eicosane is utilized.
6. **31105:** Ethane is utilized.
7. **31106:** N-Heptadecane is utilized.
8. **31107:** N-Heptane is utilized.
9. **31108:** N-Hexadecane is utilized.
10. **31109:** N-Hexane is utilized.
11. **31110:** Methane is utilized.
12. **31111:** N-Nonadecane is utilized.
13. **31112:** N-Nonane is utilized.
14. **31113:** N-Octadecane is utilized.
15. **31114:** N-Octane is utilized.
16. **31115:** N-Pentadecane is utilized.
17. **31116:** N-Pentane is utilized.
18. **31117:** N-Propane is utilized.
19. **31118:** N-Tetradecane is utilized.
20. **31119:** N-Tridecane is utilized.
21. **31120:** N-Undecane is utilized.

### HYDROCARBONS - ALKANES (BRANCHED)

22. **31121:** Dimethyl Octane is utilized.
23. **31122:** 3-Ethyl Tetradecane is utilized.
24. **31123:** 2-Methyl Heptane is utilized.
25. **31124:** 3-Methyl Heptane is utilized.
26. **31125:** 4-Methyl Heptane is utilized.
27. **31126:** 2-Methyl Hexane is utilized.
28. **31127:** 3-Methyl Hexane is utilized.
29. **31128:** 2-Methyl Pentadecane is utilized.
30. **31129:** 3-Methyl Pentadecane is utilized.
31. **31130:** 4-Methyl Pentadecane is utilized.
32. **31131:** 5-Methyl Pentadecane is utilized.
33. **31132:** 6-Methyl Pentadecane is utilized.
34. **31133:** 7-Methyl Pentadecane is utilized.
35. **31134:** 8-Methyl Pentadecane is utilized.

### HYDROCARBONS - CYCLIC ALKANES

36. **31135:** N-Butylcyclohexane is utilized.
37. **31136:** Cyclohexane is utilized.
38. **31137:** Cis-Decalin is utilized.
39. **31138:** Dimethylcyclohexane is utilized.

### HYDROCARBONS - ALKENES (UNBRANCH)ED

40. **31139:** 1,11-Dodecadiene is utilized.
41. **31140:** 1-Dodecene is utilized.
42. **31141:** Ethylene is utilized.
43. **31142:** 1-Heptene is utilized.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31143:* 1-Hexadecene (hexadecylene) is utilized.
31144:* 1-Octadecene is utilized.
31145:* 1-Octene (n-caprylene) is utilized.
31146:* Propylene is utilized.

HYDROCARBONS - CYCLIC ALKENES
31147:* Cyclic Olefines are utilized.
31148:* Pinene is utilized.

HYDROCARBONS - ALKYNES
31149:* Acetylene is utilized.

HYDROCARBONS - DERIVATIVES
31150:* 1,2-Epoxyoctane is utilized.
31151:* Propylene oxide is utilized.

HYDROCARBONS - MIXTURES
31152:* Asphalt is utilized.
31153:* Gasoline is utilized.
31154:* Kerosine is utilized.
31155:* Paraffin Oil is utilized.
31156:* Paraffin Wax is utilized.
31157:* Petroleum is utilized.

HYDROCARBONS - AROMATIC
31158:* Anthracene is utilized.
31159:* Benzene is utilized.
31160:* N-Butylbenzene is utilized.
31161:* P-Cymene is utilized.
31162:* N-Dodecylbenzene is utilized.
31163:* Ethylbenzene is utilized.
31164:* Mesitylene is utilized.
31165:* 2-Methylnaphthalene is utilized.
31166:* 1-Methylnaphthalene is utilized.
31167:* 3-Methylenanthrene is utilized.
31168:* 9-Methylenanthrene is utilized.
31169:* Naphthalene is utilized.
31170:* 1-(Alpha-Naphthyll-Hendecane is utilized.
31171:* Phenanthrene is utilized.
31172:* Omega-Phenyldecane is utilized.
31173:* Omega-Phenyldecane is utilized.
31174:* 3-Phenyleicosane is utilized.
31175:* Omega-Phenyleicosane is utilized.
31176:* Pseudocumene is utilized.
31177:* Pyrogallol is utilized.
31178:* Toluene is utilized.
31179:* Xylene is utilized.

HYDROCARBONS - AROMATIC DERIVATIVES
31180:* Cumyl Hydroperoxide is utilized.

KETONES
31181: At least one ketone is utilized (growth measurement).

KETONES OF ALKANES (UNBRANCHED)
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31182:* Acetone is utilized.
31183:* 2-Butanone is utilized.
31184:* Dihydroxyacetone is utilized.
31185:* 2-Octadecanone is utilized.
31186:* 2-Pentanone is utilized.
31187:* 2-Tridecanone is utilized.

KETONES OF CYCLIC ALKANES
31188:* Camphor is utilized.
31189:* Cyclohexane-1,2-dione is utilized.
31190:* Cyclohexane-1,3-dione is utilized.
31191:* Cyclohexanone is utilized.
31192:* Cyclopentanone is utilized.
31193:* Cyclooctanone is utilized.

KETONES OF AROMATIC HYDROCARBONS
31194:* Coumarin is utilized.
31195:* 1,2-Naphthoquinone is utilized.
31196:* 2-Naphthoquinone is utilized.

HYDROCARBONS
31197: At least one hydrocarbon is oxidized (manometric, polarographic, etc. measurement).

HYDROCARBONS - ALKANES (UNBRANCHED)
31198:* N-Butane is oxidized.
31199:* N-Decane is oxidized.
31200:* N-Docosane is oxidized.
31201:* N-Dodecane is oxidized.
31202:* N-Eicosane is oxidized.
31203:* Ethane is oxidized.
31204:* N-Heptadecane is oxidized.
31205:* N-Heptane is oxidized.
31206:* N-Hexadecane is oxidized.
31207:* N-Hexane is oxidized.
31208:* Methane is oxidized.
31209:* N-Nonadecane is oxidized.
31210:* N-Nonane is oxidized.
31211:* N-Octadecane is oxidized.
31212:* N-Octane is oxidized.
31213:* N-Pentadecane is oxidized.
31214:* N-Pentane is oxidized.
31215:* N-Propane is oxidized.
31216:* N-Tetradecane is oxidized.
31217:* N-Tridecane is oxidized.
31218:* N-Undecane is oxidized.

