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**Collection of published 5S, 5.8S and 4.5S ribosomal RNA sequences**

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The 1985 collection of published 5S, 5.8S and 4.5S ribosomal RNA sequences (1) is updated. We would like to thank those colleagues who have sent us their pre- or reprints on small ribosomal RNAs in 1985, and who have pointed out mistakes in our previous collection.

The 5S, 5.8S and 4.5S rRNA databases are part of the Berlin RNA Databank which uses the formats of the EMBL Nucleotide Sequence Data Library. The Berlin RNA Databank, including pure data as well as complete alignments, is online accessible worldwide via the I.P.Sharp Timesharing Network. Magnetic tapes or diskettes are also available from our laborator

#### THE ALIGNMENT

This year, the alignment is divided into 4 groups: eubacteria including plastids, mitochondria, archaebacteria, and eukaryotes. Since plastidial 5S rRNA exhibits no exclusive features distinct from cyanobacterial 5S rRNA, it is included in the eubacterial alignment. The alignment has been obtained by running the programs ALIGNSTAT or ALIGNSEC (2) and adjusted manually to account for potential secondary structure interactions. The programs were purchased as part of the genetic engineering program package, SAGE, for the IBM PC/XT from Technoma GmbH, Heidelberg, F.R.Germany. It was run on the IBM 3081 computer of I.P.Sharp Associates in Toronto, Canada. We do not want to give the impression that there are no alignment problems, so that changes must be considered when more sequence data come up.

One improvement of the alignment output is the presentation of the sequence references. They occur opposite the sequence

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page and are numbered according to the sequence numbers. In addition, all available publications are listed, even if a sequence is determined several times.

The taxonomic position for each species is indicated in parentheses following the species name. We tried to adhere to the concept of phylogenetic systematics sensu Hennig (3), therefore only recognized monophyla are given without any rank. These are taken mainly from the following references: Hennig (metazoa)(4), Strasburger et al. (plants and algae)(5), Ainsworth et al. (eumycota)(6), International Society of Protozoologists (protozoa) (7), Schnabel et al. (archaebacteria)(8), and Woese (eubacteria)(9).

### THE NOMENCLATURE

An achievement of this year's compilation is the introduction of a generalized numeration. We adopted the idea of Sprinzl and Gauss for tRNA who took the best understood molecule as a basis, namely tRNA<sup>Phe</sup> of the yeast Saccharomyces cerevisiae. Similary Delihias and Andersen (10) have proposed to use the E.coli 5S rRNA as a basis, and we would like to elaborate this proposal in which positions not present in the E.coli sequence are designated by a decimal fraction. The advantage of this is the universal comparability of 5S rRNA sequences, for example G44. in eubacteria will also be G44 in eukaryotes as well as in archaebacteria. The disadvantage lies in the fact that the generalized numeration might be changed in the future in those regions of alignment uncertainties.

A new loop nomenclature has been developed, assigning small letters to the loops following the helices. One may refer to Helix B and Loop b, but also to segment B, segment B', segment b, segment b', corresponding to the 5' and 3' portions of the respective structures (see alignment).

### THE MINIMAL MODEL

Another feature of this year's compilation is the formulation of a minimal model most researchers agree to. This was first proposed in 1974 by Nishikawa and Takemura for eukaryotes (11) and by Fox and Woese in 1975 for eubacteria (12). First attempts to use 5S rRNA as a phylogenetic marker were made in

1975 by Hori (13) and subsequently further developed to gain common secondary structure models (14,15,16). The present minimal model is based on investigation published in the early eighties by Studnicka et.al.(17), MacKay et al. (18), Delihias and Andersen (10), DeWachter et al. (19),and Küntzel et al.(20).

The minimal model could be constructed for eubacteria(covering to date 3 of the 9-10 recognized phylogenetic divisions), eukaryotes, and halophilic-methanogenic archaeobacteria (Figures 1-3) and also includes deviations (insertions/deletions) for special monophyla that are represented by at least two species. Other archaeobacterial divisions are only covered by single species and are shown separately (Figures 4-6).

Due to the lack of compensating base changes as a proof, the following base-pairs have been expelled from helices: 23/60 at the end of Helix B, G69/U107 at the beginning of Helix D in eukaryotes and archaeobacteria, and U74/A102 at the end of Helix D in some eukaryotes.

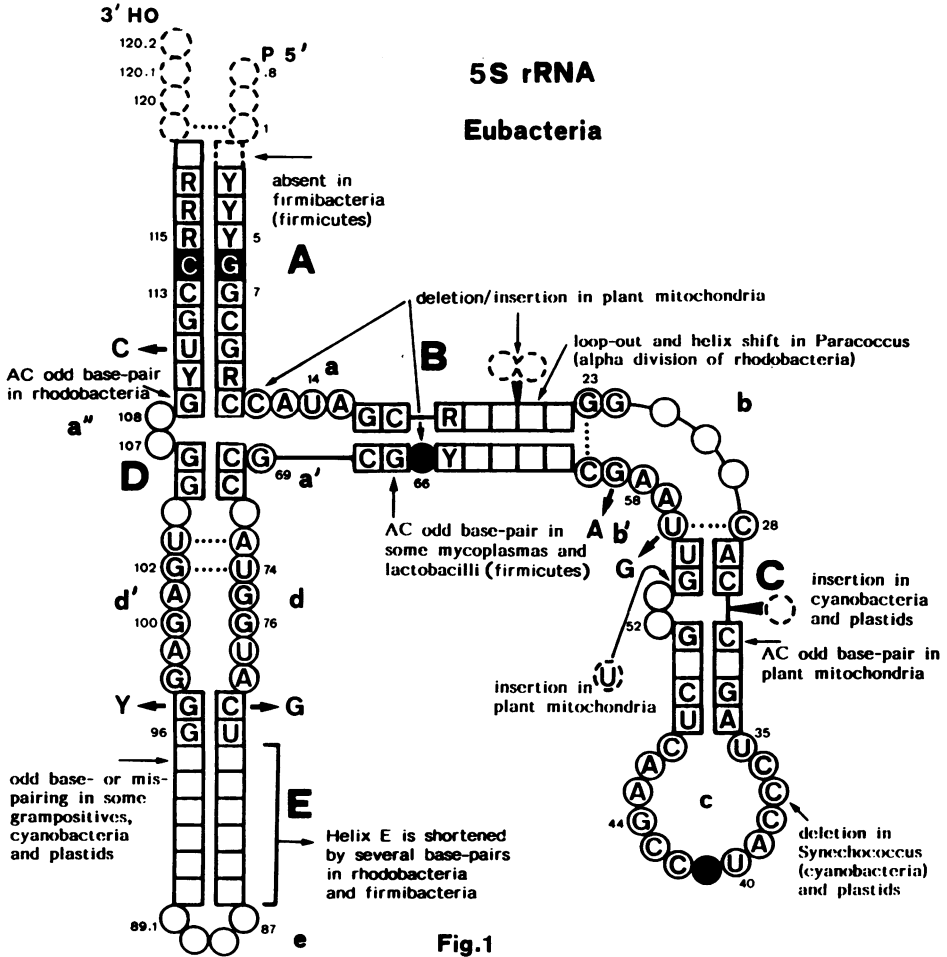
To avoid problems concerning the variability of positions (discussed in detail by Fox (21), page 277) the bases indicated in the minimal models are the ones supposedly ancestral to the respective groups. Where a different base is present in the majority of the species, this is indicated with an arrow.

