Lesson !

Modeling a Molecule

Level: 9th grade and up

Correlation
The Way Life Works Chapter 1, p. 11. Ch 3 pp. 74-75, pp. 88-89. Chapter 6, p. 154
CD of graphics
National standards
LS K-12
LS E technology
LS G

Purpose:
To emulate the scientific process skills (observing, communicating, predicting: Based on observations measurements and inferences about relationships, inferring, defining operationally while manipulating physical models

To discover and describe how models are similar and different from their real prototypes in:
1. Size
2. Complexity
3. Materials
4. Accessibility
5. Energetics/ functionality

To describe what models can be useful for:
1. visualizing
2. testing
3. predicting

Background

Benchmarks for Science Literacy devotes considerable attention to the role of models in science and learning. The following skills have been drawn largely from Benchmarks for Science Literacy. To be skillful in the use of models, students must learn to:
Recognize the similarity between models and the things they represent. Examples of activities appropriate for different age levels from K - 12 include:

- discussing how dolls, stuffed animals, toy cars and model airplanes are like or unlike the real things;

- talking about how the things they play with relate to real things in the world (in this regard, imaginative conversation is better than getting the "right" answer);
- reflecting upon how graphs and other mathematical concepts relate to nature;
- recognizing what is and is not a model.

Assess the limits of a model in accurately describing and predicting the behavior of the real thing it represents. Examples of activities appropriate for different age levels include:

- comparing objects, drawings, and constructions to the things they portray or resemble;
- modifying models and discussing their limitations in predicting how the real thing would change;
- discovering the limits of reduced scale models because of many reasons, including that some factors change more than others;
- using computers for graphing and simulations that compute and display the results of changing factors in the model.

Create their own models to explain things they cannot observe directly. Examples of activities appropriate for different age levels which are prerequisites for being skillful at creating models of their own include:

- getting to know about materials, things, and processes in the accessible world around them through direct, hands-on experience;
- acquiring images and understandings that come from drawing, painting, sculpting, playing music, acting in plays, listening to and telling stories, reading, participating in games and sports, doing work, and living life;
- imagining that something they do not understand is in some way like something that they do understand;
- learning how to create different types of models in many different contexts.

Use models in many different contexts to gain new knowledge. Examples of activities appropriate for different age levels include:

- testing their own models and changing them as more information is acquired;
- using conceptual models to suggest interesting questions;
- carrying out an experiment with a model that is not possible or practical to do with the real thing; (mutation)
- identifying the kinds of conclusions you can draw from experiments with models.

Time: One 50 minute class period

Materials:

Per teacher

Overhead or digital image of scale graphic

Per cooperative group of 3-5 students

One familiar model (airplane, train, car, heart, cell, solar system, Earth globe)

One double helix model

Per student

Observation (Interactive) Notebook
Activity sheet: Observing a Model
Graphic: From Atoms to Organisms
Fact sheet

Procedure:

- Place one familiar model on each group table (save the double helix models for later). Give each student a copy of the observation questions. Have students answer the observation questions in their notebooks.

- When students have answered the questions, have a spokesperson from each group share with the class what that group found surprising, interesting, or useful in their observations of the model.

- Give each group the double helix model and each student the fact sheet and the graphic: From Atoms to Organisms.

- Have students determine where on the graphic their helix would fall. (molecular structure)

- Have students answer the question: Why might this molecular model be useful?

Important terms:

Scale
DNA
Physical model
function
accessibility
manipulability

Activity Sheet
Observing a Model

Observe the model at your table. Discuss the following questions with your team as you answer them in your notebook.

What does this model represent?

Why are you looking at a model rather than the real thing?

How does the model compare in size to the real thing? (do we want to quantify)?

Make a list of all the ways the model is different from the real thing.

1. size (see the scale graphic attached)
2. complexity
3. function
4. accessibility
5. how it can be handled

Does it have all the parts the real thing has?

What parts are missing?

Why do you think those parts are missing?

What makes it move?

