

## **2010NSC SYSTEMS MICROBIOLOGY**

### **Module on Scientific Literature & Communication (Total 40%)**

This Module is made up of the following assessment items:

1. Log of Learning Activities (Searching for references & referencing style) – Marks out of 20 (5%)
2. E-poster – Marks out of 100 (15%)
3. Seminar- Marks out of 100 (20%)

#### **Module Aims:**

The module is designed to assist you in developing skills in scientific communication informatics. To develop this skill, the module will teach you how to search for relevant scientific literature, limit / narrow the literature using search definition and download the information as database records e.g. EndNote and Word), aggregate this information and prepare scientific communiqué e.g documents and presentations (posters, seminars, videos). communications on biodiversity informatics and.

You will develop an understanding on how to search for important scientific information, aggregate and summarise this information and communicate the most important points to your fellow classmates by using either a poster and an oral seminar presentation or by using a video presentation which you have developed. Posters and oral seminars are popular at scientific conferences and videos are popular for online teaching / communication. The exposure to appropriate tools and technology (multimedia) for communication is not only important in conveying a scientific message but is also an important tool for career development and, for example, it can be used at interviews.

Powerpoint is a very powerful aid for conveying your message to your audience. Most of you would have some experience of presenting a seminar using powerpoint. You can also use Powerpoint to produce a template for posters. You may have seen scientific brochures which can be regarded as A4 / A3 version of posters. Posters are usually presented at an informal session (a tea and / or lunch break). So most posters are viewed casually and within a small time frame. However, seminars are formal and focused and have more details than the posters. In addition, speakers have to adhere to a strict timeline. Therefore, the format for, and content of, the poster is somewhat different to that of a seminar.

As computer technologies improve so do the audio visual tools (multi media) and what was achievable in the past by movie producers can now be achieved by almost anyone who has an interest in this multi-media (movie) presentations (most of you would play computer games and would appreciate the multimedia experience!!).

#### **Module Activities:**

The module offers four activities as outlined below. You can elect to either complete activities 1, 2 and 3 **OR** complete activities 1 and 4.

- Activity 1. Assignment of a topic from Appendix 1 & scientific literature search
- Activity 2. Creating a poster: Information aggregation and written presentation on the topic
- Activity 3. Presenting a seminar: Information aggregation and oral presentation using Powerpoint
- Activity 4. Creating and presenting a video instead of a poster and a seminar

#### **Schedule for Module Activities:**

Week 1. Students will be given a pre-assigned special topic for their poster and seminar presentation. Instructions on how to search for scientific literature and useful ways by which broad literature searches on a topic of interest can be narrowed and focussed to a more specific sub-topic will be demonstrated. In addition, tips on scientific poster and seminar presentation will also be provided.

Weeks 2 & 3. Students will develop search definitions for searching literature and perform literature searches. Further demonstration and discussions on the utility of the searches will be held during the workshop.

Week 4. Students will tweet (remember the 140 character tweet limit) or email their search definitions. This is a pass / fail assessment item

Weeks 5 to 7. Students will continue to develop their skills for literature search and discuss their findings

Week 8. Students will email their final search definitions and the literature. They will cite 10 formatted references which will be most likely used in their poster and seminar presentations. This forms part of the

assessment for the course and is worth 5%

Week 11. Students should submit an electronic version of the poster by Friday, week 11 and a hard copy of the poster is to be handed in it has been shown to the class during the seminar presentation (see below).

Weeks 12 and 13: Students will present seminars and submit posters. Both posters and seminars will be presented at the same time. At the beginning of this activity state your name and the title of your poster while holding up the poster to the class for approximately a minute. This will allow your fellow classmates to view the poster from a distance. You will then give the poster to me and continue with the seminar presentation. The seminar is for 10 min. duration.