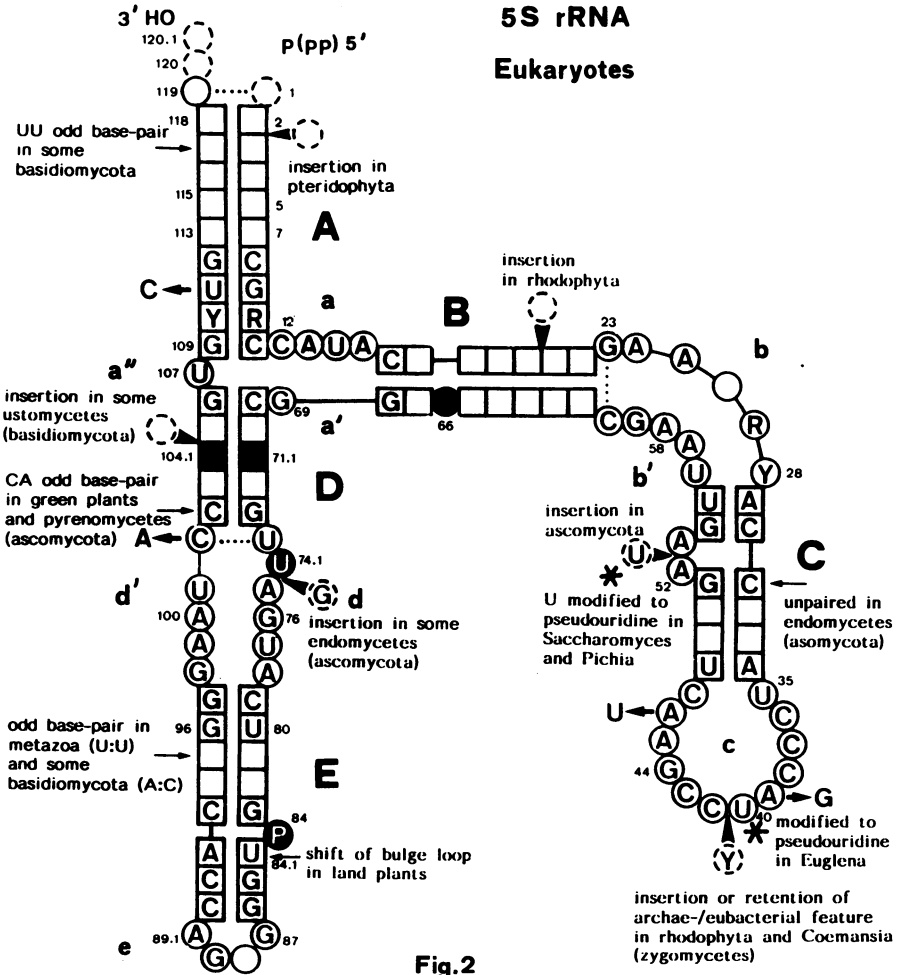
This new nomenclature and the minimal model resolved from discussions with George E. Fox and N. Delihias, we would like to extend this discussion to all researchers in the field during 1986.

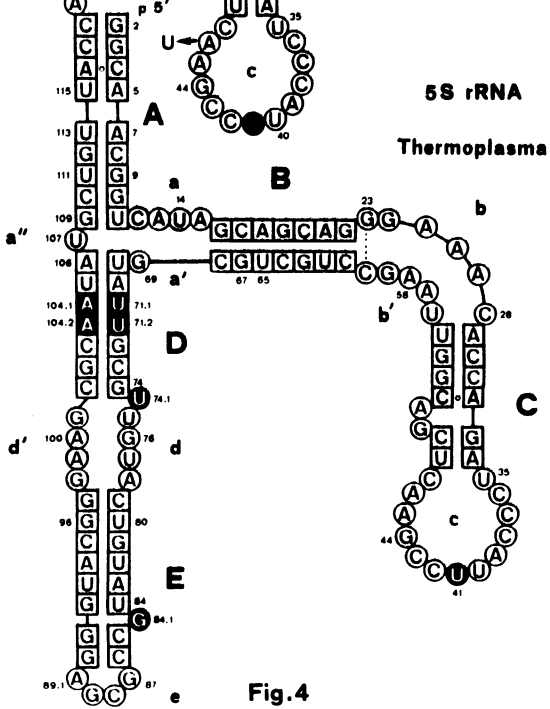
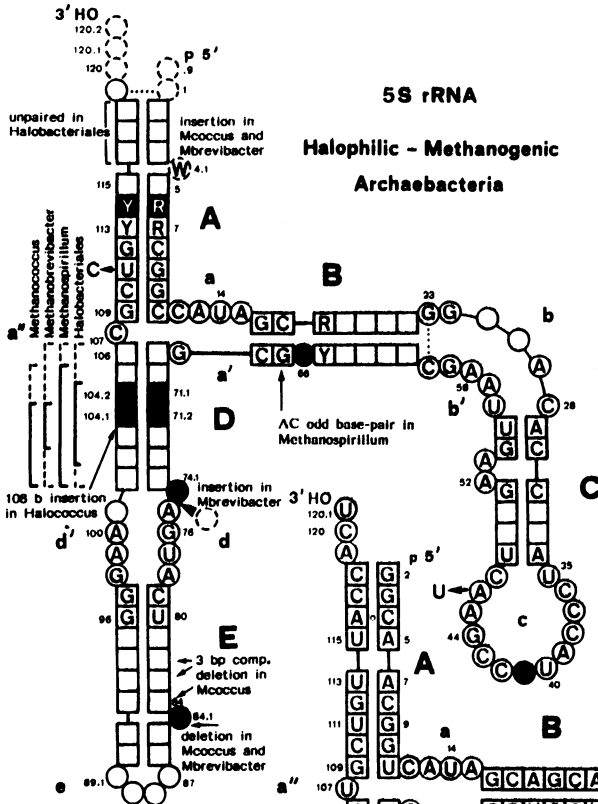
#### ACKNOWLEDGEMENT

We would like to thank Angela Schreiber for the extraordinary drawings and proofreading the sequences, and Martin Digweed for the help with the English text. Jörn Wolters is financed by the Deutsche Forschungsgemeinschaft (Sfb-9/B5).

Figures 1-6: Minimal models of 5S rRNA secondary structure. Squares indicate conserved base-pairing, circles unpaired nucleotides. Dotted lines indicate possible helix extensions. Filled squares and circles indicate positions that are unique to one group. Bases indicated in the minimal models are supposedly ancestral for the respective group. Different bases in the majority of species are marked with an arrow. Hypervariable positions remain blank. The occurrence of AC and UU odd base-pairs is also marked.







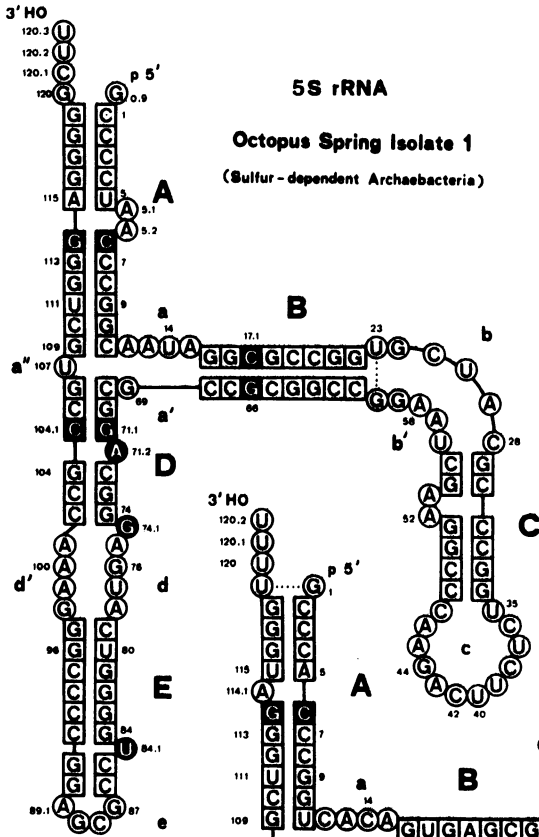


Fig. 5

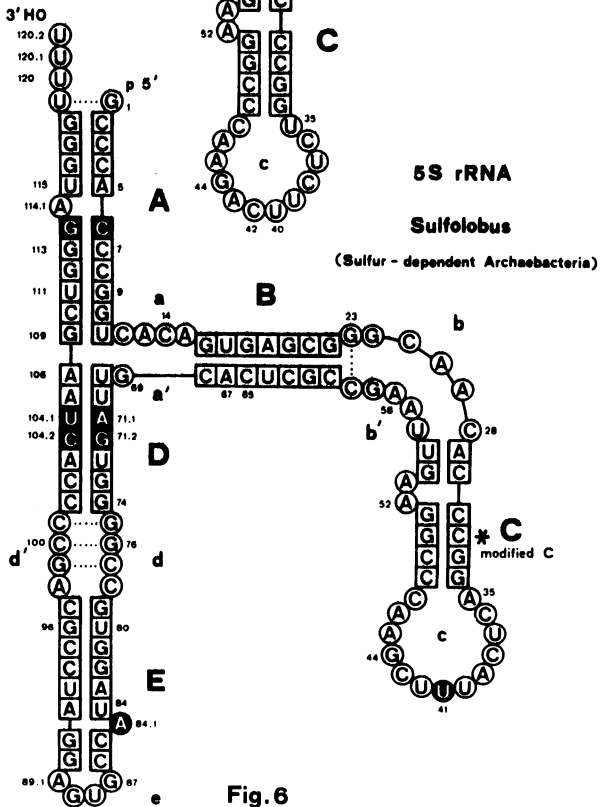


Fig. 6

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**Table 1:** Alignment of 5S rRNAs. The sequences are numbered sequentially, the number is repeated on the opposite page in order to correlate the sequences with the corresponding publication. Identical sequences are only listed once with the name of the species first examined. Additional species are listed on the opposite page. Only the corrected sequence appears in the alignment, if the published sequence has been reexamined later. If different publications led to different sequences of the same species or strain, all sequences are aligned and given a capital letter suffix. If different variants within one species or strain have been isolated and sequenced, all sequences are aligned and numbered sequentially. DNA sequences are indicated by T occurring instead of U. Heterogeneity in specific positions is indicated as recommended by the IUB-IUPAC joint commission on biochemical nomenclature (22). If all 4 nucleotides are present, this is indicated by N, incomplete sequence analysis is indicated by X. Length heterogeneity is indicated by lower case letters. Modified bases are indicated as follows: F for Pseudouridine, 2'-O-Methyl-ribose by underscoring. Helix segments are boxed and named according to the secondary structure model in Figure 1. Plastidial and mitochondrial sequences are preceded by pt and mt, respectively. The term Firmicutes for Grampositives, comprising the two subdivisions Firmibacteria (low GC-content, "clostridia") and Thallobacteria (high GC-content, "actinomycetes") has been proposed by Gibbons and Murray (23), the term Rhodobacteria for purple bacteria and their relatives by Wolters and Erdmann (24). Because of their phylogenetic ancestry mycoplasmas are classified as Firmicutes.

















