

Water Microbes and Human Health Exercise

Purpose

This activity, in which students research and create a crossword puzzle using appropriate terms, encourages students to explore the possible sources and human health effects of various illness-causing water microbes.

Overview

Microbial contamination of water can be an issue for both marine and freshwater sources. This exercise will require students to research the possible sources and human health effects of microbes found in recreational and drinking water. This will enable students to explore the range of negative outcomes of contact with contaminated recreational and drinking water by creating their own crossword puzzle using their new vocabulary and concepts.

Time

A 1 hour session to distribute the Water Microbes and Human Health Exercise with 1 session of homework as an individual or in groups to perform the research and create and exchange the crossword puzzles.

Key Concepts

Human exposure to microbes in contaminated recreational and drinking water through a variety of routes can lead to a wide range of human health effects.

Skills

This exercise can enhance students' critical reading, internet research, writing and word skills. In groups or as individuals, students will independently research common water microbes to find out about their human health effects. They will then define key terms and create a cross word puzzle using a list of key terms concerning microbial contamination and human health effects; the students will provide the questions for the cross word puzzle and use internet-based software to create the puzzle.

Materials

Table worksheet
List of Websites
Access to computer and internet

Facilitator Preparation

Knowledge of the computer software (particularly search engines and the software for the creation of the crossword puzzles and other word games) will optimize this session. Prior knowledge of the Teachers' Guide to Water Quality, as well as other modules, will prepare you for the range of issues addressed in this section.

Background

A range of microbes (bacteria, viruses, protozoa, and other organisms) have been associated with a variety of human health effects which arise from contact with recreational and drinking water contaminated by these microbes. The routes of exposure are through oral contact with contaminated water or food, although skin exposure is also a possible important route of exposure. Although the primary illness resulting from microbial contamination is gastroenteritis, there are also specific severe illnesses (such as cholera) as well as other illnesses (such as life-threatening skin infection from *Vibrio vulnificus*).

Microbial contamination of recreational water can be an issue from both marine and freshwater sources. The primary source of microbial contamination is believed to be human and animal fecal waste (“poop”) and/or improperly treated sewage. The primary mode of detection is the use of a “coliform count” which demonstrates the number and type of bacterial organisms (which are similar to pathogenic fecal organisms) from a water sample. Current regulations for both recreational and drinking waters are based on this coliform count, as well as other measures of pathogenic and non pathogenic organisms. Other potentially pathogenic organisms such as viruses and protozoa are not necessarily measured in this test. Furthermore, due to environmental conditions in subtropical and tropical waters, these pathogenic organisms may be natural inhabitants rather than from an animal or human fecal contamination.

Procedure

Students will research some key concepts to the human health effects of microbial contamination as individuals or in groups. A table worksheet is enclosed which can be used to aid in this research. Then students as individuals or in groups will create a crossword puzzle using a list of key terms derived from the table worksheet, and publicly available websites for creating crossword puzzles.

1. Give the students the enclosed table worksheet and ask them to research and fill in this table as individuals or in groups. Of note, additional organisms and other information can be added to this table and should be encouraged as part of the research.
2. Have a class discussion about which terminology and information they found.
3. Give the students the enclosed list of key terms (derived from the table worksheet) for microbial contamination and human health. As individuals or in groups, have them define each key term and then create questions in a crossword puzzle format such that the key terms are the answers to the created questions. Of note, students may add to the key terms list if they wish as long as they provide a definition and question for each new key term.
4. As individuals or in groups, have the students use publicly available websites to create a Microbial Contamination and Human Health Crossword Puzzle.
5. As individuals or in groups, have the students solve the crossword puzzles of their peers.

Crossword Puzzle Creation Websites:

Free and Shareware Puzzle making software

<http://www.qualint.com/worksheets.html>
<http://mywebpages.comcast.net/saweyer/z/crozzword.htm>
<http://www.crauswords.com/>
<http://www.varietygames.com/>
<http://www.puzzlexpress.com/>
<http://www.alsoftpublishing.com/>
<http://www.crosswordkit.com/>
<http://www.x-word.com/>
http://www.smartcode.com/cwk_scr.htm

Microbial Contamination & Human Health Effects Websites

<http://www.great-lakes.net/humanhealth/drink/microbe.html>
<http://www.envirohealthaction.org/water/contamination/>
<http://www.epa.gov/waterscience/humanhealth/microbial/microbial.html>
<http://www.epa.gov/microbes/>
<http://www.epa.gov/waterscience/beaches/1986crit.pdf>
<http://www.epa.gov/waterscience/humanhealth/>
<http://www.epa.gov/waterscience/biocriteria/>
<http://www.cce.cornell.edu/factsheets/wq-fact-sheets/factsheet1.htm>
<http://www.germology.com/index.htm>
<http://www.cdc.gov/>
<http://www.dpd.cdc.gov/dpdx/HTML/FreeLivingAmebic.htm>
<http://hermes.ecn.purdue.edu/cgi/convwqtest?/fs-2.me.ascii>
http://checc.sph.unc.edu/rooms/library/docs/hogs/hogs_hhealth.html

Extension Activities

Other types of puzzles can be created such as word scrambles and word searches using similar programs.