Alternative, students can opt to present a video that is made by them on the topic. The video should be of 10 min. duration

### **Presence and Participation:**

It is compulsory for all students to attend the activities associated with this module. In addition, all students should also be present during the poster / seminar / video presentation unless there are valid extenuating circumstances. Non-attendance could result in student getting a zero mark. Following the conclusion of each presentation, there will be a 5 min question time. It is expected that each student will participate during this time by asking questions or by providing feedback to the presenters. Please state your name before you ask a question or provide feedback so that a note can be made on your contribution.

### **Allocation of Marks:**

1. Week 4. Submit literature search definitions by email or tweet (remember 140 character limit) – pass / fail
2. Week 8. Submit final search definitions and 10 formatted references by email – 5%
3. Poster – 15% and Seminar presentation 20% OR video presentation – 35%

The following will taken into consideration for marking:

- Scientific content
- Production (fonts size, aesthetics, color, layout, images)
  - Poster
  - Seminar
- Keeping the presentation to time
- Participation by asking questions and / or making positive contribution

## **Biodiversity informatics- Searching scientific literature (10%)**

### **I. INTRODUCTION.**

Biodiversity informatics is defined as "the creation, integration, analysis, and understanding of information regarding biological diversity". Biological diversity includes all life on our planet as described in the **Tree of Life**.

The ability to carry out a comprehensive, appropriate and specific literature search is the first and most important step in biodiversity informatics. An efficient and effective search will enable you to find out what is known about a specific topic you are interested in quickly and precisely. Though general web search engines are useful, they can turn up many items of information that have not been peer reviewed, and hence information contained in such searches may be incorrect. In addition, general search engines do not provide links between scientific literature and informatics. Therefore general web searches are regarded NOT be particularly useful for searching scientific literature.

Entrez is NCBI PubMed's "Biodiversity informatics search engine" - <http://www.ncbi.nlm.nih.gov/Class/MLACourse/Original8Hour/Entrez/index.html#Top> and is widely used by biologists. Entrez not only searches published scientific literature using a database such as PubMed but also provides useful links eg literature references on a particular taxon and sequence data in a database.

**Note:** PubMed comprises more than 21 million citations for biomedical literature from MEDLINE, life science journals, and online books. Citations may include links to full-text content from PubMed Central and publisher web sites. PubMed can also be accessed via EndNote. EndNote is a reference database manager and can be used in conjunction with Microsoft word to assist in writing assignments. EndNote is available to Griffith University students free of charge and information on the software is available at the library help desk or can be accessed through the University's web pages.

## About PubMed Entrez Browser

Click [Entrez browser](#) or copy and paste this URL <http://www3.ncbi.nlm.nih.gov/Entrez/> into your web browser. Some of the key features of the Entrez search engine are listed below:

1. Free and accessible to everyone
2. Clipboard feature allows for easy generation of subsets of hits
3. Related articles can help broaden a search to capture articles that would not appear in the initial term
4. Links to full text of textbooks – textbooks are useful starting point for background information
5. Allows access to nucleotide and protein databases

## II. AN EXAMPLE ON HOW TO SEARCH NCBI USING ENTREZ

Below is an example of an Entrez search that uses Boolean Operators, the Clipboard, Limits, Related Articles, Books and Full Text on-line.

### Example 1:

We are interested in developing a sensitive PCR test for detecting a newly isolated infectious bacterium from food. The initial target gene for the test is the 16S rRNA gene (but later we can also include other target genes involved in the pathogenesis process.) We are fortunate as the 16S rRNA gene as well as its genome of the bacterium have been sequenced and deposited in GenBank (one of the many databases that Entrez searches across).

Simply searching with the term “16S rRNA” on 24<sup>th</sup> July 2012 brings up the information shown in Figure 1. The first thing you will notice is the voluminous information across all databases.

The search can be narrowed by including the term bacteria: 16S rRNA AND bacteria. The term “AND” is one of three Boolean operators (AND, OR, NOT) used to limit and make the search more precise to the user needs. (We can add further terms to narrow the search (refer to NLM controlled vocabulary if you wish to find out more about the terminologies that can be used with Entrez search). The information is now less than what we started off with as indicated in Figure 2.