- DUGESIA JAPONICA FROM SAMAGE, J (PLANARIAN, , FLANARIE)  
 ; WHOLE ORGANISM  
 PABCILOPUS BOLDI  
 ; WHOLE ORGANISM  
 RIFTIA PACYPTILA (VESTIMENTIFERAN TUBE WORM, , )  
 ; WHOLE ORGANISM  
 TRUNK WALL AND TROPHODERME  
 LINBULA ANATINA FROM ARTAKE BAY, J (LAMP-SHELL, , )  
 ; WHOLE ORGANISM
- BUGULA HERTINA FROM BUGASHIMA, J (MOSS-ANIMAL, , MOOSTIERCHEN)  
 ; WHOLE ORGANISM  
 CAENORHABDITIS ELEGANS (1-3) BRISTOL N2  
 CAENORHABDITIS BRIGSSAE (1)  
 ; WHOLE HERMAPHRODITE ORGANISMS  
 CONFLICT 113  
 66 INSTEAD OF G IN DNA (3)
- RHABDITIS TOKAI  
 ; WHOLE ORGANISM  
 BRACHIONUS PLICATILIS (PLANKTON ROTIFER, , RAEDERTIER)  
 ; WHOLE ORGANISM  
 SPYROCCON BALTATRIX FROM SETO INLAND SEA NEAR USHIMADO, J  
 ; WHOLE ORGANISM  
 OVARIES  
 ; WHOLE ORGANISM  
 DOBLEINI FROM SETO INLAND SEA NEAR USHIMADO, J (HYDROID, , )  
 ; WHOLE ORGANISM  
 OVARIES  
 ; WHOLE ORGANISM  
 CHRYSOORA QUINQUECIRRA FROM SETO INLAND SEA NEAR USHIMADO, J  
 (OCEANIC JELLYFISH, , HOCHSEEQUALLE) ; OVARIES  
 AURELIA AURITA FROM SETO INLAND SEA NEAR USHIMADO, J (WHITE SEA  
 JELLY, , QUALLE) ; OVARIES  
 ; WHOLE ORGANISM  
 AURITA FROM CANADA (WHITE SEA JELLY, , QUALLE)  
 ; WHOLE ORGANISM  
 OVARIES  
 ; WHOLE ORGANISM  
 ANTHOLEURA JAPONICA (SEA ANEMONE, , SEEANEMONE)  
 ; WHOLE ORGANISM  
 HYPENACION SANGUINEA FROM ADRESSELLES, F (SLIMY PAPILLATED  
 SPONGE, , ) AND HALICONDRIA JAPONICA (CRUMB OF BREAD SPONGE,  
 BROTKRUMBSCHWAMM) ; WHOLE ORGANISM  
 HALICONDRIA PANICEA FROM ADRESSELLES, F (CRUMB OF BREAD SPONGE,  
 BROTKRUMBSCHWAMM)  
 ; WHOLE ORGANISM  
 HALICONDRIA OCELLATA  
 ; WHOLE ORGANISM  
 FROM ADRESSELLES, F (DEADMAN'S FINGERS, , )  
 ; WHOLE ORGANISM
- 52 (1) OHAMA T., KUMAZAKI T., HORI H., OSAMA S., TAKAI M.;  
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 NUCL. ACIDS RES. 10:7405-08(1982).  
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 NUCL. ACIDS RES. 10:5297-5302(1982).



DICYEMA HISAKIENSE  
 BLASTOCYSTIDIELLA SIMPLEX ATCC 24579  
 PHLYCTOCYTRIUM IRREGULARE ATCC 32066  
 DIPBACIDRYCES ACHMINDOPORUS ATCC 14302  
 LINDERINA MICROSPORA  
 COENANSTIA MOLAVENSIS  
 CUNNINGHAMELLA ELEGANS ATCC 9245  
 BLAKESLEA TRISPORA ATCC 14271  
 HORTIERELLA FORMOSENSIS ATCC 24542  
 PHYCODYCES BLAKESLEEANUS NRRL 1355 (ALGAL WATER HOLD, ALGENFILZ)  
 BASIDIORHIZUS MAGNUS ATCC 15379  
 SHITTIUM CULISETAE ATCC 16244  
 BENISTELLOIDES HIBERNUS  
 CAPNIDRYCES STELLATUS  
 SCHIZOSACCHARODYCES POMBE (11)C2 IF00345 (3) ADE6 SUP3-704  
 + CLONES (2) PSPRI, 11, 36 AND 41 (3) PYS3 AND PYS116  
 PROTOZYCES INNOVATUS ATCC 28130  
 YARROWIA LIPOLYTICA ATCC 8661  
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 85 (1) WALKER M.F.;  
 SYSTEM. APPL. MICROBIOL. 6:46-53 (1985).



LIPONICES LIPONICES ATCC 32031	86 [1] WALKER M.F.,
MAUSONIA FULVESCENS ATCC 24234	87 [1] WALKER M.F.,
CANDIDA ALBICANS MCR1 0001 ( , PUSPILZ)	88 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
TORULORPIS UTILIS	89 [1] NUCL. ACIDS RES. 12:1481-92(1984).
CONFLICT 33 34	89 [1] FIBRE LETT. 40:106-09(1974).
UC 18 CU IN OLIGONUCLEOTIDE SEQUENCING (1-3)	90 [1] HAYASHI M.,
SACCHAROMYCES CARLSBERGENSIS (BREWERY'S YEAST, BIENHEFE)	91 [1] PETER P.H.,
SACCHAROMYCES CEREVISIAE (BREWERY'S YEAST, , BIENHEFE)	92 [1] PETER P.H.,
KLUYVEROMYCES LACTIS	93 [1] HAYASHI M.,
CONFLICT 33 34	94 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
UC 18 CU IN OLIGONUCLEOTIDE SEQUENCING (1-3)	95 [1] NUCL. ACIDS RES. 12:1481-92(1984).
SACCHAROMYCES CEREVISIAE 32180-19 (BAKERY'S YEAST, LEVURE, BACKERHEFE) , CLONES PYEBS AND PYEE147	96 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
SACCHAROMYCES CEREVISIAE 32180-19 (BAKERY'S YEAST, LEVURE, BACKERHEFE) , CLONES PYEBS AND PYEE147	97 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
PICHIA HENRIKSENII	98 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
ASPERGILLUS NIDULANS MCR1 A007 ( , GIESSKANNENSCHIMMEL)	99 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
ASPERGILLUS NIDULANS (13 PABA A1, B1 A1 (23 MCR1 A007 ( , GIESSKANNENSCHIMMEL)	100 [1] CHEN H.-H., ANNE J., VOLCKAERT B., HUYSHANS E., VANDENBERGHE A., DE WACHTER M.,
ASPERGILLUS NIDULANS MCR1 A007 ( , GIESSKANNENSCHIMMEL)	101 [1] NUCL. ACIDS RES. 12:1481-92(1984).
ASPERGILLUS FLAVUS MCR1 A003	102 [1] J. BIOL. CHEM. 257:11395-11404(1982).
ASPERGILLUS NIGER BEECHAM PHARMACEUTICALS M8115	
PENICILLIUM CHRYSOGENUM ATCC 10002 ( , PINSELSCHIMMEL)	
PENICILLIUM PATULUM MCR1 P031 ( , PINSELSCHIMMEL)	
THERMOPHYCES LANGUINOSUS ATCC 16455 ( , WAERPEPILZ)	
THERMOPHYCES LANGUINOSUS ATCC 16455 ( , WAERPEPILZ)	



