Enough is Enough

Overview: Students conduct experiments to examine how excessive amounts of necessary resources affect plant growth.

Time:
Groundwork: 30 minutes
Exploration: 40 minutes setup; 4 weeks ongoing explorations
Making Connections: ongoing

Materials:
- fertilizer
- potting mix
- seeds (beans, marigolds, cucumbers, or radishes)
- 4- or 6-inch pots
- "Problem Solving for Growing Minds" reproducible, page 283
- "Observation Journal" reproducible, page 286

Background: Page 39

Laying the Groundwork

Objective: To consider how even healthy things, in excess, might be harmful to humans and plants.

1. Set the stage by asking students if they think one can have "too much of a good thing." Have small groups of students each generate a list of three things that are good for us in smaller doses, but harmful in larger amounts. To stimulate thinking, ask: What do you think might happen if you breathed twice as much air, ate twelve meals a day, or played baseball for twelve hours? Ask each group to share their ideas to be added to a class list.

2. As a class, consider how this concept might apply to plants. Make a list of things that are good for plants, but that students think might be harmful in excess.

Exploration

Objective: To conduct an investigation and recognize that excesses of certain necessary resources can be harmful.

1. As a class discuss which factors, generated in Step 2 of Laying the Groundwork, you'd like to test. Using the Problem Solving for Growing Minds process, page 10, decide how you'll set up a class investigation. Nutrients and water, given to plants in excess, will yield the most dramatic results in the GrowLab. The sample experiment described uses nutrients, in the form of fertilizer, as the experimental variable.
Question: How will an excess of nutrients affect bean plants?

Group A
No fertilizer

Group B (control)
Recommended dose of fertilizer

Group C
2x recommended dose

Group D
10x recommended dose

Just budding in: When doing this experiment, use whichever fertilizer you’re already using in the GrowLab. Although most fertilizer directions recommend a dose every two weeks, many classroom teachers find it easier to use the recommended amount every time they water. So, in this setup, the control group (B) would receive the recommended dosage, Group C, 2x the recommended dosage, and Group D, 10x the recommended dosage, every time the plants are watered.

2. As a class, brainstorm a list of observations you’ll make and record on the “Observation Journal” reproducible - for example, average height of plants per pot, tallest plants per group, leaf color, number of leaves, and/or size of leaves.

Consider having students work in small groups, each taking responsibility for observing two factors. Remind groups they’ll be responsible for collecting and presenting information to be used by other class members.

3. After four weeks, each group of record keepers should prepare and present their findings to the rest of the class. Encourage reporting that allows findings to be compared at a glance. See “Create-a-Chart,” page 287, for suggestions. Display these results around the room. An example follows.

Don’t Drown Me!

To teach younger students that too much of a good thing can be harmful, try an exploration using water. Since a big problem facing many classroom plants is overzealous waterers, this exploration will hopefully result in healthier GrowLab plants in the long run.

Engage students by asking them to consider their own water needs and how they’ve felt when they’ve had too much or too little to drink. Ask: How would you feel if I gave you each a gallon of water and told you to drink it before you went home today, whether you were thirsty or not?

Set up a simple experiment with three small plants (bean, cucumber, marigold, or tomato) as illustrated. Make daily observations for two weeks.

Pot A
1 T. water per week

Pot B
(control)
water as needed

Pot C
Leave pot in bowl of water

Discuss whether all plants need the same amount of water. Ask: Have you observed some GrowLab plants that need more water than others? Can you name some types of plants that require very little water (e.g., cactus)?

Too much water can be as harmful to plants as too little water. Overwatered plants may be yellow, stunted, and may die. Practice how to tell when plants need water, as described on page 47 of GrowLab: A Complete Guide to Gardening in the Classroom.

Average size of leaves
Many people refer to the mineral nutrients given to plants in the form of fertilizer as plant “food.” In reality, green plants produce their own food during photosynthesis using light energy. The nutrients in the fertilizers we use are more analogous to the minerals needed by humans to help our bodies grow, repair, and function properly.

What to Expect: Plants receiving a shortage of nutrients, particularly nitrogen, tend to look pale, yellow, and/or stunted. An extreme excess of nutrients also has a number of observable effects, again primarily related to the excess of nitrogen. Too much nitrogen will result in a dark green leaf color and will promote unnaturally rapid, lush foliage growth at the expense of flower development. Because the plants grow so rapidly, they may appear leggy and develop thin, weak cell walls and stems. This encourages pest and disease problems (aphids love high nitrogen levels!). An extreme excess can kill the plant.

An excess of water is one of the most common causes of unhealthy plants in classroom gardens. Too much water can result in stunted, yellow plants, rotting roots, mold growth and, ultimately, the death of the plant.

Making Connections

1. As groups compare their data, ask:
   - How did an excess of this basic necessity seem to affect the plants?
   - How did your results compare with your original predictions?
   - What signs tell you when you’re getting too much of a good thing?
   - Has this activity given you ideas about how to be a better gardener?
     What are they?

2. Have groups reflect on their experiment by making a list of all the things, other than the experimental factor, that might have affected their results (e.g., unequal watering or different distances from lights).

Branching Out

- Research and experiment with the effects of specific nutrient deficiencies. Use fertilizers with one major nutrient missing.
- Experiment by giving plants an excess of a different necessity (water, CO₂, fertilizer, light).
- Experiment to determine specifically how much fertilizer, beyond the recommended dose, will result in the death of bean plants.
• Research "organic" fertilizers and conduct experiments to compare them with synthetic fertilizers.

• Set up a series of jars containing pond water and different levels of fertilizers. Observe the differences in algae growth. Find out about eutrophication (see "Dirty Waters" sidebar).

• Given the recommended dose of fertilizer and your average rate of watering, calculate how much fertilizer you would need for a week, a month, and a year of indoor gardening.

• In small groups, create poems, songs, skits, or pictures expressing how you might feel if you experienced "too much of a good thing"—if you were set loose in a candy store, for example, or if you were a plant that had been overwatered. Or write about your own personal experiences of getting "too much."