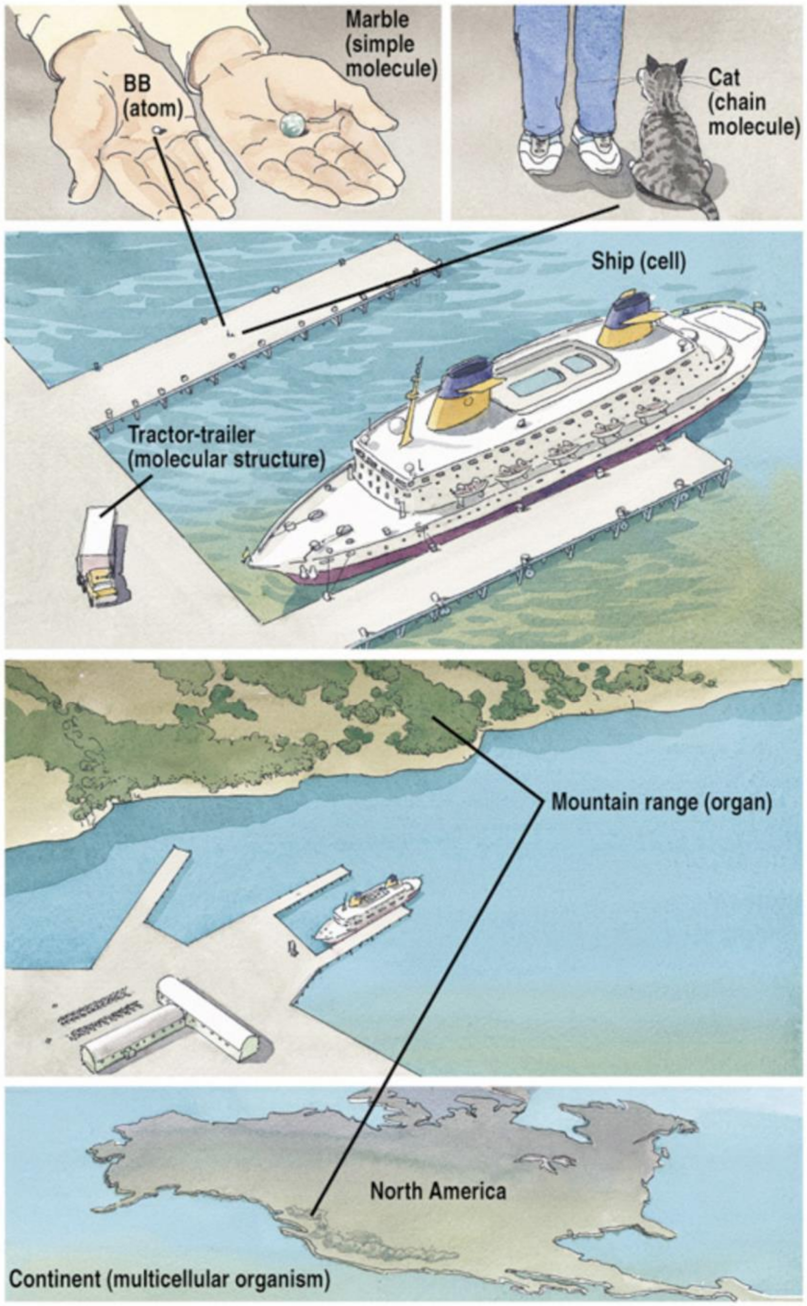
In what ways does it work like the real thing?

(Would the model be easier to make than the real thing)

In what ways is it easier to use this model than to use the real thing?

Can you make this model do most of the things the real thing can do?

Comparing Sizes



Fact Sheet

Scale

If DNA in a single human cell were the size of the model (.5 meters X 10cm wide) X 3 billion pairs (c. 30,000 genes) it would be 93 million miles long)

The average cell in our body is about 50 micrometers (0.05mm) in diameter.

From: info@KnowledgeNews.net by Michael Hunick and Christina Carton July 20, 2006
If just one of the 10 to 100 trillion cells in your body were the size of a baseball park, the average bacterium wouild be the size of a pitcher's mound, and the average virus would be the size of a baseball.
You can see bacteria through a microscope that magnifies them 1000 times virus 1 million times

From: Cell Parts Howstuffworks

Your body is made of about **10 trillion cells**. The largest human cells are about the diameter of a human hair, but most human cells are smaller -- perhaps one-tenth of the diameter of a human hair.
Run your fingers through your hair now and look at a single strand. It is not very thick -- maybe 100 microns in diameter (a micron is a millionth of a meter, so 100 microns is a tenth of a millimeter). A typical human cell might be one-tenth of the diameter of your hair (10 microns).

Look down at your little toe -- it might represent 2 or 3 billion cells or so, depending on how big you are. Imagine a whole house filled with baby peas. If the house is your little toe, the peas are the cells. That's a lot of cells!

Bacteria are about the simplest cells that exist today. A bacterium is a single, self-contained, living cell. An ***Escherichia coli*** bacterium (or ***E. coli*** bacterium) is typical -- it is about one-hundredth the size of a human cell (maybe a micron long and one-tenth of a micron wide),

Inside a bacterium there are about 1,000 types of enzymes (proteins). All of the enzymes float freely in the cytoplasm waiting for the molecule they recognize to float by. There are hundreds or millions of copies of each different type of enzyme, depending on how important a reaction is to a cell and how often the reaction is needed. These enzymes do everything from breaking glucose down for energy to building cell walls, constructing new enzymes and allowing the cell to reproduce. Enzymes do all of the work inside cells.

MATH Exercise
http://www.ugrad.math.ubc.ca/coursedoc/math100/notes/zoo/cell.html **Cell Size and Division or How Big Would You Want To Be If You Were A Cell**