- NEUROSPORA CRASSA [1,1,3] EMC25A (ATCC 10815)  
 ; [2] CONIDIA OR YOUNG MYCELIA, CLONES PKD51 AND PKD52
- NEUROSPORA CRASSA  
 ; CONIDIA OR YOUNG MYCELIA, CLONES PKD51 AND PKD52
- NEUROSPORA CRASSA OAK RIDGE 74-OR23-1A (FBSC 986) ; GENE 17  
 AND BEADLE AND TATUM 25A (FBSC 353) ; GENE 17
- NEUROSPORA CRASSA BEADLE AND TATUM 25A (FBSC 353) ; GENE 21
- NEUROSPORA CRASSA OAK RIDGE 74-OR8-1A (FBSC 988)
- NEUROSPORA CRASSA OAK RIDGE 74-OR8-1A (FBSC 988)
- ACREMONIUM PERSICINUM CBS 169.65 [-=PRAECILIOYCES PERSICINUS]
- ACREMONIUM PERSICINUM CBS 169.65 [-=PRAECILIOYCES PERSICINUS]
- ACREMONIUM PERSICINUM CBS 169.65 [-=PRAECILIOYCES PERSICINUS]
- ACREMONIUM CHRYSOGENUM ATCC 14553 [-=CEPHALOSPORIUM ACREMONIUM]
- MONILINIA FRUCTICOLA ATCC 9684
- TRICHOPHEA ABUNDANS ATCC 26431
- AUREBASIDIUM PULLULANS ATCC 28998
- USTILAGO VIOLACEA (FLAG-SMUT, CHARBON, FLUGBRAND)  
 ; YEAST PHASE
- RHODOSPORIDIUM TORULOIDES  
 ; YEAST PHASE
- AESSOSPORON SALMONICOLOR  
 ; YEAST PHASE
- USTILAGO SCABIOSAE 60 1423
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- SPHACELOTHECA SPEC GD 1127
- RHIZOCTONIA CROCODRUM ATCC 11070 [=HELICOBASILUM PURPUREUM]  
(RHIZOCTONIA, RHIZOCTONIE, RHIZOCTONIA)  
RHIZOCTONIA HIEMALIS ATCC 14016 [=TRICHOPHAEA BULLATA?]  
PACHYCYBE FERRUGINEA  
I MYCELIA  
RHODOSPORIDIUM MALVINELLUM CBS 6082
- AGARICOTYLUM PALMICOLUM  
I YEAST PHASE  
TRICHOMONIDES DEDUCEPHALIS ATCC 16988  
I MYCELIA  
MONILIELLA ACETABUTANS ATCC 18455  
I MYCELIA  
TILLETARIA ANOMALA ATCC 24038  
EXOBASIDIUM VACCINII ATCC 24312
- TRICHOPORON ORYZAE ATCC 28323  
USTILAGO LONGISSIMA GD 646 (SMUT, , BRAND)  
GINANNIELLA PRIMULICOLA GD 1394 (SMUT, , BRAND)  
HETS 119 30/100 IN GINANNIELLA  
TILLETIA CONTROVERSA  
USTILAGO MORDEI GD 935  
HETS 119 20/100  
USTILAGO MAYDIS GD 1042
- FARYSIA THUFENII GD 1309
- MICROSTROMA JUGLANDIS PB4142 (RUST, , ROST)
- CHLONOSPHAERA APOBASIDIALES  
I YEAST PHASE
- 120 [1] BLANZ P.A., GOTTSCHALK H.,  
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- STERIGMATOCYCES PENICILLIATUS ATCC 32127  
 † YEAST PHASE  
 † TREMELLA HESEMERICA  
 † YEAST PHASE
- BULLERA ALBA ATCC 18568  
 † YEAST PHASE  
 † AGARICUS EDULIS (PSALLIOTA/'MUSHROOM', PSALLIOTE,  
 EGERLING/'CHAMPIGNON')  
 † FRUITBODY  
 † CRONOPUS ALBIDUS ATCC 10666 (=FILOBASIDIUM SPEC?)  
 † YEAST PHASE  
 † ITERDONILIA PERPLEXANS ATCC 15495  
 † MYCELIA  
 † PHAFFIA RHODOZYMA ATCC 24202  
 † YEAST PHASE  
 † FILOBASIDIUM FLORIFORME  
 † GUNDELINERPEPPIVIT R. BAUER 778 (RUST, † ROST)  
 † YEAST PHASE  
 † MET3 119 40/100 ENDOPHYLLIUM ONLY
- FILOBASIDIUM CAPSULIGENUM  
 † YEAST PHASE
- SCHIZOPHYLLUM COMMUNE AND COPRINUS CINEREUS (INKY CAP, ENCRIER,  
 TINTENBLAUETTERPILZ/STISCHMARR) † MYCELIA
- BUJKAENDERA ADUSTA  
 † MYCELIA
- COPRINUS RADIATUS ATCC 28538 (INKY CAP, ENCRIER,  
 BLAUER KOPF/STISCHMARR)  
 † MYCELIA  
 † RUSSULA CYANEIVANTHA (BLUE AND YELLOW RUSSULA, RUSSULE CHARCONNIERE,  
 FRAUNTAEBLIND)  
 † FRUITBODY  
 † MET3 119
- PLEUROTUS OSTREATUS (OYSTER MUSHROOM, NOURET, AUSTERNSCHWAMM)  
 † FRUITBODY  
 † JUDICULARIA AURICULATA-JUDAE (JEW'S EAR, HIRNEDE OREILLE DE JUDAS,  
 HIRNEDE)  
 † FRUITBODY  
 † DACRYMYCES DELIQUESCENS ATCC 13292 (TEAR MUSHROOM, † TRAEINENPILZ)  
 † MYCELIA  
 † RHIZOCTONIA GLOBULARIS ATCC 14015 (=SEBACINA SPEC?)  
 † MYCELIA
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COLEOPORUM TUSSILAGINIS R. BAUER 776 (RUST, ., ROST)  
 GYNOSPORAELIUM CLAVARIAEFORME R. BAUER 855 (RUST, ., BITTERROST)  
 PLEUCONIA PEARLII R. BAUER 830 (RUST, ., BETREIDEROST)  
 EMBEDIA BICOLORIS BROWN FROM PYCNOSPORES  
 CLONING PLASMODIUM  
 SARCOTHECIUM FROM IBE-BAY NEAR SUBASHIMA, J  
 F. FOLIOSE SARCOTHECIUM  
 SARCOTHECIUM FROM IBE-BAY NEAR SUBASHIMA, J  
 SARCOTHECIUM FENAX ATCC 26116  
 PYTHIUM HYDROSPORIUM ATCC 26929  
 CRYPTHECOIDIUM COMNII (PLASTID LESS SPECIES)  
 TETRAMYCEA THERMOPHILA [1] B [2] MATING TYPE IV [3] B-1868-VII  
 TETRAMYCEA PYRIFORMIS [3] BL AND W  
 TETRAMYCEA VORAX [4] V28  
 TETRAMYCEA LEUCOPHRYS [4] TUR  
 CONFLICT 2 Y IS U IN C2, C IN C3(14)  
 CONFLICT 115 R IS G IN C3(14)  
 CONFLICT 116 M IS G IN C2  
 CONFLICT 117 R IS B IN C2  
 TETRAMYCEA THERMOPHILA B VII, B IV AND CUS37  
 TETRAMYCEA PARAVORAX RP  
 TETRAMYCEA PATULA L-PF AND NEI  
 SARCOTHECIUM  
 COLPIDIUM CAMPYLUM  
 COLPIDIUM COLPODA  
 PARAMYCEUM TETRAURELIA MATING TYPE VIII (SLIPPER ANIMALCULE, .  
 PANTOFFELTIERCHEN  
 BLEPHARISMA JAPONICUM RIC  
 BRESSLAUA VORAX  
 EUPLOTES HODDRUFFI  
 CHLORONAS PARAMYCEIUM (PLASTID LESS SPECIES)  
 . WOLLE ORGANISER

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ACANTHAMEBA CASTELLANII ATCC 30010  
 DICTYOSTELIUM DISCOIDEUM NC-4 (CELLULAR SLIME MOLD, \* ZELLULAERER SCHLEIMPILZ)  
 PHYSARUM POLYCEPHALUM (PLASMODIAL SLIME MOLD, \* PLASMODIALER AMOEBIDIUM PARASITICUM SCHLEIMPILZ)  
 EUBLENA GRACILIS Z HETEROTROPH ( , \* AUGENTIERCHEN)  
 EUBLENA GRACILIS Z PLASTID-LESS MUTANT CH500 ( , \* AUGENTIERCHEN)  
 CRITHIDIA FASCICULATA (TRYPANOSOMATIDIAN, \* TRYPANOSOM)  
 TRYPANOSOMA BRUCEI TATAT 1,2; CLONES P55-2 AND P55-11.5  
 TRYPANOSOMA BRUCEI TATAT 1,1; CLONE P55-7  
 THAKUSTOCHYTRIUM VISURGENSE ATCC 28208  
 SCHIZOCHYTRIUM AGGREGATUM ATCC 28209  
 SECALE CEREALE [1-2] LOVASZPATONAI [3] SOMRO (RYE, SEIGLE, ROGGEN)  
 Triticum aestivum [4] THATCHER (WHEAT, BLE, WEIZEN)  
 ZEAS MAYS (MAIZE, MAIS, MAIS)  
 HET3 120 ONLY REPORTED IN [3] FOR SECALE