HYDROCARBONS - ALKANES (BRANCHED)
31219:* Dimethyl Octane is oxidized.
31220:* 3-Ethyl Tetradecane is oxidized.
31221:* 2-Methyl Heptane is oxidized.
31222:* 3-Methyl Heptane is oxidized.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31223:* 4-Methyl Heptane is oxidized.
31224:* 2-Methyl Hexane is oxidized.
31225:* 3-Methyl Hexane is oxidized.
31226:* 2-Methyl Pentadecane is oxidized.
31227:* 3-Methyl Pentadecane is oxidized.
31228:* 4-Methyl Pentadecane is oxidized.
31229:* 5-Methyl Pentadecane is oxidized.
31230:* 6-Methyl Pentadecane is oxidized.
31231:* 7-Methyl Pentadecane is oxidized.
31232:* 8-Methyl Pentadecane is oxidized.

HYDROCARBONS - CYCLIC ALKANES
31233:* N-Butylcyclohexane is oxidized.
31234:* Cyclohexane is oxidized.
31235:* Cis-Decalin is oxidized.
31236:* Dimethylcyclohexane is oxidized.

HYDROCARBONS - ALKENES (UNBRANCHED)
31237:* 1,11-Dodecadiene is oxidized.
31238:* 1-Dodecene is oxidized.
31239:* Ethylene is oxidized.
31240:* 1-Heptene is oxidized.
31241:* 1-Hexadecene (hexadecylene) is oxidized.
31242:* 1-Octadecene is oxidized.
31243:* 1-Octene (n-caprylene) is oxidized.
31244:* Propylene is oxidized.

HYDROCARBONS - CYCLIC ALKENES
31245:* Cyclic Olefines are oxidized.
31246:* Pinene is oxidized.

HYDROCARBONS - ALKYNES
31247:* Acetylene is oxidized.

HYDROCARBONS - DERIVATIVES
31248:* 1,2-Epoxyoctane is oxidized.
31249:* Propylene oxide is oxidized.

HYDROCARBONS - MIXTURES
31250:* Asphalt is oxidized.
31251:* Gasoline is oxidized.
31252:* Kerosine is oxidized.
31253:* Paraffin Oil is oxidized.
31254:* Paraffin Wax is oxidized.
31255:* Petroleum is oxidized.

HYDROCARBONS - AROMATIC
31256:* Anthracene is oxidized.
31257:* Benzene is oxidized.
31258:* N-Butylbenzene is oxidized.
31259:* P-Cymene is oxidized.
31260:* N-Dodecylbenzene is oxidized.
31261:* Ethylbenzene is oxidized.
31262:* Mesitylene is oxidized.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31263: * 2-Methylnaphthalene is oxidized.
31264: * 1-Methylnaphthalene is oxidized.
31265: * 3-Methylphenanthrene is oxidized.
31266: * 9-Methylphenanthrene is oxidized.
31267: * Naphthalene is oxidized.
31268: * 1-(Alpha-Naphthyl)-Hendecane is oxidized.
31269: * Phenanthrene is oxidized.
31270: * Omega-Phenyldecan e is oxidized.
31271: * Omega-Phenyldecane is oxidized.
31272: * 3-Phenyleicosane is oxidized.
31273: * Omega-Phenylloctadecane is oxidized.
31274: * Pseudocumene is oxidized.
31275: * Pyrogallol is oxidized.
31276: * Toluene is oxidized.
31277: * Xylene is oxidized.

HYDROCARBONS - AROMATIC DERIVATIVES
31278: * Cumyl Hydroperoxide is oxidized.

KETONES
31279: At least one ketone is oxidized (manometric, polarographic, etc. measurement).

KETONES OF ALKANES (UNBRANCHED)
31280: * Acetone is oxidized.
31281: * 2-Butanone is oxidized.
31282: * Dihydroxyacetone is oxidized.
31283: * 2-Octadecanone is oxidized.
31284: * 2-Pentanone is oxidized.
31285: * 2-Tridecanone is oxidized.

KETONES OF CYCLIC ALKANES
31286: * Camphor is oxidized.
31287: * Cyclohexane-1,2-dione is oxidized.
31288: * Cyclohexane-1,3-dione is oxidized.
31289: * Cyclohexanone is oxidized.
31290: * Cyclooctanone is oxidized.
31291: * Cyclopentnone is oxidized.

KETONES OF AROMATIC HYDROCARBONS
31292: * Coumarin is oxidized.
31293: * 1,2-Naphthoquinone is oxidized.
31294: * 2-Naphthoquinone is oxidized.

HYDROCARBONS
31295: At least one hydrocarbon is reduced (manometric, polarographic, etc. measurement).

HYDROCARBONS - ALKANES (UNBRANCHED)
31296: * N-Butane is reduced.
31297: * N-Decane is reduced.
31298: * N-Docosane is reduced.
31299: * N-Dodecane is reduced.
31300: * N-Eicosane is reduced.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31301:* Ethane is reduced.
31302:* N-Heptadecane is reduced.
31303:* N-Heptane is reduced.
31304:* N-Hexadecane is reduced.
31305:* N-Hexane is reduced.
31306:* Methane is reduced.
31307:* N-Nonadecane is reduced.
31308:* N-Nonane is reduced.
31309:* N-Octadecane is reduced.
31310:* N-Octane is reduced.
31311:* N-Pentadecane is reduced.
31312:* N-Pentane is reduced.
31313:* N-Propane is reduced.
31314:* N-Tetradecane is reduced.
31315:* N-Tridecane is reduced.
31316:* N-Undecane is reduced.

HYDROCARBONS - ALKANES (BRANCHED)

31317:* Dimethyl Octane is reduced.
31318:* 3-Ethyl Tetradecane is reduced.
31319:* 2-Methyl Heptane is reduced.
31320:* 3-Methyl Heptane is reduced.
31321:* 4-Methyl Heptane is reduced.
31322:* 2-Methyl Hexane is reduced.
31323:* 3-Methyl Hexane is reduced.
31324:* 2-Methyl Pentadecane is reduced.
31325:* 3-Methyl Pentadecane is reduced.
31326:* 4-Methyl Pentadecane is reduced.
31327:* 5-Methyl Pentadecane is reduced.
31328:* 6-Methyl Pentadecane is reduced.
31329:* 7-Methyl Pentadecane is reduced.
31330:* 8-Methyl Pentadecane is reduced.