Students can draw a human body and indicate on the body the organ systems involved in illnesses associated with waterborne pathogens (see enclosed example from the Microbe Library of the American Society for Microbiology at www.asmtusa.org entitled "Cholera" which illustrates how the bacteria, *Vibrio cholera*, causes the human disease cholera in the human body at <http://www.microbelibrary.org/images/Hyman/titledcholera.mov>; this requires Quicktime add in to play).

Students in groups or as individuals can perform additional research and create research papers on a particular microbial contaminant and present this research orally to their peers.

This activity can be followed by the Sewage Matrix Field Experience Activity to see how some of the sources of microbial contamination can be controlled.

Microbiologist, particularly from the local Health Department or sewage treatment plants, can be invited to speak about their work and concerns.

Student Assessment

Give the following components to each student as individuals or in groups so that the students can:

- ❖ Research human health effects of microbial contamination
- ❖ Fill in the enclosed table worksheet
- ❖ Participate in a class discussion concerning human health effects of microbial contamination
- ❖ Define the key terms
- ❖ Create questions for the crossword puzzle such that each key term has a corresponding question
- ❖ Create a Microbial Contamination and Human Health Crossword Puzzle
- ❖ Solve another student's Microbial Contamination and Human Health Crossword Puzzle

Assign points for the following components:

- ❖ Identify the key sources and human health effects associated with microbial contamination.
- ❖ Fill in the enclosed table worksheet
- ❖ Define the key terms
- ❖ Create questions for the key terms
- ❖ Create Microbial Contamination and Human Health Crossword Puzzle
- ❖ Solve another student's Microbial Contamination and Human Health Crossword Puzzle

Microbial Contamination and Human Health Table Worksheet

Research the following microbial organisms which have been associated with human disease. Fill in the table worksheet below based on the results of your research. Add additional organisms and terms as you find them in your research.

Organism	Type	Source	Route of Exposure	Human Disease
Escherichia coli (E Coli)				
Vibrio cholerae				
Vibrio vulnificans				
Staphylococcus aureus				
Giardia				
Hepatitis A				
Norwalk Virus (Norovirus)				
Cryptosporidium				
Salmonella typhi				
Shigella				
Schistosoma				
Adenoviruses				
Poliovirus				
Entamoeba histolytica				
Fecal Coliforms				
Guinea worm				

Microbial Contamination and Human Health: Key Terms

Define the following key terms associated with microbial contamination and human health using 1 complete sentence/key term. Add 3 additional Key Terms and define these terms based on your research.

Microbe
Bacteria
Virus
Protozoa
Fecal Oral
Norwalk Virus
Hepatitis A
Cryptosporidium
Giardia
Gastroenteritis
Hepatitis
Cholera
Giardiasis
Staphylococcus aureus
Escherichia coli (E Coli)
Vibrio cholerae
Vibrio vulnificus
Coliform Count
Shigella
Salmonella typhi
Schistosoma
Adenovirus
Poliovirus
Entamoeba histolytica
Fecal coliforms
Guinea worm
Adenovirus
Cocci
Bacilli

Create a Microbial Contamination and Human Health Crossword Puzzle

Create a short clues for each of these terms such that the key term is the answer to the short question in crossword puzzle format. The questions can be based on the definitions or word plays or both. Again additional key terms can be added to the list and new clues created.

Microbe
Bacteria
Virus
Protozoa
Fecal Oral
Norwalk Virus
Hepatitis A
Cryptosporidium
Giardia
Gastroenteritis
Hepatitis
Cholerae
Giardiasis
Staphylococcus aureus
Escherichia coli (E Coli)
Vibrio cholera
Vibrio vulnificus
Coliform Count
Shigella
Salmonella typhi
Schistosoma
Adenovirus
Poliovirus
Entamoeba histolytica
Fecal coliforms
Guinea worm
Adenovirus
Cocci
Bacilli

Using the following publicly available Websites, create your own **Microbial Contamination and Human Health Crossword Puzzle**. The puzzle must incorporate all of the key terms listed above

Crossword Puzzle Creation Websites:

Free and Shareware Puzzle making software

<http://www.qualint.com/worksheets.html>

<http://mywebpages.comcast.net/saweyer/z/crozzword.htm>

<http://www.crauswords.com/>
<http://www.varietygames.com/>
<http://www.puzzlexpress.com/>
<http://www.alsoftpublishing.com/>
<http://www.crosswordkit.com/>
<http://www.x-word.com/>
http://www.smartcode.com/cwk_scr.htm