TRITICUM AESTIVUM CHINESE SPRING (WHEAT, BLE, WEIZEN)  
 ENRYO CLONE PTA704  
 ENRYO CLONE PTA794  
 TRITICUM AESTIVUM CHINESE SPRING (WHEAT, BLE, WEIZEN)  
 ENRYO CLONE PTA729  
 LEMNA MINOR (COMMON DUCKWEED, PETITE LENTILLE D'EAU, KLEINE WASSERLINSE)

LINUM USITATISSIMUM (FLAX, LIN, FLACHS;LEIN)  
 LUPULUS PRURIENS AND PUGI  
 VICIA FABA (LORDAD BEAN, FEVE DE MARAIS, SAUBOHNE)

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 ; HYPOCOITYLS, CLONE PARL.  
 LUPINUS LUTEUS (YELLOW LUPINE, LUPTINE JAUNE, GELBE LUPINE)  
 ; HYPOCOITYLS, CLONE PARL.  
 METASEQUOIA ALYPTOSTROBILIS (COAST REDWOOD, KUESTENNAHNTAUM)  
 GINKGO BILOBA (MAIDENHAIR TREE, )  
 CYCAS REVOLUTA  
 DRYOPTERIS ACUMINATA FROM MISHIMA, J (WOOD FERN, , HURUFARN)  
 EQUISETUM ARVENSE FROM (13) NAGAYA, J (23) BERLIN, D (HORSETAIL, PRELE DES CHAMPS/QUEUE-DE-CHEVAL, ACKERSCHACHTELHALM)
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- LYCOPodium clavatum (CLUB MOSS, , BAERLAPP)  
 Psilotum nudum (WHISK FERN, , GABELBLATT)  
 Plagiomnium trichomanes from KYOTO, J  
 Marchantia polymorpha (LIVERSHORT, , LEBERKRAUT)  
 ; CULTURED CELLS  
 Lophocolea heterophylla (LIVERWORT, , )  
 ; CULTURED CELLS  
 Anthoceros punctatus (HORNWORT, CORNIFLE, HORNBLATT)  
 ; CULTURED CELLS

11111111111.2222222222233333333333334444444444455.55555555666666666677.777.77777788888.88888.  
 121345789012345678910123456789012345678901234567890123456789012345678901234567891

A: AUGGUCGGUCUAACAC:156QJAAUGGCGCCGAJCCCAU:CCGAACUCGSA:AGDCAAGGCGCCGGAU:AGUACUGGGAUGGUGA 205  
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F: AUGCUACGGUCUAACAC:CAQBAAGGACCCGAJCCCAU:CAGAACUCGSA:AGUJAGAGGUGGUGGCGCCAGAAU:AGUACUGGGLUGAGGA 210  
G: AUGCUACGGUCUAACAC:CAQBAAGGACCCGAJCCCAU:CAGAACUCGSA:AGUJAGAGGUGGUGGCGCCAGAAU:AGUACUGGGLUGAGGA 211  
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J: AUGCUACGGUCUAACAC:CAQBAAGGACCCGAJCCCAU:CAGAACUCGSA:AGUJAGAGGUGGUGGCGCCAGAAU:AGUACUGGGLUGAGGA 214  
K: AUGCUACGGUCUAACAC:CAQBAAGGACCCGAJCCCAU:CAGAACUCGSA:AGUJAGAGGUGGUGGCGCCAGAAU:AGUACUGGGLUGAGGA 215  
L: AUGCUACGGUCUAACAC:CAQBAAGGACCCGAJCCCAU:CAGAACUCGSA:AGUJAGAGGUGGUGGCGCCAGAAU:AGUACUGGGLUGAGGA 216

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A: CCUCGUGGAAAGCCCT::GGJGCUAGUACCUA: 205 NITELLA FLEXILIS  
B: UACCUUGGGAACCCCU::GGJGCUAGUAGUGU: 206 SPIROGYRA SPEC  
C: UACCUUGGGAACCCCG::AGJGACGUGAGUGU: 207 CHLORELLA SPEC  
D: UACCUUGGGAACCCCG::AGJGACGUGAGUGU: 208 SCENEDESMUS QUADRICAUDA  
E: UACCUUGGGAACCCCG::AGJGACGUGAGUGU: 209 SCENEDESMUS OBLIQUUS  
F: UACCUUGGGAACCCCG::AGJGACGUGAGUGU: 210 ULVA PERTUSA  
G: CCACGUGGAAUCCU::AGJGACGUAUCCGU: 211 CHLAMYDOMONAS REINHARDII 1  
H: CCACGUGGAAUCCU::AGJGACGUAUCCGU: 212 CHLAMYDOMONAS REINHARDII 2  
I: CCACGUGGAAUCCU::AGJGACGUAUCCGU: 213 CHLAMYDOMONAS SPEC  
J: CCACGUGGAAUCCU::AGJGACGUAUCCGU: 214 PORPHYRA YEZOENSIS  
K: CCACGUGGAAUCCU::AGJGACGUAUCCGU: 215 PORPHYRA TENERA  
L: CCACGUGGAAUCCU::AGJGACGUAUCCGU: 216 GRACILARIA COMPRESSA

EUKARYOTA

(CHAROPHYTA)  
 (CHLOROPHYTA, ZYGNEMATOPHYCEAE)  
 (CHLOROPHYTA, CHLOROCOCCALES)  
 (CHLOROPHYTA, CHLOROCOCCALES)  
 (CHLOROPHYTA, CHLOROCOCCALES)  
 (VOLVOPHYTA, ULOTRICHALES)  
 (VOLVOPHYTA)  
 (VOLVOPHYTA)  
 (VOLVOPHYTA)  
 (RHODOPHYTA, BANGIOPHYCEAE)  
 (RHODOPHYTA, BANGIOPHYCEAE)  
 (RHODOPHYTA, FLORIDEOPHYCEAE)

- NITELLA FLEXILIS (STONEWORT, , APFLEUCHTERALGE)  
 SPIROBYRA SPEC ( , , SCHRAUBENALGE)  
 CHLORELLA [1-4] PYRENOIDOSA SAB 211/88 [3] SPEC ATCC 11469
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- SCENEDESMUS QUADRICAUDA ATCC 11460  
 SCENEDESMUS OBLIQUUS  
 ULVA PERTUSA FROM ISE-BAY NEAR SUGASHIMA, J (SEA LETTUCE, ULVE,  
 MEERSALAT)  
 CHLAMYDOMONAS REINHARDII CELL WALL DEFICIENT MUTANT CM15
- CHLAMYDOMONAS REINHARDII CELL WALL DEFICIENT MUTANT CM15  
 CHLAMYDOMONAS SPEC  
 PORPHYRA VEZOENSIS FROM DENSHINAWA BEACH, HOKKAIDO, J (LAVER,  
 PORPHYRE, FURPURTANG) ; GAMETOPHYTES  
 PORPHYRA TENERA (LAVER, PORPHYRE, FURPURTANG)  
 GRACILARIA COMPRESSA



- STREPTOMYCES GRISEUS 45-H  
MICROCOCCUS LUTEUS ATCC 4698 (-M, LYSODEIKTIQUS)
- MICROCOCCUS LUTEUS ATCC 9341 (+SARCINA LUTEA)  
CLOSTRIDIUM PASTEURIANUM ATCC 4013  
UNSURE 97 101  
AASBAG MAYBE AASBAG [1] SELECTION  
ACC.TO HOMOLGY
- BACILLUS ACIDOALDARICUS  
BACILLUS BREVIS ATCC 8185  
BACILLUS PASTEURII ATCC 11889  
BACILLUS STEAROTHEROPHILUS 1430R AND 1430FV  
BACILLUS STEAROTHEROPHILUS 799  
BACILLUS MEGATERIUM KM  
BACILLUS FIRMIUS ATCC 14575  
BACILLUS SUBTILIS BD170 AND 168
- BACILLUS Q  
BACILLUS LICHENIFORMIS S244  
BACILLUS SUBTILIS 168  
BACILLUS Q  
BACILLUS LICHENIFORMIS S244
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SIMMONS J.;  
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- LACTOBACILLUS VIRIDESCENS ATCC 12706
- LACTOBACILLUS VIRIDESCENS ATCC 12706
- LACTOCOCCUS LACTIS CREMORIS ATCC 11603 (=STREPTOCOCCUS L. C. 3)
- STAPHYLOCOCCUS AUREUS SMITH
- STAPHYLOCOCCUS EPIDERMIDIS ATCC 14990
- CLOSTRIDIUM INNOCUUM
- ANNEROPLASMA BACTOCLASTICUM 3LA
- ANNEROPLASMA ABACTOCLASTICUM 6-1
- ACHOLEPLASMA LAIDLAMII K2
- ACHOLEPLASMA MODICUM SQUIRE (NCTC 10134)
- MYCOPLASMA MYCOIDES MYCOIDES
- MYCOPLASMA MYCOIDES SSP. CAPRI P63
- MYCOPLASMA CAPRICOLUM ATCC 27343
- MYCOPLASMA PNEUMONIAE FN (NCTC 10119)
- MYCOPLASMA GALLISEPTICUM AS969
- SPIROPLASMA HONEYBEE BC3