HYDROCARBONS - CYCLIC ALKANES

31331:* N-Butylcyclohexane is reduced.
31332:* Cyclohexane is reduced.
31333:* Cis-Decalin is reduced.
31334:* Dimethylcyclohexane is reduced.

HYDROCARBONS - ALKENES (UNBRANCHED)

31335:* 1,11-Dodecadiene is reduced.
31336:* 1-Dodecene is reduced.
31337:* Ethylene is reduced.
31338:* 1-Heptene is reduced.
31339:* 1-Hexadecene (hexadecylene) is reduced.
31340:* 1-Octadecene is reduced.
31341:* 1-Octene (n-caprylene) is reduced.
31342:* Propylene is reduced.

HYDROCARBONS - CYCLIC ALKENES

31343:* Cyclic Olefines are reduced.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31344: Pinene is reduced.

HYDROCARBONS - ALKYNES
31345: Acetylene is reduced.

HYDROCARBONS - DERIVATIVES
31346: 1,2-Epoxyoctane is reduced.
31347: Propylene oxide is reduced.

HYDROCARBONS - MIXTURES
31348: Asphalt is reduced.
31349: Gasoline is reduced.
31350: Kerosine is reduced.
31351: Paraffin Oil is reduced.
31352: Paraffin Wax is reduced.
31353: Petroleum is reduced.

HYDROCARBONS - AROMATIC
31354: Anthracene is reduced.
31355: Benzene is reduced.
31356: N-Butylbenzene is reduced.
31357: P-Cymene is reduced.
31358: N-Dodecylbenzene is reduced.
31359: Ethylbenzene is reduced.
31360: Mesitylene is reduced.
31361: 2-Methylnaphthalene is reduced.
31362: 1-Methylnaphthalene is reduced.
31363: 3-Methylenaphthanthrene is reduced.
31364: 9-Methylenaphthanthrene is reduced.
31365: Naphthalene is reduced.
31366: 1-(Alpha-Naphthyll)-Hendecane is reduced.
31367: Phenanthrene is reduced.
31368: Omega-Phenyldecane is reduced.
31369: Omega-Phenyloctadecane is reduced.
31370: 3-Phenyleicosane is reduced.
31371: Omega-Phenyloctadecane is reduced.
31372: Pseudocumene is reduced.
31373: Pyrogallol is reduced.
31374: Toluene is reduced.
31375: Xylene is reduced.

HYDROCARBONS - AROMATIC DERIVATIVES
31376: Cumyl Hydroperoxide is reduced.

KETONES
31377: At least one ketone is reduced (manometric, polarographic, etc. measurement).

KETONES OF ALKANES (UNBRANCHED)
31378: Acetone is reduced.
31379: 2-Butanone is reduced.
31380: Dilhydroxyacetone is reduced.
31381: 2-Octadecanone is reduced.
31382: 2-Pentanone is reduced.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31383:* 2-Tridecanone is reduced.

KETONES OF CYCLIC ALKANES
31384:* Camphor is reduced.
31385:* Cyclohexane-1,2-dione is reduced.
31386:* Cyclohexane-1,3-dione is reduced.
31387:* Cyclohexanone is reduced.
31388:* Cyclooctanone is reduced.
31389:* Cyclopentnone is reduced.

KETONES OF AROMATIC HYDROCARBONS
31390:* Coumarin is reduced.
31391:* 1,2-Naphthoquinone is reduced.
31392:* 2-Naphthoquinone is reduced.

HYDROCARBONS
31393: Acid is produced from at least one hydrocarbon (indicator dye or pH measurement).

HYDROCARBONS - ALKANES (UNBRANCHED)
31394:* Acid is produced from N-Butane.
31395:* Acid is produced from N-Decane.
31396:* Acid is produced from N-Docosane.
31397:* Acid is produced from N-Dodecane.
31398:* Acid is produced from N-Elcosane.
31399:* Acid is produced from Ethane.
31400:* Acid is produced from N-Heptadecane.
31401:* Acid is produced from N-Heptane.
31402:* Acid is produced from N-Hexadecane.
31403:* Acid is produced from N-Hexane.
31404:* Acid is produced from Methane.
31405:* Acid is produced from N-Nonadecane.
31406:* Acid is produced from N-Nonane.
31407:* Acid is produced from N-Octadecane.
31408:* Acid is produced from N-Octane.
31409:* Acid is produced from N-Pentadecane.
31410:* Acid is produced from N-Pentane.
31411:* Acid is produced from N-Propane.
31412:* Acid is produced from N-Tetradecane.
31413:* Acid is produced from N-Tridecane.
31414:* Acid is produced from N-Undecane.

HYDROCARBONS - ALKANES (BRANCHED)
31415:* Acid is produced from Dimethyl Octane.
31416:* Acid is produced from 3-Ethyl Tetradecane.
31417:* Acid is produced from 2-Methyl Heptane.
31418:* Acid is produced from 3-Methyl Heptane.
31419:* Acid is produced from 4-Methyl Heptane.
31420:* Acid is produced from 2-Methyl Hexane.
31421:* Acid is produced from 3-Methyl Hexane.
31422:* Acid is produced from 2-Methyl Pentadecane.
31423:* Acid is produced from 3-Methyl Pentadecane.
### SECTION 31: HYDROCARBON OR KETONE METABOLISM

