

## Unit 6.5

### “Grow Baby Grow”:

# The Factors that Influence Individual Growth

## Unit Overview

### Unit Summary

Students examine how environmental conditions, resource availability, competition, and genetics affect organism growth and reproduction (MS-LS1-5, MS-LS2-1). Students replicate an experiment to understand the impacts of these factors on plants grown in the classroom and to model good scientific practice when an experiment provides unexpected results. Students practice developing predictions and making claims supported by evidence and reasoning.

This unit explores the main factors that determine how individual plants and animals grow. Students will leave this unit with a basic understanding of what an organism needs to maximize its growth. They will be able to explain in general how to maximize an organism's growth, and see tradeoffs between maximizing individual organism growth vs. production per unit area.

### Unit Challenge Questions

- What affects how plants grow?

### Unit Big Ideas

- The growth of organisms is affected by multiple things, including:
  - environmental conditions
  - resources available
  - how those resources are shared by individuals
  - the organism's breed

## Connection to 21<sup>st</sup> Century Issues

Humanity's growing population requires more and more food grown to sustain itself. This need often comes into conflict with a desire to conserve rainforests, rivers, and other ecosystems, which are often either converted to farmland, or negatively-impacted by nearby farming.

One approach to resolve this conflict is called land-sparing agriculture. The goal of land-sparing agriculture is to maximize the amount of food that is produced by each acre of farmed land. This minimizes the area of farms needed to meet humanity's needs, and leaves more land untouched by farming.

For this approach to work, farmers, managers, and policy makers all require a deep knowledge of what the plants and animals need to grow. Organisms need to be matched to the environmental conditions and provided the resources needed to grow their absolute best. This takes a lot of research to determine both the conditions under which these organisms need to grow their best, as well as the conditions in each area being farmed.

Additionally, some crops like salad greens, may benefit from being grown indoors. By developing plants with the right genetics, and providing appropriate conditions and resources, large amounts of food could be grown in a very small footprint. By moving the farm indoors, crops can be grown near the people who will actually eat it, rather than needing to be trucked in. This also frees up more farmland for other crops or conservation.

This unit introduces students to the general principles that determine an individual organism's growth namely environmental conditions, resource availability, competition and genetics. These principles can be applied to any situation where we want to maximize an organism's growth, whether that is through land-sparing agriculture, growing the perfect golf fairway, or growing fresh food on the International Space Station.

## Unit Challenge

### Unit Challenge Summary

Students help replicate an experiment designed to test the factors that affect a plant's growth after the Unit Challenge's protagonist gets an unexpected result. Students explore the conceptual underpinning of the experiment to ensure that the predictions are based on

sound science, collect and analyze their own data, and then finally troubleshoot the initial experiment to identify what led to the unexpected result.

### **Unit Challenge Scenario**

NASA is holding a science fair competition and the prize is a trip to space camp. Olivia plans to compete with her idea to spice up astronauts' meals on long space voyages.

Due to the low gravity in outer space, astronauts are often congested. This makes it hard for astronauts to taste their food. Olivia wants to wow the competition judges with her designs to grow mustard plants. These plants have been bred to grow indoors and produce lots of seeds very quickly. Her plan is to eventually design a system to grow lots of these plants. Their seeds can then be used to make mustard (the condiment) or to make flavorful curry sauces, adding an extra kick to the astronauts' meals.

Olivia designed an experiment to test how different factors affect mustard seed production. The data from this experiment will be used as evidence to support her design of a mustard farming system that would work on long space voyages. There's just one problem. She finished her experiment and she had confusing results!

First, everything took longer than advertised. Her plants grew about 30% slower than they were supposed to. Then it got even more confusing at the end when she analyzed her data! She had predicted that some plants would produce fewer seeds. But some of her plants ended up making about the same number of seeds!

She has done a thorough review of her experiment, and she still can't figure out why her results were so different from what she expected. Were her thoroughly-researched predictions actually incorrect, or did something else go wrong?

She knows that sometimes in science our predictions don't match our results, and that we should repeat our experiment when we can't figure out why that is. Unfortunately, her family is sick of her growing setup taking up the kitchen table. They are done with her plant growing for at least a year.

Can you help her by repeating the experiment and identifying everything that should happen in the experiment?

| Lesson Sequencing Table |                                                                                                                                                                             |                                                                                                                                                                          |        |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Lesson #                | Lesson Questions                                                                                                                                                            | What students do...                                                                                                                                                      | # days |
| 1 (opener)              | <ul style="list-style-type: none"> <li>What affects how plants grow?</li> </ul>                                                                                             | Students express their current understanding of plants and seeds, and explore a typical flowering plant's life cycle.                                                    | 2-4    |
| 2                       | <ul style="list-style-type: none"> <li>How does the environment affect plant growth?</li> </ul>                                                                             | Students discover that organisms have a range of environmental conditions within which they grow best.                                                                   | 3-4    |
| 3                       | <ul style="list-style-type: none"> <li>How do resources like fertilizer affect plant growth?</li> <li>Does adding resources always allow organisms to grow more?</li> </ul> | Students investigate how resources and resource limitation affects growth.                                                                                               | 3-5    |
| 4                       | <ul style="list-style-type: none"> <li>How does the number of organisms in a space affect their growth?</li> </ul>                                                          | Students discover how competition for resources can affect individual growth.                                                                                            | 4-6    |
| 5                       | <ul style="list-style-type: none"> <li>What causes an organism to grow differently given the same environment?</li> </ul>                                                   | Students explore how genetic factors, namely breed, determine the growth of organisms.                                                                                   | 3-4    |
| 6 (closer)              | <ul style="list-style-type: none"> <li>What affects how plants grow?</li> </ul>                                                                                             | Students collect and analyze data from their experiment and use this data to support their predictions. Students also identify the source of Olivia's unexpected result. | 4-6    |