However the information is still too voluminous and needs to be limited. So we add another term and do a more specific search. We now include a technique called Real-Time PCR and target the 16S rRNA gene for detecting bacteria. The result of this search is shown in Figure 3.

### 1. Use of the Clipboard

Let us now look at some of the information on the response pages (Figures 1 to 3). Click on PubMed and as you scroll through the pages of hits, check the box adjacent to the reference number for the articles that look of interest. BEFORE you go to the next page, click the Send button (found at the top as well as the bottom of the page) and select Clipboard from the pull down menu. This will capture the checked references on a clipboard. You can turn to page two and repeat the process. Using the Send to clipboard pull down menu will add the checked references from the second page to the clipboard. (note: Items on the clipboard are only retained for eight hours).

You can now check the clipboard (faint blue heading in topmost grey band) to view the items on the clipboard. The default display shows author, article title and journal. For more information, change the Display pull-down menu from Summary to Abstract and click on the Display button. This will now display a full abstract.

### 2. Use of Limits

Clicking on the “**Show Additional Filters**” on the LHS panel of the page allows you to restrict your search in a number of ways.

**a) Publication types-** Allows you to restrict hits to specific types of articles or specific languages. Choosing Review Articles is very useful if you want to get an overview of what has been done on a specific topic. Try a new search e.g. VIP AND inflammation brings up over 180 articles. Click on the Limits tab and use the Publication Type pull down menu to select only Reviews and then click on Go button again. Now only 40 articles appear

**b) Subject limits:** You can also limit on ages of experimental human subjects (.e. pediatric vs gerontological). You can limit articles to humans or to animal studies or both, you can limit by gender, by age of subjects, by date of publication or specify article language. (note: if you do employ limits on one search, make sure you

uncheck this box before proceeding with another search or the limits will still be applied to the subsequent searches.

### 3. Use of Truncation

It is possible to employ the \* to search for all terms that begin with a defined text string. For example, searching on myo\* will search for all articles dealing with myoblast, myocyte, myocystitis, myopathy, etc up to 150 variations. Searching on myocyte\* will search for myocyte or myocytes or myocytomia but not myocytoma.

### 4. Use of Related Articles

To the right of the journal entry, you can survey "related articles" (those that MEDLINE analyzes as related by virtue of shared keyword entries). These will be brought up not in publication date order, but in order of degree of relatedness. This can be a very useful tool to finding related publications that do not include your search terms in either title or abstract.

### 5. Use of Books

If you click on Links and scroll down to Books, you will bring up the title and abstract with a number of terms highlighted as links. These terms are linked to the collection of books whose full text is available on line via PubMed. This can be extremely useful for getting some fundamental background information on a subject. The number of full text books on line is increasing with each year.

### 6. Full Text On-Line

Most of the journals which give an icon indicating full text on-line actually require a Password to see the full text. However, some journals (e.g. Proc. Natl. Acad. Sci. USA) are actually available as full text in the form of a html or pdf document. One of the advantages of using OVID via the Tufts library is that a much wider selection of journals is available as full text on-line via Tufts and the OVID search engine indicates which journals are available.

### 7. Other Databases Accessible from Entrez

Entrez is powerful because it is actually a set of linked databases. With a given search term you can also search the DNA sequence databases, the protein structure databases, the online Mendelian Inheritance in Man (OMIM) database, and a number of others from one central page. If you are searching for a gene you can cross reference in OMIM to see if it is associated with any known human genetic disease (ONE CAVEAT: BE VERY CAREFUL IN PRINTING THESE - OMIM ENTRIES ARE LARGE AND CAN GIVE MORE THAN 50 PAGES OF HIGHLY TECHNICAL TEXT. It is better to cut and paste relevant material to a word processor).

## III. EXERCISE - A Literature Search Using Entrez:

(i) Construct a literature search for research papers published on the topic that you have been assigned using Entrez. Send me (a) a list of search terms that you have used and the total number of hits for your search -- suggest using a table as given below.