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>31424</td>
<td>Acid is produced from 4-Methyl Pentadecane.</td>
</tr>
<tr>
<td>31425</td>
<td>Acid is produced from 5-Methyl Pentadecane.</td>
</tr>
<tr>
<td>31426</td>
<td>Acid is produced from 6-Methyl Pentadecane.</td>
</tr>
<tr>
<td>31427</td>
<td>Acid is produced from 7-Methyl Pentadecane.</td>
</tr>
<tr>
<td>31428</td>
<td>Acid is produced from 8-Methyl Pentadecane.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - CYCLIC ALKANES</td>
</tr>
<tr>
<td>31429</td>
<td>Acid is produced from N-Butylcyclohexane.</td>
</tr>
<tr>
<td>31430</td>
<td>Acid is produced from Cyclohexane.</td>
</tr>
<tr>
<td>31431</td>
<td>Acid is produced from Cis-Decalin.</td>
</tr>
<tr>
<td>31432</td>
<td>Acid is produced from Dimethylcyclohexane.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - ALKENES (UNBRANCHED)</td>
</tr>
<tr>
<td>31433</td>
<td>Acid is produced from 1,11-Dodecadiene.</td>
</tr>
<tr>
<td>31434</td>
<td>Acid is produced from 1-Dodecene.</td>
</tr>
<tr>
<td>31435</td>
<td>Acid is produced from Ethylene.</td>
</tr>
<tr>
<td>31436</td>
<td>Acid is produced from 1-Heptene.</td>
</tr>
<tr>
<td>31437</td>
<td>Acid is produced from 1-Hexadecene (hexadecylene).</td>
</tr>
<tr>
<td>31438</td>
<td>Acid is produced from 1-Octadecene.</td>
</tr>
<tr>
<td>31439</td>
<td>Acid is produced from 1-Octene (n-caprylene).</td>
</tr>
<tr>
<td>31440</td>
<td>Acid is produced from Propylene.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - CYCLIC ALKENES</td>
</tr>
<tr>
<td>31441</td>
<td>Acid is produced from Cyclic Olefines.</td>
</tr>
<tr>
<td>31442</td>
<td>Acid is produced from Pinene.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - ALKynes</td>
</tr>
<tr>
<td>31443</td>
<td>Acid is produced from Acetylene.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - DERIVATIVES</td>
</tr>
<tr>
<td>31444</td>
<td>Acid is produced from 1,2-Epoxyoctane.</td>
</tr>
<tr>
<td>31445</td>
<td>Acid is produced from Propylene oxide.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - MIXTURES</td>
</tr>
<tr>
<td>31446</td>
<td>Acid is produced from Asphalt.</td>
</tr>
<tr>
<td>31447</td>
<td>Acid is produced from Gasoline.</td>
</tr>
<tr>
<td>31448</td>
<td>Acid is produced from Kerosine.</td>
</tr>
<tr>
<td>31449</td>
<td>Acid is produced from Paraffin Oil.</td>
</tr>
<tr>
<td>31450</td>
<td>Acid is produced from Paraffin Wax.</td>
</tr>
<tr>
<td>31451</td>
<td>Acid is produced from Petroleum.</td>
</tr>
<tr>
<td></td>
<td>HYDROCARBONS - AROMATIC</td>
</tr>
<tr>
<td>31452</td>
<td>Acid is produced from Anthracene.</td>
</tr>
<tr>
<td>31453</td>
<td>Acid is produced from Benzene.</td>
</tr>
<tr>
<td>31454</td>
<td>Acid is produced from N-Butylbenzene.</td>
</tr>
<tr>
<td>31455</td>
<td>Acid is produced from P-Cymene.</td>
</tr>
<tr>
<td>31456</td>
<td>Acid is produced from N-Dodecylbenzene.</td>
</tr>
<tr>
<td>31457</td>
<td>Acid is produced from Ethylbenzene.</td>
</tr>
<tr>
<td>31458</td>
<td>Acid is produced from Mesitylene.</td>
</tr>
<tr>
<td>31459</td>
<td>Acid is produced from 2-Methylnaphthalene.</td>
</tr>
<tr>
<td>31460</td>
<td>Acid is produced from 1-Methylnaphthalene.</td>
</tr>
<tr>
<td>31461</td>
<td>Acid is produced from 3-Methylenaphthrene.</td>
</tr>
<tr>
<td>31462</td>
<td>Acid is produced from 9-Methylenaphthrene.</td>
</tr>
<tr>
<td>31463</td>
<td>Acid is produced from Naphthalene.</td>
</tr>
</tbody>
</table>
SECTION 31: HYDROCARBON OR KETONE METABOLISM

<table>
<thead>
<tr>
<th>Reaction Description</th>
<th>Reference</th>
<th>Metabolized Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid is produced from 1-(Alpha-Naphthyl)-Hendecane.</td>
<td>31464*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Phenanthrene.</td>
<td>31465*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Omega-Phenyldecane.</td>
<td>31466*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Omega-Phenylundecane.</td>
<td>31467*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from 3-Phenyleicosane.</td>
<td>31468*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Omega-Phenyloctadecane.</td>
<td>31469*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Pseudocumene.</td>
<td>31470*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Pyrogallol.</td>
<td>31471*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Toluene.</td>
<td>31472*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Xylene.</td>
<td>31473*</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons - Aromatic Derivatives</td>
<td>31474*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cumyl Hydroperoxide.</td>
<td></td>
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</tr>
<tr>
<td>KETONES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid is produced from at least one ketone (indicator dye or pH measurement).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketones of Alkanes (Unbranched)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cumyl Hydroperoxide.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketones of Cyclic Alkanes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Camphor.</td>
<td>31482*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cyclohexane-1,2-dione.</td>
<td>31483*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cyclohexane-1,3-dione.</td>
<td>31484*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cyclohexaneone.</td>
<td>31485*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cyclooctanone.</td>
<td>31486*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Cyclopentnone.</td>
<td>31487*</td>
<td></td>
</tr>
<tr>
<td>Ketones of Aromatic Hydrocarbons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid is produced from Coumarin.</td>
<td>31488*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from 1,2-Naphthoquinone.</td>
<td>31489*</td>
<td></td>
</tr>
<tr>
<td>Acid is produced from 2-Naphthoquinone.</td>
<td>31490*</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas is produced from at least one hydrocarbon.</td>
<td>31491*</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons - Alkanes (Unbranched)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Butane.</td>
<td>31492*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Decane.</td>
<td>31493*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Docosane.</td>
<td>31494*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Dodecane.</td>
<td>31495*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Eicosane.</td>
<td>31496*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from Ethane.</td>
<td>31497*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Heptadecane.</td>
<td>31498*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Heptane.</td>
<td>31499*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Hexadecane.</td>
<td>31500*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from N-Hexane.</td>
<td>31501*</td>
<td></td>
</tr>
<tr>
<td>Gas is produced from Methane.</td>
<td>31502*</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31503:* Gas is produced from N-Nonadecane.
31504:* Gas is produced from N-Nonane.
31505:* Gas is produced from N-Octadecane.
31506:* Gas is produced from N-Octane.
31507:* Gas is produced from N-Pentadecane.
31508:* Gas is produced from N-Pentane.
31509:* Gas is produced from N-Propane.
31510:* Gas is produced from N-Tetradecane.
31511:* Gas is produced from N-Tridecane.
31512:* Gas is produced from N-Undecane.