- UREAPLASMA UREALYTICUM 960-CXB (NCTC 10177)
- THERMUS THERMOPHILUS HB8  
 RNA 1 123  
 RNA 1 122  
 RNA 2 122  
 RNA 2 123  
 THERMUS AQUATICUS ATCC 25104  
 BAND 1  
 BAND 2  
 BAND 3  
 BAND 4 (HEAT)
- OCTOPUS SPRING ISOLATE 2, YELLOWSTONE NATIONAL PARK  
 OCTOPUS SPRING ISOLATE 3, YELLOWSTONE NATIONAL PARK  
 THIOBACILLUS NEAPOLITANUS X  
 THIOBACILLUS M1 (=THIOBACILLUS FERROOXIDANS)  
 THIONICROSPIRA PELOPHILA ATCC 27801  
 THIONICROSPIRA L12, GALAPAGOS SUBMARINE HYDROTHERMAL VENT  
 ACINETOBACTER CALCOACETICUS IT6 59
- RIFTIA SYMBIONT  
 CALYPTOBEMA SYMBIONT  
 SOLENYA SYMBIONT  
 ODONTELLA SYMBIONT  
 AZOTOBACTER VINELANDII NC18 8789  
 PSEUDONONAS AERUGINOSA CCEB 481 (ATCC 10145)  
 PSEUDONONAS FLUORESCENS ATCC 13420 AND 13525
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::UGUCUGGUGUAAU:AGCAUUGUGGACCCAC:CUGAU::CCC AUCCCSAQCUCAGAGUGAQAACSCAAU:UGCG:CCGSAUGGUAAGUGUGGG:UCU:: 269
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EUBACTERIA

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EUBACTERIA
::UGUUUGUGAQCAGU:U:AUCCGCCAGGCA:: 268 'VIBRIO' MARINUS (RHODOBACTERIA, GAMMA-3)
::CCC AUUGUABAGUABG:UCAUUGCCAGGCAU:: 269 SHEWANELLA PUTREFACIENS (RHODOBACTERIA, GAMMA-3)
::CCC AUUGUABAGUABG:UCAUUGCCAGGCG:: 270 SHEWANELLA BENTHICA (RHODOBACTERIA, GAMMA-3)
::CCC AUUGUABAGUABG:ADAUUGCCAGGCAU:: 271 LISTONELLA FENLAGIA (RHODOBACTERIA, GAMMA-3)
::CCC AUUGUABAGUABG:ADAUUGCCAGGCAU:: 272 LISTONELLA DAMSELA (RHODOBACTERIA, GAMMA-3)
::CCC AUUGUABAGUABG:ADAUUGCCAGGCAU:: 273 VIBRIO PARAHAE MOLY TICUS (RHODOBACTERIA, GAMMA-3)
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::CCC AUUGUABAGUABG:ADAUUGCCAGGCAU:: 284 VIBRIO METSCHNIKOVII (RHODOBACTERIA, GAMMA-3)

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- VIBRIO MARINUS MP-1 (ATCC 15381)
- SHEWANELLA PUTREFACIENS ATCC 8071 (=ALTERNOMAS PUTREFACIENS,  
#PSEUDOMONAS PUTRIFICANS)
- SHEWANELLA BENTHICA [A] UM40 AND [B] M145
- LISTONELLA PELAGIA ATCC 25916 (=VIBRIO PELAGIUS)
- LISTONELLA DAMSELA ATCC 33539 (=VIBRIO D.)
- VIBRIO PARHAMMOLYTICUS ATCC 17082
- VIBRIO NATRIEENS ATCC 14048
- VIBRIO FLUVIALIS NCTC 11328 (ATCC 33812)
- VIBRIO MIMICUS ATCC 33655
- VIBRIO CHOLERAE ATCC 14033 AND EB498
- VIBRIO VULNIFICUS ATCC 27562
- VIBRIO ALGINOLYTICUS ATCC 17749
- VIBRIO CARCHARIAE ATCC 35084
- VIBRIO DIAZOTROPHICUS ATCC 33466
- VIBRIO [=RENECKEA] HARVEYI 392
- VIBRIO GAZOGENES ATCC 29788
- VIBRIO METSONIKOVII ATCC 7708
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VIBRIO PROTEOLYTICUS ATCC 15336  
 VIBRIO CINCINNATIENSIS ATCC 35912  
 VIBRIO ANSULLANUM ATCC 19264  
 PHOTOBACTERIUM FISCHERI ATCC 7744 (=VIBRIO F.)  
 PHOTOBACTERIUM LOEBI ATCC 15382 (=VIBRIO L.)  
 PHOTOBACTERIUM LEIGOWITHI ATCC 25521  
 PHOTOBACTERIUM ANGLIUM ATCC 25915  
 PHOTOBACTERIUM MAGNIFICUM 6265  
 AERONONAS SALMONICIDA ATCC 27013  
 AERONONAS MEDIA ATCC 52097  
 AERONONAS HYDROPHILA ATCC 9071  
 AERONONAS PSYCHROCYTIVUS ATCC 27564 (=VIBRIO P.)  
 AERONONAS BN-1  
 PROTEUS SHIGELLOIDES ATCC 14029 (=PLESIONONAS SH.)  
 PROTEUS VULGARIS  
 ESCHERICHIA COLI K12-MF5518(RNC), K12-CAO1(RND1,RRNF)  
 K12-A19(SPECIES A1), K12-JAC001(MAJ), K12-CAG22(MAJ) AND MRE400(MAJ)  
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	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	302				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	303				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	304				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	305				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	306				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	307				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	308				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	309				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	310				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	311				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	312				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	313				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	314				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	315				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	316				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	317				
::UGUCUGGCGGCAU::AGCGGGGUGUCCDAC::CUGAC::CCCAUGCCGAADUCAGAAAGUAAAACCCGGU::AGCG::CCGAGUGAUGUAGUGGGB::UCU::	318				
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	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>
CCCAUGGCGGAGUAGG::GAACUGCCAGGCAU::	302	ESCHERICHTIA COLI MRE600 [MINJ	(RHODOBACTERIA,	GAMMA-3)	
CCCAUGGCGGAGUAGG::GAACUGCCAGGCAU::	303	ESCHERICHTIA COLI [RRND2]	(RHODOBACTERIA,	GAMMA-3)	
CCUCCGGAAGUAGG::UACCCGCGAGAC::	304	THIOBACILLUS FERROXIDANS	(RHODOBACTERIA,	BETA)	
CCUCCGGAAGUAGG::UACCCGCGAGAC::	305	THIOBACILLUS THIOXIDANS	(RHODOBACTERIA,	BETA)	
CCUCCGGAAGUAGG::UACCCGCGAGAC::	306	THIOBACILLUS THIOFARUS	(RHODOBACTERIA,	BETA)	
CCCAUGGCGGAGUAGG::UACCCGCGAGAC::	307	CHINO ISOLATE 2	(RHODOBACTERIA,	BETA)	
CCCGUGGAAAGUAGG::ACUCCGUCAG::	308	RHODOCYCLUS GELATINOSUS	(RHODOBACTERIA,	BETA-1)	
CCCGUGGAAAGUAGG::ACUCCGUCAG::	309	THIOBACILLUS INTERMEDIUS	(RHODOBACTERIA,	BETA-1)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	310	PSEUDOMONAS CEFALIA	(RHODOBACTERIA,	BETA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	311	AQUASPIRILLUM SERPENS	(RHODOBACTERIA,	BETA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	312	ALCALIGENES FAECALIS	(RHODOBACTERIA,	BETA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	313	THIOBACILLUS ACIDOPHILUS	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	314	ACIDIPHILUM CRYPTUM	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	315	THIOBACILLUS NOVELLUS	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	316	AGROBACTERIUM TUMEFACIENS	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	317	THIOBACILLUS VERSUTUS	(RHODOBACTERIA,	ALPHA-3)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	318	RHODOBACTER SPHAEROIDES	(RHODOBACTERIA,	ALPHA-3)	
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	<b>K</b>	<b>L</b>	<b>M</b>	<b>N</b>	<b>O</b>
CCCAUGGCGGAGUAGG::GAACUGCCAGGCAU::	302	ESCHERICHTIA COLI MRE600 [MINJ	(RHODOBACTERIA,	GAMMA-3)	
CCCAUGGCGGAGUAGG::GAACUGCCAGGCAU::	303	ESCHERICHTIA COLI [RRND2]	(RHODOBACTERIA,	GAMMA-3)	
CCUCCGGAAGUAGG::UACCCGCGAGAC::	304	THIOBACILLUS FERROXIDANS	(RHODOBACTERIA,	BETA)	
CCUCCGGAAGUAGG::UACCCGCGAGAC::	305	THIOBACILLUS THIOXIDANS	(RHODOBACTERIA,	BETA)	
CCUCCGGAAGUAGG::UACCCGCGAGAC::	306	THIOBACILLUS THIOFARUS	(RHODOBACTERIA,	BETA)	
CCCAUGGCGGAGUAGG::UACCCGCGAGAC::	307	CHINO ISOLATE 2	(RHODOBACTERIA,	BETA)	
CCCGUGGAAAGUAGG::ACUCCGUCAG::	308	RHODOCYCLUS GELATINOSUS	(RHODOBACTERIA,	BETA-1)	
CCCGUGGAAAGUAGG::ACUCCGUCAG::	309	THIOBACILLUS INTERMEDIUS	(RHODOBACTERIA,	BETA-1)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	310	PSEUDOMONAS CEFALIA	(RHODOBACTERIA,	BETA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	311	AQUASPIRILLUM SERPENS	(RHODOBACTERIA,	BETA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	312	ALCALIGENES FAECALIS	(RHODOBACTERIA,	BETA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	313	THIOBACILLUS ACIDOPHILUS	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	314	ACIDIPHILUM CRYPTUM	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	315	THIOBACILLUS NOVELLUS	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	316	AGROBACTERIUM TUMEFACIENS	(RHODOBACTERIA,	ALPHA-2)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	317	THIOBACILLUS VERSUTUS	(RHODOBACTERIA,	ALPHA-3)	
CCCGUGGAAAGUAGG::UACCCGCGAGAC::	318	RHODOBACTER SPHAEROIDES	(RHODOBACTERIA,	ALPHA-3)	