Number	Search Terms Used	Search Date	Numbers of Hits
1			
2			
3			
4			
5			

(ii) List five articles (in the form of citations / references) you deem most interesting (based on reading of the abstracts). Use a consistent reference style. An example of a referencing style is given below:

Patel, S. and Goyal, A. (2012). Recent developments in mushrooms as anti-cancer therapeutics: a review. 3 Biotech 2:1-15

(iii) Click on Books and you will see a number of terms in the abstract are now in the form of links. Click on the links and read the abstracts / content. Select one book / chapter of the book and display it in abstract display. Provide me with the abstract of this article.

(iv) Check to see how many review articles deal with your topic. List **one** review article you deem most interesting and state your reasons as to why you find this interesting.

#### IV. EXERCISE: Creating a Reference Database using EndNote and PubMed (FROM 2013)

Create a reference database in EndNote using PubMed. All Griffith University students can download EndNote software free of cost. Refer to <http://libraryguides.griffith.edu.au/content.php?pid=265213&sid=2309040> for more details.

The screenshot shows the NCBI Entrez search interface. The search term "16S rRNA" is entered in the search bar. The results are displayed in a grid format, showing the number of records found in various databases. The databases are grouped into sections: PubMed, Nucleotide, Protein, Gene, and others. The results are as follows:

Database	Count	Description
PubMed	22881	biomedical literature citations and abstracts
PubMed Central	23870	free, full text journal articles
Site Search	35	NCBI web and FTP sites
Books	163	online books
OMIM	6	online Mendelian Inheritance in Man
Nucleotide	4275426	Core subset of nucleotide sequence records
EST	5020	Expressed Sequence Tag records
GSS	2729	Genome Survey Sequence records
Protein	99010	sequence database
Genome	1577	whole genome sequences
Structure	532	three-dimensional macromolecular structures
Taxonomy	none	organisms in GenBank
SNP	2	short genetic variations
dbVar	286	Genomic structural variation
Gene	30164	gene-centered information
SRA	3886	Sequence Read Archive
BioSystems	210	Pathways and systems of interacting molecules
HomoloGene	3	eukaryotic homology groups
Probe	984	sequence-specific reagents
BioProject	166	aggregated biological research project data
dbGaP	988	genotype and phenotype
UniGene	6	gene-oriented clusters of transcript sequences
CDD	57	conserved protein domain database
Clone	583	integrated data for clone resources
UniSTS	none	markers and mapping data
PopSet	19647	population study data sets
GEO Profiles	740	expression and molecular abundance profiles
GEO DataSets	909	experimental sets of GEO data
Epigenomics	none	Epigenetic maps and data sets
PubChem BioAssay	601	bioactivity screens of chemical substances
PubChem Compound	none	unique small molecule chemical structures
PubChem Substance	341	deposited chemical substance records
Protein Clusters	223	a collection of related protein sequences
OMIA	1	online Mendelian Inheritance in Animals
BioSample	1346	biological material descriptions
NLM Catalog	11	catalog of books, journals, and audiovisuals in the NLM collections
MeSH	10	detailed information about NLM's controlled vocabulary

Figure 1. Entering the term “16S rRNA” in Entrez brings up voluminous information on this term as shown in Figure 1 Note:

1. The date for the search was 24<sup>th</sup> July 2012 Taking note of the date of the search is important as this information will change as new information is added to the databases on a daily basis.
2. Further terms can be added to narrow the search (refer to NLM controlled vocabulary if you wish to find out more about the terminologies that can be used with Entrez search)

HOME SEARCH SITE MAP PubMed All Databases Human Genome GenBank Map Viewer BLAST

Search across databases **16S rRNA AND bacteria** GO Clear Help

- Result counts displayed in gray indicate one or more terms not found

20095 PubMed: biomedical literature citations and abstracts	84 Books: online books
21556 PubMed Central: free, full text journal articles	1 OMIM: online Mendelian Inheritance in Man
17 Site Search: NCBI web and FTP sites	