HYDROCARBONS -ALKANES (BRANCHED)
31513:* Gas is produced from Dimethyl Octane.
31514:* Gas is produced from 3-Ethyl Tetradecane.
31515:* Gas is produced from 2-Methyl Heptane.
31516:* Gas is produced from 3-Methyl Heptane.
31517:* Gas is produced from 4-Methyl Heptane.
31518:* Gas is produced from 2-Methyl Hexane.
31519:* Gas is produced from 3-Methyl Hexane.
31520:* Gas is produced from 2-Methyl Pentadecane.
31521:* Gas is produced from 3-Methyl Pentadecane.
31522:* Gas is produced from 4-Methyl Pentadecane.
31523:* Gas is produced from 5-Methyl Pentadecane.
31524:* Gas is produced from 6-Methyl Pentadecane.
31525:* Gas is produced from 7-Methyl Pentadecane.
31526:* Gas is produced from 8-Methyl Pentadecane.

HYDROCARBONS - CYCLIC ALKANES
31527:* Gas is produced from N-Butylcyclohexane.
31528:* Gas is produced from Cyclohexane.
31529:* Gas is produced from cis-Decalin.
31530:* Gas is produced from Dimethylcyclohexane.

HYDROCARBONS - CYCLIC ALKENES
31531:* Gas is produced from 1,11-Dodecadiene.
31532:* Gas is produced from 1-Dodecene.
31533:* Gas is produced from Ethylene.
31534:* Gas is produced from 1-Heptene.
31535:* Gas is produced from 1-Hexadecene (hexadecylene).
31536:* Gas is produced from 1-Octadecene.
31537:* Gas is produced from 1-Octene (n-caprylene).
31538:* Gas is produced from Propylene.

HYDROCARBONS - ALKENES
31539:* Gas is produced from Cyclic Olefines.
31540:* Gas is produced from Propene.

HYDROCARBONS - ALKYNES
31541:* Gas is produced from Acetylene.

HYDROCARBONS - DERIVATIVES
31542:* Gas is produced from 1,2-Epoxyoctane.
31543:* Gas is produced from Propylene oxide.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

HYDROCARBONS - MIXTURES
31544:* Gas is produced from Asphalt.
31545:* Gas is produced from Gasoline.
31546:* Gas is produced from Kerosine.
31547:* Gas is produced from Paraffin Oil.
31548:* Gas is produced from Paraffin Wax.
31549:* Gas is produced from Petroleum.

HYDROCARBONS - AROMATIC
31550:* Gas is produced from Anthracene.
31551:* Gas is produced from Benzene.
31552:* Gas is produced from N-Butylbenzene.
31553:* Gas is produced from P-Cymene.
31554:* Gas is produced from N-Dodecylbenzene.
31555:* Gas is produced from Ethylbenzene.
31556:* Gas is produced from Mesitylene.
31557:* Gas is produced from 2-Methylnaphthalene.
31558:* Gas is produced from 1-Methylnaphthalene.
31559:* Gas is produced from 3-Methylphenanthrene.
31560:* Gas is produced from 9-Methylphenanthrene.
31561:* Gas is produced from Naphthalene.
31562:* Gas is produced from 1-(Alpha-Naphthyl)-Hendecane.
31563:* Gas is produced from Phenanthrene.
31564:* Gas is produced from Omega-Phenyldecane.
31565:* Gas is produced from Omega-Phenyldecane.
31566:* Gas is produced from 3-Phenyleicosane.
31567:* Gas is produced from Omega-Phenylloctadecane.
31568:* Gas is produced from Pseudocumene.
31569:* Gas is produced from Pyrogallol.
31570:* Gas is produced from Toluene.
31571:* Gas is produced from Xylene.

HYDROCARBONS - AROMATIC DERIVATIVES
31572:* Gas is produced from Cumyl Hydroperoxide.

KETONES
31573: Gas is produced from at least one ketone.

KETONES OF ALKANES (UNBRANCHED)
31574:* Gas is produced from Acetone.
31575:* Gas is produced from 2-Butanone.
31576:* Gas is produced from Dlhydroxyacetone.
31577:* Gas is produced from 2-Octodecanone.
31578:* Gas is produced from 2-Pentanone.
31579:* Gas is produced from 2-Trldecanone.

KETONES OF CYCLIC ALKANES
31580:* Gas is produced from Camphor.
31581:* Gas is produced from Cyclohexane-1,2-dione.
31582:* Gas is produced from Cyclohexane-1,3-dione.
31583:* Gas is produced from Cyclohexanone.
31584:* Gas is produced from Cyclooctanone.
SECTION 31: HYDROCARBON OR KETONE METABOLISM

31585:* Gas is produced from Cyclopentnone.

KETONES OF AROMATIC HYDROCARBONS
31586:* Gas is produced from Coumarin.
31587:* Gas is produced from 1,2-Naphthoquinone.
31588:* Gas is produced from 2-Naphthoquinone.

