A PILOT DVD PROJECT

DON'T JUDGE A MICROBE BY ITS SIZE

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Title: Don't judge a microbe by its size
HHMI Lecture: 2000 and beyond - confronting the microbe menace (December 1999)
Course: Biology 1; Anatomy & Physiology; Integrated Science
Goals: To impart to the student an understanding of the relative sizes of various bacteria and viruses; students will correctly use size conversion factors and scientific notation. Students will also learn about the modes of transmission of various microbial diseases, as well as their symptoms and possible treatments.
Standards: National Standards Use technology and mathematics to improve investigation and communication (p.175) The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled or cured (p.197)
Objectives: Students will explore various microbial diseases. They will be able to visualize the size difference between various viruses and bacteria and will be able to convert from nanometers to micrometers to meters, and be able to use scientific notation.

Activity A: Disease diorama

Time Frame: Two hours or homework

Materials List:

DVD sections: lecture 1: 13-31 (viral disease); lecture 2: 12-30 (bacterial diseases). Lecture 3: 8-23; Lecture 4: 22-32
Markers, shoebox (baby shoe preferred), construction paper, scissors, crayons, glue sticks, glitter, various art supplies.

Teacher directions:

After watching the DVD the discussion should include the following topics: What are viruses? How do they affect other cells? Which cells are affected? How do we know the shapes of viruses? Are viruses living? How do they interact with bacteria? What is the difference between bacterial and viral disease?
Students will choose either a bacterial or viral disease and begin to design an informative shoebox diorama. Students can begin their project with library and Internet resources. Suggested diseases are listed in the attachment (Infectious Diseases)
The box should be designed as follows:

1. Top of box	Name of disease, cause of disease
2. Front of box	Mode of transmission
3. Back of box	Symptoms
4. Bottom of box	Treatment/name/per./date/teacher

The student should complete the design in a creative and original way.

Levels: This activity can be used at all levels.

Evaluation:

Scoring Rubric

1. Name of disease	5 pts
2. Creative gimmick	35 pts
3. Cause: accuracy/creative illustration	20 pts
4. Symptoms: accuracy/creative illustration	20 pts
5. Treatment-accuracy/creative illustration	20 pts

REMEMBER: BE CREATIVE, ACCURATE, AND ORIGINAL AND HAVE FUN !!!

Activity B: Sizing up microbes

Time Frame: Two hours

Materials list: DVD sections: lecture 1: 10-14; lecture 2: 5
Rulers, meter rule, cash register rolls or large rolls of paper, clay, cardboard, tape, glue.

Teacher directions:
Conversion of units and scientific notation should first be discussed. Students should be able to fill in the attached table (see attachment Table 1) with the correct scientific notation. They can make a linear model using cash register rolls for poliovirus, HIV, E.coli and human skin cell. More advanced students should be able to figure out the volume of the organism and make a scale 3-d model of at least one virus and one bacteria. Suggestions for the shape and dimensions of the models are given with the attached table (Table 1A).

Levels: Level 2 and 3 students can fill in the table. Level 2 students can make a linear model. Level 3 students can make a 3-d model.

Evaluation:
Students should be assessed on the accuracy of their answers. Level 2 students should be assessed on the accuracy of the linear model. Level 3 students may be assessed on the accuracy and creativity of their models.

Extensions
Students may do their own research on the shapes and sizes of other viruses and bacteria, and their importance to humans.

Websites: www**.microbeworld.org**

INFECTIOUS DISEASES

Syphilis	**Rubella**
E. coli bacteria	**Hepatitis**
Tobacco mosaic virus	**Ebola virus**
Polio virus	**Hantavirus**
Influenza virus	**Ross river virus**
Herpes virus	**Mononucleosis**
HIV virus	**Herpes simplex**
AIDS	**Adenovirus**
Anthrax	**Botulism poisoning**
Tetanus	**Shingles**
Typhoid fever	**Mumps**
Pneumonia	**Colon cancer**
Spinal meningitis	**Prostrate cancer**
West Nile Virus	**Breast cancer**
German measles	**Bubonic plague**
Pertussis	**Malaria**
Diphtheria	**Rabies**
Measles	**Lyme disease**
Gonorrhea	**Chicken pox**
Smallpox	**Common cold**

TABLE 1 (student)

Cell type	Diameter µm	Diameter nm	Diameter mm	Dia – sci. notation (m)	Length	Shape	Volume
Human skin cell	15				15 µm	Cube	
Human erythrocyte	10					Flattened disk	
E.coli bacteria	2				4µm	Cylinder	
Tobacco mosaic virus	0.02				0.05µm	Cylinder	
Polio virus	0.02					Polyhedron	
Influenza virus	0.1					Polyhedron	
Herpes virus	0.2					Polyhedron	
HIV virus	0.1					Polyhedron	

TABLE 1A

Cell type	Diameter µm	Diameter nm	Diameter mm	Dia – sci. notation (m)	Length	Shape	Volume (μm^3)
Human skin cell	15	15,000	0.015	$1.5x10^{-5}$	15 µm	**Cube**	3375
Human erythrocyte	10	10,000	0.010	$1.0x10^{-5}$		**Flattened disk**	523
E.coli bacteria	2	2,000	0.002	$2x10^{-6}$	4µm	**Cylinder**	12.5
Tobacco mosaic virus	0.02	20	0.00002	$2x10^{-8}$	0.05µm	**Cylinder**	0.000016
Polio virus	0.02	20	0.00002	$2x10^{-8}$		**Polyhedron**	0.0000042
Influenza virus	0.1	100	0.0001	$1x10^{-7}$		**Polyhedron**	0.00052
Herpes virus	0.2	200	0.0002	$2x10^{-7}$		**Polyhedron**	0.0042
HIV virus	0.1	100	0.0001	$1x10^{-7}$		**Polyhedron**	0.00052

N.B. For the purpose of calculating volume, the polyhedron can be approximated to a sphere, and the formula to obtain volume would be: $4/3\ p\ r^3$, where r is the radius (diameter/2).
For the cylinder the volume would be: $p r^2 h$, where h is the length and r is the radius (diameter/2)
For a cube it would be the length cubed.

To make a model comparing length (diameter) use poliovirus, HIV, E.coli bacteria and human skin cell.
Suggested scale: poliovirus: 0.2 cm (2mm); HIV : 1cm; E. coli: 40 cm; human skin cell: 150 cm.

For 3-d models: HIV: radius = 0.5cm (use modeling clay – circumference of sphere will be about 3 cm)
E.coli: cylinder with radius 10cm and length 40 cm
Human skin cell: cube 150cm x 150cm x 150 cm