3593441 Nucleotide: Core subset of nucleotide sequence records	165 dbGaP: genotype and phenotype
3 EST: Expressed Sequence Tag records	none UniGene: gene-oriented clusters of transcript sequences
2728 GSS: Genome Survey Sequence records	43 CDD: conserved protein domain database
89035 Protein: sequence database	none Clon: integrated data for clone resources
1559 Genome: whole genome sequences	none UniSTS: markers and mapping data
485 Structure: three-dimensional macromolecular structures	15002 PopSet: population study data sets
none Taxonomy: organisms in GenBank	625 GEO Profiles: expression and molecular abundance profiles
none SNP: short genetic variations	101 GEO DataSets: experimental sets of GEO data
9 dbVar: Genomic structural variation	none Epigenomics: Epigenetic maps and data sets
27477 Gene: gene-centered information	44 PubChem BioAssay: bioactivity screens of chemical substances
546 SRA: Sequence Read Archive	none PubChem Compound: unique small molecule chemical structures
80 BioSystems: Pathways and systems of interacting molecules	50 PubChem Substance: deposited chemical substance records
none HomoloGene: eukaryotic homology groups	220 Protein Clusters: a collection of related protein sequences
929 Probe: sequence-specific reagents	none OMIA: online Mendelian Inheritance in Animals
81 BioProject: aggregated biological research project data	124 BioSample: biological material descriptions

7 NLM Catalog: catalog of books, journals, and audiovisuals in the NLM collections	1 MeSH: detailed information about NLM's controlled vocabulary
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Figure 2.

HOME SEARCH SITE MAP PubMed All Databases Human Genome GenBank Map Viewer BLAST

Search across databases **16S rRNA AND bacteria AND Real Time PCR** GO Clear Help

- Result counts displayed in gray indicate one or more terms not found

787 PubMed: biomedical literature citations and abstracts	7 Books: online books
3966 PubMed Central: free, full text journal articles	none OMIM: online Mendelian Inheritance in Man
1 Site Search: NCBI web and FTP sites	

2411 Nucleotide: Core subset of nucleotide sequence records	6 dbGaP: genotype and phenotype
none EST: Expressed Sequence Tag records	none UniGene: gene-oriented clusters of transcript sequences
none GSS: Genome Survey Sequence records	none CDD: conserved protein domain database
186 Protein: sequence database	none Clon: integrated data for clone resources
none Genome: whole genome sequences	none UniSTS: markers and mapping data
none Structure: three-dimensional macromolecular structures	36 PopSet: population study data sets
none Taxonomy: organisms in GenBank	none GEO Profiles: expression and molecular abundance profiles
none SNP: short genetic variations	4 GEO DataSets: experimental sets of GEO data
none dbVar: Genomic structural variation	none Epigenomics: Epigenetic maps and data sets
2 Gene: gene-centered information	none PubChem BioAssay: bioactivity screens of chemical substances
none SRA: Sequence Read Archive	none PubChem Compound: unique small molecule chemical structures
14 BioSystems: Pathways and systems of interacting molecules	none PubChem Substance: deposited chemical substance records
none HomoloGene: eukaryotic homology groups	none Protein Clusters: a collection of related protein sequences
62 Probe: sequence-specific reagents	none OMIA: online Mendelian Inheritance in Animals
4 BioProject: aggregated biological research project data	none BioSample: biological material descriptions

1 NLM Catalog: catalog of books, journals, and audiovisuals in the NLM collections	none MeSH: detailed information about NLM's controlled vocabulary
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Figure 3. Note: Boolean operators have to be typed in all caps. They can also be grouped by use of parenthesis. e.g. say we want to obtain information on the use of 16S rRNA or Real Time PCR for quantitation. You could phrase this as: (16S RNA OR Real Time PCR) AND diagnostic. How you group the parenthesis is important. Instructions for constructing focused searches are provided as tutorials or FAQ sheets in PubMed.