99031: Hydrocarbon or ketone metabolism: Comments.
SECTION 32: FAT AND OIL METABOLISM

32001: At least one fat is hydrolyzed.
32002:* Beef Tallow is hydrolyzed.
32003:* Butter Fat is hydrolyzed.
32004:* Coconut Oil is hydrolyzed.
32005:* Corn Oil is hydrolyzed.
32006:* Cottonseed Oil is hydrolyzed.
32007:* Lard is hydrolyzed.
32008:* Linseed Oil is hydrolyzed.
32009:* Olive Oil is hydrolyzed.
32010:* Tributyrin is hydrolyzed.
32011:* Tricaprin is hydrolyzed.
32012:* Tricaprin is hydrolyzed.
32013:* Tricaprylin is hydrolyzed.
32014:* Trilaurin is hydrolyzed.
32015:* Trimyristin is hydrolyzed.
32016:* Trilaurin is hydrolyzed.
32017:* Triolein is hydrolyzed.
32018:* Tripropionin is hydrolyzed.
32019:* Tristearin is hydrolyzed.
32020:* Tween 20 is hydrolyzed.
32021:* Tween 40 is hydrolyzed.
32022:* Tween 60 is hydrolyzed.
32023:* Tween 80 is hydrolyzed.

99032: Fat and oil metabolism: Comments.
SECTION 33: PRESERVATION OF CULTURES

33001: Cultures may be stored at 25 C for 30 days.
33002: Cultures may be stored at 5 C for 30 days.
33003: Agar slant cultures with a petrolatum overlay may be stored for 30 days.
33004: Cultures may be stored in sterile soil (pH 6.0-8.0) for 30 days.
33005: Cultures require complete anaerobiosis during storage.
33006: Cultures may be successfully lyophilized.
33007: Cultures may be frozen at -20 C for 30 days.
33008: Cultures may be frozen at -65 C (solid carbon dioxide) for 30 days.
33009: Cultures may be frozen at -196 C (liquid nitrogen) for 30 days.
33010: Cultures survive only if maintained in appropriate animal hosts or in tissue cultures from these hosts.
33011: Cultures survive storage in 15% glycerol at 0 C or below for 30 days.
33012: Cultures survive 70% ethanol for 60 minutes.
99033: Preservation of cultures: Comments.

NOTE 2: Enzymes common to two or more pathways are mentioned in first only.

GLYCOLYSIS (EMP PATHWAY)
34001: Hexoses are catabolized, at least in part, to two moles of pyruvate (and beyond) by EMP pathway (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34002: Hexokinase (2.7.1.1) is present.
34003: A specific glucokinase (2.7.1.2) is present.
34004: A specific keto-hexokinase (2.7.1.3) is present.
34005: Hexoses are phosphorylated by an enzyme not using adenosine triphosphate as the phosphate donor.
34006: Glucosephosphate isomerase (5.3.1.9) is present.
34007: Fructose 1, 6-diphosphate aldolase (4.1.2.13) is present.
34008: Triosephosphate isomerase (5.3.1.1) is present.
34009: Glyceraldehyde-3-phosphate dehydrogenase (1.2.1.11) is present.
34010: Phosphoglycerate kinase (2.7.2.3) is present.
34011: Phosphoglyceromutase (2.7.5.3) is present.
34012: Phosphopyruvate hydratase (4.2.1.11) is present.
34013: Pyruvate kinase (2.7.1.40) is present.

ENTNER-DOUDOROFF PATHWAY
34015: Hexoses are catabolized, at least in part, to equimolar quantities of glyceraldehyde-3-phosphate and pyruvate (and beyond) by the Entner-Doudoroff Pathway (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34016: Glucose-6-phosphate dehydrogenase (1.1.1.49) is present.
34017: Glucono-lactonase (3.1.1.17) is present.
34018: Phosphogluconate dehydratase (4.2.1.12) is present.
34019: 2-Keto-3-deoxy-6-phosphogluconate aldolase (4.1.2.14) is present.

HEXOSE MONOPHOSPHATE OR WARBURG-DICKENS SYSTEM
34020: Hexoses are catabolized, at least in part, to carbon dioxide and pyruvate (and beyond) by the HMP system (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34021: Pentoses are catabolized, at least in part, to pyruvate (and beyond) by the HMP system (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply
SECTION 34: METABOLIC PATHWAYS AND ENZYMES

34022: Pentoses are catabolized, at least in part, to carbon dioxide and pyruvate (and beyond) by the HMP system (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34023: D-Xylose isomerase (5.3.1.5) is present.
34024: D-Xylulose kinase (2.7.1.17) is present.
34025: L-Arabinose isomerase (5.3.1.4) is present.
34026: L-Ribulokinase is present.
34027: L-Ribulose-5-phosphate-4-epimerase (5.1.3.4) is present.
34028: D-Ribokinase (2.7.1.15) is present.
34029: D-Ribulosephosphate 3-epimerase (5.1.3.1) is present.
34030: 6-Phosphogluconate dehydrogenase (decarboxylating, 1.1.1.44) is present.
34031: Ribosephosphate isomerase (5.3.1.6) is present.
34032: Ribulosephosphate 3-epimerase (5.1.3.1) is present.
34033: Transketolase (2.2.1.1) is present.
34034: Transaldolase (2.2.1.2) is present.
34035: Hexosediphosphatase (3.1.3.11) is present.

PHOSPHOKETOLASE PATHWAYS

34036: Pentoses are catabolized, at least in part, to acetate and pyruvate (and beyond) by the pentose phosphoketolase pathway (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34037: Hexoses are catabolized, at least in part, to erythrose-4-phosphate and acetylphosphate (and beyond) by the hexose phosphoketolase pathway (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34038: Pentose phosphoketolase (4.1.2.9) is present.
34039: Hexose phosphoketolase (4.1.2.1) is present.
34040: Acetokinase (acetate kinase, 2.7.2.1) is present.

CITRIC ACID CYCLE

34041: Pyruvate is catabolized to carbon dioxide through the citric acid cycle (demonstrated by isotope distribution studies, or equivalent specific test, NOT simply stoichiometry).

34042: Pyruvate dehydrogenase (ferricytochrome b1 oxidoreductase, 1.2.2.2) is present.

34043: Citrate synthase (4.1.3.7) is present.
34044: Aconitase hydratase (4.2.1.3) is present.
34045: D-Isocitrate dehydrogenase (NAD linked, 1.1.1.41) is present.
34046: Isocitrate dehydrogenase (NADP linked, 1.1.1.42) is present.
34047: Alpha-Ketoglutarate dehydrogenase (1.2.4.2) is present.
34048: Lipase acetyltransferase (2.3.1.12) is present.
34049: Succinyl-CoA hydrolase (3.1.2.3) is present.
34050: Succinyl-CoA synthetase (6.2.1.4) is present.
34051: Succinate dehydrogenase (1.3.99.1) is present.
SECTION 34: METABOLIC PATHWAYS AND ENZYMES

Fumarate hydratase (4.2.1.2) is present.
Malate dehydrogenase (L-malate-NAD oxidoreductase, 1.1.1.37) is present.
Malate synthase (4.1.3.2) is present.

