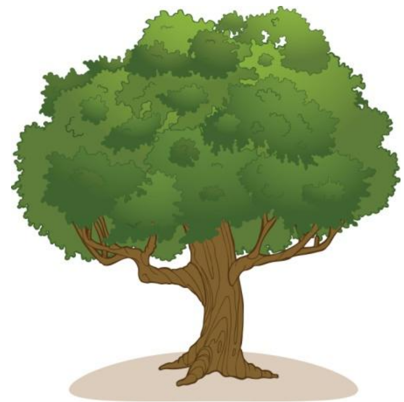
Biodiversity Big and Small



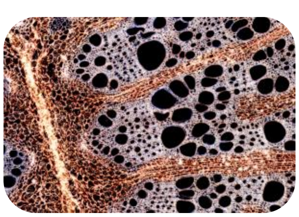
Principle of Plant Biology #7
Plants exhibit diversity in size and shape ranging from single cells to gigantic trees.

Imagine giving directions to someone who doesn't understand the size relationships between rooms, houses, streets, neighborhoods, and towns. They might be able to memorize your directions, but they wouldn't be able to follow them. On the other hand, someone who understands simple size relationships can learn and utilize information relatively easily. This is certainly true for understanding plants.

Try to remember the following levels of biological organization, listed from smallest to biggest: atoms, molecules, organelles, cells, tissues, organs, organisms, populations, ecosystems, and the biosphere. The first letter of each spells "AMOCTOOPEB," which might help you keep things in order. Each size category consists of the ones before it. For example, a cell consists of organelles, molecules, and atoms, just as a neighborhood consists of streets, houses, and rooms.

The sizes and shapes of plant forms illustrate two important themes of Biology. First, form relates to function. In other words, the shape of something in a living system usually relates to its function. We intuitively know that form relates to function on the level of organisms (i.e. the shape of a leaf allows it to collect sunlight), but this is also true for molecules, cells, and other levels. Second, there is tremendous biodiversity at every level. A plant has thousands of different types of molecules, dozens of cell types, and unique adaptations on the level of tissues and organs. It also has innumerable relationships with other organisms within ecosystems and the biosphere. Therefore, every plant represents millions of unique units of biodiversity. There is diversity at every level of life – biodiversity big and small!

In the following activity, you will make connections between the form and function of plants in a natural ecosystem.



Real-world Connection:
Plant forms have inspired many human creations in art, architecture, engineering, and product design.

Activity: Form and Function

Procedure:

1. Go to a natural area. [Alternatively, your teacher may provide plant material.]

2. Find and draw as many different plant forms as you can find. A "form" might be a whole plant, a large part of a plant, or a tiny (even microscropic) piece of a plant. If microscopes are available, use them! Record observations in the table below.

3. Note the function of each form. For example, if you draw a leaf, you could note that it is flat to maximize surface area for photosynthesis. For those that you're not sure about, make a hypothesis.

Observations:

<u>Form (pictures)</u>   <u>Function (hypotheses)</u>

Invention!

Consider the practical applications of at least 3 of the forms you observed. How might human society use a similar form? Feel free to be creative and invent something.

1.

2.

3.

Student-Designed Experiments

Using the methods you learned in the activity above and the "Guide for Student Experimentation" below, design and carry out your own inquiry. Question topics you might consider include comparing structures between different plants, comparing plant structures in different ecosystems, testing your hypothesis about the function of a plant structure, etc.

Guide for Student Experimentation

Guidelines for Achieving Great Experiments

1. Ask a very specific, testable question.
2. Test a control for comparison (a group that does not receive the experimental treatment).
3. Use a sample size large enough to allow firm conclusions.
4. To understand a whole population, obtain a random sample of that population to avoid bias.
5. Replicate each part of the experiment (at least 3 times).
6. Hold all variables constant between trials except the variable being tested.
7. Collect quantitative data whenever possible.
8. Measure using metric units.
9. Gather data carefully and accurately.
10. Be objective and honest.

Introduction

Question:

Hypothesis:

Materials and Methods

Independent variable:

Dependent variable:

Experimental constants:

Control:

Protocol:

Results

Data collected:

Other observations:

Graph(s):

Discussion

Interpretation of data:

Conclusions:

Teacher's Guide to
"Biodiversity Big and Small"

Links to National Science Education Standards

Grades 5-8:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry
- Structure and function of living systems
- Diversity and adaptations of organisms
- Science and technology in society

Grades 9-12:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry
- The cell
- Matter, energy, and organization in living systems
- Science and technology in local, national, and global challenges

Materials

- Rulers (optional, but useful)
- Microscopes (optional, but useful); magnifying glasses are also useful
- If no natural area is available, then a variety of plant materials are needed. Bring in a variety of plants and/or plants parts which can be dissected.

Teaching hints

1. Push students to investigate forms that are both big and small. The microscopic world is likely to be more interesting and surprising to students.

2. Successful student-designed experiments:

- Emphasize the "Guidelines for Achieving Great Experiments."
- Before students design experiments, tell them how much time they will have.
- Allow students to present their experiments and lead a short discussion about each one. Encourage other students to ask questions.

Acknowledgements

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