### **Creating a poster: Information aggregation and written presentation (15%)**

Posters and seminars are popular at scientific conferences. Posters are usually presented at an informal session (a tea and / or lunch break). So most posters are viewed casually and within a small time frame. However, seminars are formal and focused and have more details than the posters. In addition, speakers have to adhere to a strict timeline. Therefore, the format and content of the poster is somewhat different to that of a seminar.

The following are suggestions **to get you started** on a poster:

1. Do extensive research on your topic.
2. Develop ideas.
3. Start early - Posters take time and thoughts to develop and put together.
4. Remember that only a few minutes are spent by readers (scientists) at each poster!!
5. What to look for in a poster:
  - The poster size should be limited to the size restriction of printers.
  - General Appearance
  - Easy or difficult to read, font size & color
  - Use water marks if possible
  - Aesthetics (look)
    - professional not too flashy
    - avoid “look great” but has no content
    - should have natural flow from one section to another
6. Content of the poster:
  - Poster Title
  - Authors
  - Address (Department / Institute) and contact address (E-mail)
  - Abstract
    - What was the problem about?
    - A summary of discovery
    - What is the conclusion?
  - Scientific content -
    - Use charts., pictures & figures where possible but do not over do this.
    - Do not make the content too wordy
    - Include the list of references used for the research topic

There many other ways for **preparing posters** but the following is a guide to setting out a poster using powerpoint.

1. Open Powerpoint. Select File from the pull down menu and than “page set up”. Set the following parameters for a poster canvas
  - Slides sized for “Custom”
  - Width “85 cm”
  - Height “90 cm”
2. You can scale up or down the size of the page (zoom) for viewing purposes by editing the menu containing “100%”. For example, to view the whole page, use 14%. This is an extremely useful menu.
3. Now you are ready to add information to your poster for which will need the drawing “toolbox”. If you can't see the drawing tool box than switch it on by going to the pull down menu “View”, selecting “toolbox” and ticking the box called “Drawing.”
  - To insert text, select “insert” from th epull down menu and click in the text box.
  - For insert pictures, go to the pull down menu, select “Insert” and click on picture (from file or from the clipart which comes with powerpoint). If you wish you can also create your

own graphics, scan your figures and insert them or alternately copy pictures from the web. Some of the software for these purposes are available freely via the web whereas others are shareware or fully commercial. Grabit (available from <http://www.shemes.com/index.php?p=download> and tutorials at the URL <http://www.shemes.com/grabit/>) is a useful free software for grabbing / capturing pictures from your screen. However, there are other free software that will also do screen grabs but you will need to do a search for – use google with the terms free screen capture software)

### **TIPS:**

- Draw and layout boxes on the canvas. Resize to suit your research material. Color the outline of the boxes and / or the text and / or the fill the box with color. However, you should always remember that too much color can spoil the poster.
- You will be shown some examples of posters during one of the sessions on poster presentation that were made using the above approach.
- Remember that if you were presenting the poster at a scientific meeting than your main aims are (a) attract an audience to your poster - eye-catching posters can be prepared by using a “Water mark” as a background back drop and (b) to communicate your research message to the audience.
- You can print the poster on an A3 page for proof reading. Final posters can be printed at e.g Office Works or at other stationary stores

### **Presenting a seminar: Information aggregation and oral presentation using powerpoint (20%)**

The following are some tips that will assist you in preparing and delivering a seminar. Remember that your seminar will be different from that of your poster.

#### **1. The requirement:**

Research the topic, present the topic in front of the class and teach your audience on this topic.

#### **2. Approaching your topic:**

Research your topic. If you understand your topic it will become an enjoyable and stimulating experience for you. In addition, when you present your topic, you will enjoy teaching others about what you have learned, making the entire experience both educational and entertaining.

#### **3. Entertain your audience:**

Science presentations should not be all about facts. You can incorporate a bit of humour or “did you know” type facts. This will make the presentation more interesting and if more people become interested than this will also keep you thinking creatively.