GLYOXYLATE CYCLE
Isocitrate lyase (4.1.3.1) is present.
Glyoxylate dehydrogenase (1.2.1.17) is present.

AUTOTROPHIC CARBON DIOXIDE FIXATION
Ribulose 1,5-di-phosphate (4.1.1.39) is present.
Ribulose diphosphate carboxylase (carboxydismutase, 4.1.1.39) is present.
1,3-Diphosphoglycerate dehydrogenase (NADP-linked, 1.2.1.13) is present.
Acid phosphatase (3.1.3.2) is present.
Phosphoribulokinase (2.7.1.19) is present.

HETEROTROPHIC CARBON DIOXIDE FIXATION
PEP carboxylase (pyruvate kinase, phosphopyruvate carboxylase (transphosphorylating), 4.1.1.31) is present.
PEP carboxykinase (phosphopyruvate carboxylase (transphosphorylating), 4.1.1.32) is present.
Alpha-Ketoglutarate synthase is present.
Acetyl-CoA carboxylase (6.4.1.2) is present.
Propionyl-CoA carboxylase (6.4.1.3) is present.
Beta-methylcrotonyl-CoA carboxylase (6.4.1.4) is present.
Malate dehydrogenase (decarboxylating, 1.1.1.38) is present.
Carbamate kinase (2.7.2.2) is present.
Pyruvate carboxylase (6.4.1.1) is present.

REACTIONS OF PYRUVATE GENERAL REACTIONS
Methyl-malonyl-CoA carboxytransferase (2.1.3.1) is present.
Pyruvate oxidase (1.2.3.3) is present.
L-lactate dehydrogenase (NAD, 1.1.1.27) is present.
D-lactate dehydrogenase (NAD, 1.1.1.28) is present.
L-lactate dehydrogenase (ferricytochrome C oxidoreductase, 1.1.1.24) is present.
D-lactate dehydrogenase (ferricytochrome C oxidoreductase, 1.1.2.4) is present.
Pyruvate decarboxylase (4.1.1.1) is present.

PYRUVATE TO ALCOHOL PATHWAY
Formic hydrogenlyase system is present.
Phosphotransacetylase (phosphate acetyltransferase, 2.3.1.8) is present.
Aldehyde dehydrogenase (acylating, 1.2.1.10) is present.
Aldehyde dehydrogenase (1.2.1.13) is present.
Alcohol dehydrogenase (1.1.1.1) is present.

PYRUVATE TO BUTANEDIOL PATHWAY
Pyruvate dehydrogenase (lipoate oxidoreductase, 1.2.4.1) is present.
SECTION 34: METABOLIC PATHWAYS AND ENZYMES

34084: Acetolactate decarboxylase (4.1.1.5) is present.
34085: Butanediol dehydrogenase (1.1.1.4) is present.
34086: Acetoin dehydrogenase (1.1.1.5) is present.

PYRUVATE TO BUTYRATE PATHWAY
34087: Acetoacetyl CoA thiolase (2.3.1.9) is present.
34088: 3-Hydroxybutyrate dehydrogenase (1.1.1.30) is present.
34089: Crotonase (enoyl-CoA hydratase, 4.2.1.17) is present.
34090: Butyryl CoA:(acceptor) oxidoreductase (butyryl-CoA dehydrogenase, 1.3.99.2) is present.
34091: Fatty acid-S-CoA transferase is present.

PYRUVATE TO ISOPROPA NOL PATHWAY
34092: Acetoacetate decarboxylase (4.1.1.4) is present.
34093: Isopropanol dehydrogenase is present.

PROPIONIC ACID FERMENTATION
34094: Fumarate reductase is present.
34095: Succinyl-CoA:3-oxoacid CoA transferase (2.8.3.5) is present.

POLYOL DEHYDROGENASES
34096: D-Mannitol dehydrogenase (NAD linked, 1.1.1.67) is present.
34097: D-Mannitol dehydrogenase (D-mannitol; ferricytochrome oxidoreductase, 1.1.2.2) is present.
34098: Ribitol dehydrogenase (NAD linked, 1.1.1.56) is present.
34099: Xylitol dehydrogenase (D-xylulose forming, NAD linked, 1.1.1.9) is present.
34100: D-arabinitol dehydrogenase (NAD linked, 1.1.1.11) is present.
34101: L-arabinitol dehydrogenase (L-xylulose forming, NAD linked, 1.1.1.12) is present.
34102: L-arabinitol dehydrogenase (L-ribulose forming, NAD linked, 1.1.1.13) is present.

MISCELLANEOUS ENZYMES
34103: Alginate (3.2.1.16) is present.
34104: Amidase (3.5.1.4) is present.
34105: D-amino acid oxidase (1.4.3.3) acts non-specifically.
34106: L-amino acid oxidase (1.4.3.2) acts non-specifically.
34107: Alpha-amylase (3.2.1.1) is present.
34108: Arylsulfatase (3.1.6.1) is present.
34109: Catalase (1.11.1.6) is present (hydrogen peroxide decomposed by an enzyme containing a heme or porphyrin structural group).
34110: Catalase-pseudo (an enzyme not containing a heme structural unit) decomposes hydrogen peroxide to water and oxygen.
34111: Cellulase (3.2.1.4) is present.
34112: Chitinase (3.2.1.14) is present.
34113: Cytochrome oxidase (1.9.3.1 or 1.9.3.2) is produced.
34114: Coagulase is produced (blood plasma clotted).
34115: Deoxyribonuclease (3.1.4.5-9) a deoxyribonucleic acid digesting enzyme, is produced.
34116: Dextranase (3.2.1.11) is present.
SECTION 34: METABOLIC PATHWAYS AND ENZYMES