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- THIOBACILLUS FERROOXIDANS ATCC 19859  
 CHINO 1 (COPPER LEACHING POND ISOLATE AT CHINO MINE, MURLEY, NEW MEXICO)  
 THIOBACILLUS THIOXIDANS ATCC 8095  
 SULFUR SPRING ISOLATE, YELLOWSTONE NATIONAL PARK  
 THIOBACILLUS THIOXIDANS ATCC 8136
- CHINO 2 (COPPER LEACHING POND ISOLATE AT CHINO MINE, MURLEY, NEW MEXICO)  
 RHODOCYCLUS GELATINOSUS (=RHODOPSEUDOMONAS GELATINOSA)
- THIOBACILLUS INTERMEDIUS ATCC 15446  
 THIOBACILLUS PERMUTABILIS ATCC 23370  
 PSEUDOMONAS CEPACIA ATCC 17616  
 HETS 1 ONLY PRESENT IN T. INTERMEDIUS  
 CONFLICT 1 (1) B NOT PRESENT  
 CONFLICT 6 (1) C 21 U  
 CONFLICT 31 (1) C 21 U  
 CONFLICT 116 (2) C NOT PRESENT  
 AQUASPIRILLUM SERPENS ATCC 11335
- ALCALIGENES FAECALIS NCIB 8156
- THIOBACILLUS ACIDOPHILUS DSM 700 (ATCC 27807)  
 ACIDIPHILUM CRYPTUM LHET2 (ATCC 33463)  
 THIOBACILLUS NOVELLUS ATCC 8093  
 AGROBACTERIUM TUMEFACIENS ICP8 T12
- THIOBACILLUS VERSUTUS ATCC 25264 (=THIOBACILLUS A2)  
 RHODOBACTER SPHAEROIDES (=RHODOPSEUDOMONAS S.)





- PARACOCUS DENITRIFICANS ATCC 13543  
 PARACOCUS DENITRIFICANS GOETTINGEN  
 RHODOSPIRILLUM RUBRUM S1  
 ANACYSTIS NIDULANS 1405/1
- PROCHLORON SPEC. LP
- SYNECHOCOCCUS LIVIDUS ATCC 27149 MUTANT III  
 SYNECHOCOCCUS LIVIDUS II Y-150-8
- EUGLENA GRACILIS BACILLARIS (B)  
 EUGLENA PRHOZZ, PRHOZZ, PHILLIP, PHILLIP  
 EUGLENA GRACILIS Z  
 EUGLENA GRACILIS Z  
 EUGLENA GRACILIS Z  
 EUGLENA GRACILIS Z  
 CHLAMYDOMONAS REINHARDII
- JUNGERMANNIA SUBULATA (LIVERNORT, )  
 CELL SUSPENSION CULTURES  
 MARCHANTIA POLYORPHA (LIVERNORT, LEBERKRAUT)  
 DRYOPTERIS ACUMINATA (WOOD FERN, MURFARN)  
 RRNA 1 122 LARGE SPECIES  
 RRNA 2 120 MIDDLE SPECIES  
 RRNA 3 120 SMALL SPECIES  
 UNSURE 81 87 DUE TO BAND COMPRESSION [2]  
 LEMNA MINOR (COMMON DUCKWEED, PETITE LENTILLE D'EAU, KLEINE WASSERLINSE)  
 SPIRODELA DLIBORHIZA (DUCK'S WEED, SPIRODELE, TEICHLINSE)  
 Z. CLONE PFC10M (SPINACH, SPINACH)  
 Z. CLONE PFC11M (SPINACH, SPINACH)  
 Z. CLONE PFC12M (SPINACH, SPINACH)  
 Z. CLONE PFC13M (SPINACH, SPINACH)  
 Z. CLONE PFC14M (SPINACH, SPINACH)  
 SPINACIA OLERACEA (SPINACH, SPINACH, SPINACH)
- NICOTIANA TABACUM TURKISH SAMSUM AND BRIGHT YELLOW 4 (TOBACCO, TABAC, TABAK)  
 RRNA 1 CLONE PTC7 LARGE SPECIES  
 RRNA 2 120 SMALL SPECIES  
 RRNA 3 120 MIDDLE SPECIES
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 BIOCHEM. J. 183:595-604(1979).  
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 MOL. GEN. GENET. 180:11-14(1980).  
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 MOL. GEN. GENET. 182:395-89(1981).