#### **4. Present your presentation intelligently:**

Place yourself to one side of the visual aid so that you can explain your presentation. Ensure that the font size of the slides are legible.

#### **5. Organize your information:**

Separate and organize your information – keep a sheet of paper that describes the research done, another sheet that contains facts and information and the visual aid that works with your information. Keep prepared notes for the seminar available but avoid reading these notes during presentation.

#### **6. Mention real world applications:**

You should not only copy what is present in the textbooks or papers but to make the presentation more interesting think of ways how your presentation can relate to everyday life.

### **Creating and presenting a video (35%)**

You can elect to choose a multimedia presentation in the form of a movie instead of a seminar and a poster. In this case the video should run for at least 25 mins.

For creating a video, you will need to put together a selection of images, videos and audio sound using a video editor in the form a movie. The following information will assist you in developing your mutlimedia skills.

1. OpenShot is an awesome free video editing software but is only available for the linux OS (there is currently no Windows version). Openshot 1.4.2 is the most current version at the time of writing (24<sup>th</sup> July 2012) and can be downloaded from <https://launchpad.net/openshot/+milestone/1.4.2>

I use OpenShot but if you have time you could also look at the a plethora of alternate video editors at the URL <http://alternativeto.net/software/openshot/>

2. Lightworks is for the Windows OS and is also free. The manual can be viewed downloaded from <http://www.softwarecrew.com/2010/12/edit...> and the software from <http://www.lightworksbeta.com/>

### List of Assignment Topics

Below is a list of topics for this module. You are required to select a topic from this list (or one will be pre-assigned to you) and submit the three assessment items by the time lines indicated in the course profile.

No	Assignment Topic	Relevance (pathogen, industrial importance, basic scientific understanding)
1	<i>Staphylococcus aureus</i>	
2	<i>Mycobacterium leprae</i>	
3	<i>Helicobacter pylori</i>	
4	<i>Chlamydia trachomatis</i>	
5	<i>Yersinia pestis</i>	
6	<i>Neisseria meningitidis</i>	
7	<i>Deinococcus radiodurans</i>	
8	<i>Clostridium botulinum</i>	
9	<i>Rhizobium leguminosarum</i>	
10	<i>Legionella pneumophila</i>	
11	<i>Vibrio cholera</i>	
12	<i>Bacillus thuringiensis</i>	
13	<i>Streptococcus pneumoniae</i>	
14	<i>Xanthomonas campestris</i>	
15	<i>Lactoobacillus acidophilus</i>	
16	<i>Corynebacterium glutamicum</i>	
17	<i>Leuconostoc mesenteroides</i>	
18	Extra-planetary life (Astrobiology)	
19	Origin of Life	
20	Tree of Life based on rRNA analysis	
21	Extreme environments as microbial habitats	
22	Recent developments in automated DNA Sequencing	
23	Genome Evolution	
24	Synthetic gene technologies and tailor-made enzymes	
25	Gut microbiome	
26	Prebiotics and Probiotics	
27	Skin microbiome	
28	Microbial inhibitors and enzymes in cleaning products	
29	Microbiology of built environments	
30	Two-component signal transduction system in biofilms	
31	Microbial degradation of aromatic pollutants	
32	Anaerobic lithotrophic microbes (including metal transforming bacteria)	

33	Emerging pathogens in response to environmental changes (eg climate change)		
34	Nosocomial infections		
35	Molecular methods for detecting pathogenic Microbes causing food spoilage and poisoning		
36	Pathogens as bioterrorism weapons		
37	Detail a microbiology process for beer or yoghurt production		
38	Second-generation biofuel enzymes		
39	Food preservation techniques		
40	Rumen microflora and their important role		
41	Digestion in termite guts		
42	Nanopore technology for DNA sequencing		
43	Microbial Genome Database		
44	Modern Microbial Taxonomy		
45	Rules for naming microorganisms		
46	Microbial Fuel Cell (MFC)		
47	Fecal Microbiota Transplant (FMT)		