34117: Dextran sucrase (2.4.1.5) synthesizes dextrans from sucrose.
34118: Dextrin 6-glucosyltransferase (2.4.1.2) is present.
34119: Dextrin-1,6-glucosidase (3.2.1.33) is present.
34120: Ferredoxin is present.
34121: NAD peroxidase (1.11.1.1) is present.
34122: Alpha-glucan (glycogen) phosphorylase (2.4.1.1) is present.
34123: Beta-galactosidase (3.2.1.23) is present.
34124: Glucoamylase (3.2.1.3) is present.
34125: Beta-glucosidase (3.2.1.31) is present.
34126: Hyaluronidase (3.2.1.35 or 3.2.1.36) is produced.
34127: Inulase (3.2.1.7) is present.
34128: Laminaranase (3.2.1.6) is present.
34129: Lecithinase is produced.
34130: Leucocydin is produced (lyses leucocytes).
34131: Levansucrase (2.4.1.10) synthesizes levans from sucrose.
34132: Methy1malonyl-CoA carboxyltransferase (2.1.3.1) is present.
34133: Neuroaminidase (3.2.1.18) is present.
34134: Pectinase (3.2.1.15) is present.
34135: Peroxidase (Donor-hydrogen peroxide oxidoreductase, 1.11.1.7) is present.
34136: Acid phosphatase (3.1.3.2) is produced.
34137: Alkaline phosphatase (3.1.3.1) is produced.
34138: Plasmin is produced (blood clots are lysed, i.e., fibrinolysin 3.4.4.14).
34139: A ribonucleic acid digesting enzyme, ribonuclease, (2.7.7.16 or 2.7.7.17) is produced.
34140: Ribulose diphosphate carboxylase (4.1.1.39) is present.
34141: Rubredoxin present.
34142: Trehalase (3.2.1.28) is present.
34143: Urease (3.5.1.5) is produced.
34144: Xylanase (3.2.1.8) is present.
39304: Metabolic pathways and enzymes: Comments.
EXAMPLE OF FORMS FILLED OUT FOR INPUT TO THE COMPUTER

NOTE 1: Correspondence concerning submission of data and utilization of this document in building the data bank should be addressed to either of the following persons:

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U.S.A.

NOTE 2: Blank CODE SHEETS are available from the authors of this document.
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01002: Edition of Questionnaire used (from title page):

01003: Name of person submitting information:

Surname (Family Name):

Title or Rank: (e.g., Professor, Doctor, Mister, Captain, etc.)

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FOOTNOTE:
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FORM NUMBER (FOR OFFICE USE ONLY):  | 0 1  | 2 1 | 0 1  |
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CODE SHEET FOR GENERAL INFORMATION - B
SECTION 1: GENERAL INFORMATION

01006: Category of microbe being described (Use following code):

AL = Algae  
BT = Bacteria  
VA = Viruses - Animal  
FN = Fungi  
BR = Rickettsia  
VB = Viruses - Bacterial  
FY = Yeasts  
BM = Mycoplasma  
VI = Viruses - Insect  
PZ = Protozoa  
QQ = Other  
VP = Viruses - Plant

01007: Name of Genus (or arbitrary numerical code for Group* or Group name*):

NOTE 1: Completely different sets of CODE SHEETS must be used for each Genus or Group.

NOTE 2: If the data being submitted for strains is arranged under SUBGENERA, completely different sets of CODE SHEETS must be used for each SUBGENUS. The generic name must be inserted for question 01007 in each set.

*NOTE 3: If the genus name is not known and data is being submitted for any arbitrary group of organisms, use (a) an arbitrary numerical code, e.g., "Group 22" or simply "22" OR (b) a group name, e.g., CORYNEFORMS. See DIRECTIONS for further explanation.

01008: Name of Subgenus: (Insert the name ONLY if data being submitted for strains is arranged under Subgenera, otherwise, leave this answer blank).

01009: For how many subgenera of the genus are you submitting data?

01010: Specific epithet of type species for this genus:

01011: Are the organisms of this genus procaryotic?

01012: Has a type species ever been established for this genus?

01013: Has a type culture ever been established for the type species?

01014: Is the type culture of the type species (of the genus) in living form?

01015: Is any strain of the type species in living form?

CODE SHEET FOR GENERAL INFORMATION - C
SECTION 1: GENERAL INFORMATION

01016: Has a neotype strain of the type species been established? [06]

01017: Has any strain of the type species been studied extensively in the last 20 years? [07]

01018: Have nucleic acid homologies been measured among any of the strains of species of this genus? [08]

01019: Have nucleic acid homologies been measured between any strains of species of this genus and those of other genera? [09]

01020: Has bacteriophage typing been used in this genus? [10]

01021: Has transduction been demonstrated among any strains of species of this genus? [11]

01022: Has transduction been demonstrated between any strains of species of this genus and those of other genera? [12]

01023: Has transformation been demonstrated among any strains of species of this genus? [13]

01024: Has transformation been demonstrated between any strains of species of this genus and those of other genera? [14]

01025: Have studies of the geographical distribution of any strains of the genus been carried out? [15]

01026: Have studies of the ecological distribution of any strains of species of this genus been carried out? [16]

01027: Have studies of the ecological interactions within a habitat of any strains of species of this genus been carried out? [17]

01028: Have studies of ecological distribution on any level been used for taxonomy of this genus? [18]

01029: Have immunological criteria been used for taxonomy of this genus? [19]

01030: Have any strains of species of this genus been reported as pathogenic? If any strains for which you are submitting data are pathogenic, please supply the following information on a separate sheet of paper: (a) strains by specific epithets, (b) hosts (both common and scientific names), and (c) diseases. Identify each sheet of paper with the World Directory of Culture Collections Number, if applicable, and also the same information as required in the top right corner of CODE SHEET-I. [20]

01031: What is the total number of CODE SHEETS-I, II plus III you are submitting for strains of this genus (or subgenus or arbitrary group)? (Note: all CODE SHEETS-A, B, C, D, I, II, III for the genus must be securely fastened together.) [21]

FORM NUMBER (FOR OFFICE USE ONLY): [22] 04

CODE SHEET FOR GENERAL INFORMATION - D
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<th>PAGE NUMBER</th>
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