- ZEA MAYS (MAIZE, MAIS, MAIS) ; CLONE ZPMC134  
 SPIRODELA OLIGORHIZA (DUCK'S MEAT, SPIRODELE, TEICHLINSE)  
 ; CLONE P5PC18M  
 NICOTIANA TABACUM (TOBACCO, TABAC, TABAK)  
 UNSURE 69 70 AG (DNA) IS GA IN (RNA)
- SPINACIA OLERACEA (SPINACH, EPINARD, SPINAT)  
 DRYOPTERIS ACUMINATA (WOOD FERN, WURMFARN) ; LEAVES  
 MNIUM RUGICUM ( , )  
 JUNGERMANNIA SUBULATA (LEAFY LIVERWORT, LEBERMOOS)  
 MARCHANTIA POLYORPHA (THALLOID LIVERWORT, LEBERMOOS)  
 EUGLENA GRACILIS Z ( , AUGENTIERCHEN)  
 ANACYSTIS NIDULANS [1] 6301  
 ; [1] CLONE PANH [2,3] CLONES
- ESCHERICHIA COLI HRE 600  
 PROTEUS VULGARIS  
 AEROMONAS PUNCTATA INST.PASTEUR 67.12  
 BACILLUS SUBTILIS (RNB)  
 BACILLUS PBC204  
 BACILLUS STEAROTHERMOPHILUS 1054  
 ; CLONES PKW223 AND PKW3B2  
 ZEA MAYS A188 N (MAIZE, MAIS, MAIS) ; CLONES  
 PARANECIUM PRIMAURELIA (SLIPPER ANIMALCULE,  
 PANTOFFELTIERCHEN) ; CLONES  
 PARANECIUM TETRAURELIA (SLIPPER ANIMALCULE,  
 PANTOFFELTIERCHEN) ; CLONES
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	120	130	140	150	160	170	5.6S RRNA	EUKARYOTA
58	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	VICIA FAB	(SPERMATOPHYTA, ANGIOSPERMAE)
57	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	LUPINUS LUTEUS	(SPERMATOPHYTA, ANGIOSPERMAE)
56	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	ORITZA SATIVA	(SPERMATOPHYTA, ANGIOSPERMAE)
55	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TRITICUM AESTIVUM	(SPERMATOPHYTA, ANGIOSPERMAE)
54	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	CHLAMYDOMONAS REINHARDII	(VOLVOPHYTA)
53	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	BLAUCCOMA CHATTONI	(CILIOPHORA, HYMENOSTOMATIDA)
52	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	COLPIDIUM COLPODA	(CILIOPHORA, HYMENOSTOMATIDA)
51	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	COLPIDIUM CAMPYLUM	(CILIOPHORA, HYMENOSTOMATIDA)
50	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TETRAHYMENA PATULA	(CILIOPHORA, HYMENOSTOMATIDA)
49	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TETRAHYMENA PARAVORAX	(CILIOPHORA, HYMENOSTOMATIDA)
48	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TETRAHYMENA THERIOPHILA	(CILIOPHORA, HYMENOSTOMATIDA)
47	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TETRAHYMENA PYRIFORMIS B	(CILIOPHORA, HYMENOSTOMATIDA)
46	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TETRAHYMENA PYRIFORMIS A	(CILIOPHORA, HYMENOSTOMATIDA)
45	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	CRYPTOCODINIUM COHNII	(DINOPHYTA)
44	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TRYPANOSOMA BRUCEI	(KINETOPLASTIDA, TRYPANOSOMAT.)
43	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	ACANTHAMOEBA CASTELLANI	(KINETOPLASTIDA, TRYPANOSOMAT.)
42	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	ACANTHAMOEBA CASTELLANI	(KINETOPLASTIDA, TRYPANOSOMAT.)
41	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	PHYSARUM POLYCEPHALUM	(MYXOGASTRIA)
40	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	DICTYOSTELIUM DISCOIDEUM	(ACRASEA)
39	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	SCHIZOSACCHAROMYCES POMBE	(ASCOMYCOTA, ENDOMYCETIDAE)
38	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	SACCHAROMYCES CEREVISIAE	(ASCOMYCOTA, ENDOMYCETIDAE)
37	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	NEUROSPORA CRASSA	(ASCOMYCOTA, PLECTOMYCETES)
36	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	NEUROSPORA CRASSA	(ASCOMYCOTA, PLECTOMYCETES)
35	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	HYMENIACIDON SANGUINEA	(MOLLUSCA, GASTROPODA)
34	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	ARION RUFUS	(MOLLUSCA, GASTROPODA)
33	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	ARTERIA SALINA	(ARTHROPODA, ANOSTRACA)
32	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	ACTYRHOSIPHON MAGNOLIAE	(ARTHROPODA, ANOSTRACA)
31	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	PHILOSAMIA CYNTHIA-RICINI	(ARTHROPODA, INSECTA)
30	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	BOMBYX MORI	(ARTHROPODA, INSECTA)
29	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	SCIARA COPROPHILA	(ARTHROPODA, INSECTA)
28	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	DIPTEROPHILA MELANOGASTER	(ARTHROPODA, INSECTA)
27	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	LYTECHINUS VARIEGATUS	(ECHINODERMATA, ECHINOIDEA)
26	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	SALMO GAIRODNERI	(CHORDATA, OSTEICHTHYES)
25	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	XENOPUS LAEVIS	(CHORDATA, AMPHIBIA)
24	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	XENOPUS LAEVIS	(CHORDATA, AMPHIBIA)
23	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	GALLUS GALLUS	(CHORDATA, AVES)
22	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	TERRAPENE CAROLINA	(CHORDATA, CHELONIA)
21	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	AGCCUUAUAGUU	RATTUS RATTUS	(CHORDATA, MAMMALIA)

- RATTUS RATTUS (RAT, RAT, WANDERRATTE)  
 MUS MUSCULUS (HOUSE MOUSE, SOURIS DOMESTIQUE, HAUSHAUS)  
 MONO SAPIENS (MAN, HOMME, MENSCH)  
 1 [1][2] MOVICKOFF HEPATOMA ASCITES [3] MPC-11 [3][4][5] HELA  
 [6] L-929 [7] CLONE P3Y OF CHR-84 IN PBR322 [8] CLONE PHB3 IN  
 PBR322 [9] RAT LIVER.  
 HETS 1  
 MODBASE 2  
 MODBASE 14 US PARTIALLY (20/100 IN HELA)  
 MODBASE 55 F PARTIALLY  
 MODBASE 69 F  
 MODBASE 75 G  
 MODBASE 157 U NOT PRESENT IN RATTUS  
 SITE
- TERRAPENE CAROLINA ( , AMERIKANISCHE DOSENSCHILDKROETE)  
 1 TUMOR CELLS CELSO  
 HETS 14 US 50/100  
 MODBASE 69 F  
 MODBASE 75 G3  
 GALLUS GALLUS (CHICK, POULE, HAUSHUHN)  
 1 EMBRYO FIBROBLASTS  
 HETS 2  
 MODBASE 14 US 70-90/100  
 MODBASE 35 F PARTIALLY  
 MODBASE 69 F  
 MODBASE 75 G3  
 XENOPUS LAEVIS (CLAMED TOAD, XENOPE, KRALLENFROSCH)  
 1 EMBRYO FIBROBLASTS, [3] CLONE PAL212 IN PCR1,  
 [4] CLONE PAL101 IN PBR3  
 HETS 1 40/100  
 HETS 2 20/100  
 HETS 3 40/100  
 MODBASE 15 US 30-40/100 (EXCLUDING MODBASE 19)  
 MODBASE 19 F 50/100 (EXCLUDING MODBASE 15)  
 MODBASE 70 G3  
 MODBASE 76 G3  
 VARIANT 140 C HAYBE U LESS THAN 1/100  
 HETS 159 35/100  
 HETS 160 34/100  
 XENOPUS BOREALIS (CLAMED TOAD, XENOPE, KRALLENFROSCH)  
 1 TRANSFORMED KIDNEY CELLS  
 HETS 1 40/100  
 HETS 2 20/100  
 HETS 3 40/100  
 MODBASE 15 US 30-40/100 (EXCLUDING MODBASE 19)  
 MODBASE 19 F 50/100 (EXCLUDING MODBASE 15)  
 MODBASE 70 G3
- 1 [1] NAZAR R.N., SITZ T.O., BUSCH H.;  
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TRICHOMYCES LAMINGOSUS			
MODBASE 18	F		16 [1] WILDEMAN A.G., NAZAR S.N.;
MODBASE 43	A3		J. BIOL. CHEM. 256:5675-82(1981).
MODBASE 55	F		
MODBASE 73	F		
MODBASE 75	B3		
NEUROSPORA CRASSA			
CLONE PHE2 IN PBR322			17 [1] SELVER E., YANOFSKY C.;
SACCHAROMYCES CEREVISIAE (BAKERS YEAST, LEVURE, BAECKERHEFE)			NUCL. ACIDS RES. 6:2561-67(1979).
[1] ATCC 22244 (A264A), [2] 528BC HAPLOID			18 [1] RUBIN G.M.;
HETS 1	5/100		J. BIOL. CHEM. 248:3860-75(1973).
HETS 2	5/100		[2] RUBIN G.M.;
HETS 8	90/100		EUR. J. BIOCHEM. 41:197-202(1974).
MODBASE 80	F		[3] DONIS-KELLER H., MAYAN A.H., GILBERT W.;
			FEATIE D.A. RES. 4:2527-38(1977).
			[4] PEATIE D.A.
SCHIZOSACCHAROMYCES POMBE (FISSION YEAST, LEVURE, SPALTHEFE)			19 [1] SCHNAAK J., MAO J., SDELL D.;
[1] CLONE PVM22 AND PVM5 IN PBR322			NUCL. ACIDS RES. 10:2851-64(1982).
HETS 1			
HETS 2			
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- TETRAHYMENA PYRIFORMIS W  
 MODBASE 78 G3  
 TETRAHYMENA PYRIFORMIS W AND GL  
 TETRAHYMENA VORAX V23  
 TETRAHYMENA LEUCOPHYTIS TUR
- TETRAHYMENA THERMOPHILA B-1848-VII
- TETRAHYMENA PARAVORAX RP
- TETRAHYMENA PATULA L-FF AND NEI
- COLPIDIUM CARPYLLUM
- COLPIDIUM COLPUDA
- GLAUCOMA CHARTONI
- CHLAMYDOMONAS REINHARDII CM15  
 MODBASE 42 G3  
 MODBASE 74 G3  
 TRITICUR AESTIVUM (WHEAT, BLE, WEIZEN)  
 ERVU 1 79/100  
 HETS 2 16/100  
 MODBASE 22 F  
 MODBASE 47 A3  
 MODBASE 78 F  
 MODBASE 89 F  
 MODBASE 119 C  
 UNSURE 125 A MAYBE NOT PRESENT  
 ORYZA SATIVA VAR. MANGETSUMOCHI (RICE, RIZ, REIS)  
 1 CLONE PR217  
 LUPINUS LUTEUS (YELLOW LUPINE, , GELBE LUPINE)  
 1 CLONES PAR6 AND PAR12 IN LAMIDRAGOT IN 15/100  
 VARIANT PAR1  
 VITICOLA (BROAD BEAN, , SAUBERNE)  
 1 LEAVES  
 MODBASE 22 F  
 MODBASE 47 A3  
 MODBASE 78 F  
 MODBASE 79 G3
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 [2] VAN BELL C.T.;  
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