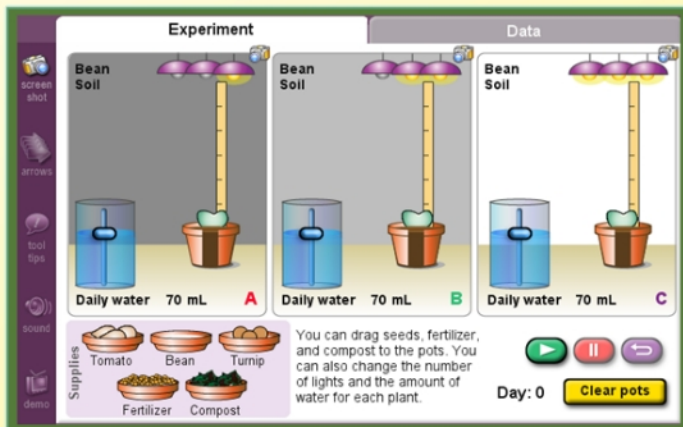


ExploreLearning is your partner in implementing the Next Generation Science Standards. Gizmos allow students to engage in inquiry-driven scientific investigations that fulfill the goals of the **Scientific and Engineering Practices**, **Crosscutting Concepts**, and **Disciplinary Core Ideas** described in *A Framework for K-12 Science Education*.

Science and Engineering Practices (SEP):

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Growing Plants Gizmo

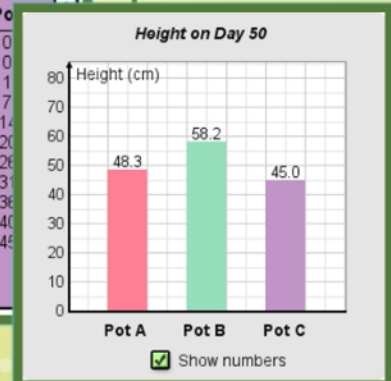


In the Growing Plants Gizmo, students can grow tomato, bean, or turnip plants. The Gizmo allows students to choose the amount of water, amount of light, and soil type. (SEP 1, 2, 3)

Plant height data (centimeters)

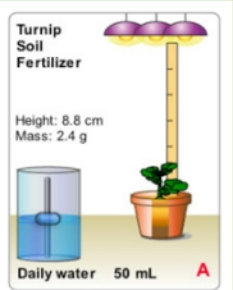
Day	Pot A	Pot B	Pot C
0	0.0	0.0	0.0
5	0.0	0.0	0.0
10	5.3	5.5	5.7
15	12.8	13.3	13.8
20	20.2	20.9	21.4
25	26.7	28.5	29.0
30	33.0	35.9	36.3
35	37.8	42.6	41.1
40	42.8	49.2	46.0
45	45.5	53.7	48.7
50	48.3	58.2	51.4

Data is displayed on tables and graphs. (SEP 4, 5, 8)



Gizmo Warm-up: Grow the Biggest Plant!

1. In the Gizmo set up the three pots however you like:
 - Choose a **seed** to drag into each pot.
 - Click on the light bulbs to turn them on or off.
 - Drag the **Water** slider up or down to set the amount of water each plant will get.
 - If you like, drag **fertilizer** or **compost** into a pot.
 - When the pots are ready, click **Play** (▶) and wait for the simulation to end.



2. How tall was your tallest plant? _____
3. Click **Reset** (↺) and **Clear pots**. Run a few more trials to grow the tallest plants you can. What conditions led to the tallest plant?

The Student Exploration Sheet leads students through a series of open-ended, inquiry-driven activities. (SEP 1 – 8)

Vocabulary: Growing Plants

Vocabulary

- **Compost** – mixed clippings
- **Fertilizer** – contains potassium
- **Mass** – the amount of matter
 - **Misconception** – went to the same, but...
- **Seed** – a small, young plant
- **Soil** – mixture of earth and organic matter
- **Variable** – a factor that can change

4. Follow-up activity: Grow your own plants (3 – 6 weeks)

After students have used the Gizmo, they are ready to grow their own plants. You will need soil, seeds, and containers such as disposable cups. You and your students can decide what plants to grow and which variables to investigate.

Scientific Background

The plant growth model used in the Gizmo was calibrated by experiments conducted by past members of ExploreLearning and their families. The model was designed to be as realistic as possible:

- Plants in the Gizmo require light and water to gain mass. In the process of photosynthesis, plants use the energy of light to convert carbon dioxide and water to simple sugars. These sugars are linked into more complex molecules to form leaves, stems, and roots. Without adequate light and water, plants will not be able to gain mass.



The Vocabulary Sheet and Teacher Guide complement the Student Exploration Sheet. The Teacher Guide provides supplementary activities, scientific background, and additional resources. (SEP 1, 2, 3, 8)

"I have seen no other program out there that can demonstrate student improvement in math and science as effectively as does Gizmos. As science professional development coordinator for Western Arkansas, I am sold on their program. As you endeavor to implement the NGSS, you will find no better tool for your educational toolbox than Gizmos."

— Science Specialist, Westen Arkansas ESC

Gizmos support Crosscutting Concepts and Disciplinary Core Ideas

The Next Generation Science Standards are based on a framework of **Crosscutting Concepts** and **Disciplinary Core Ideas**. At ExploreLearning.com, educators will find hundreds of Gizmos to help students develop a deep understanding of all core ideas. Gizmos also beautifully illustrate how concepts cut across different scientific disciplines, as shown in the example below.

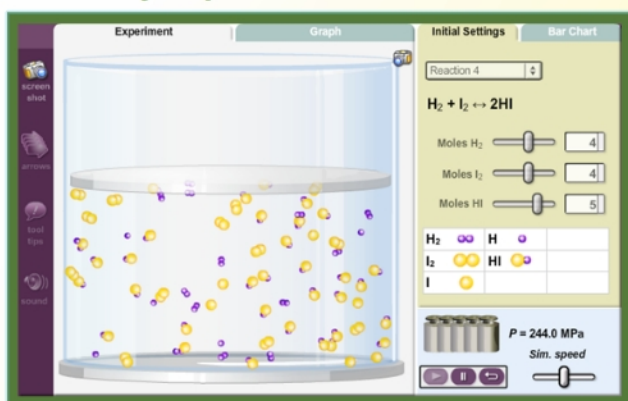
Crosscutting Concepts:

1. Patterns
2. Cause and effect: mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: flows, cycles, and conservation
6. Structure and function
7. Stability and change

Crosscutting Concept 7: Stability and Change

Stability and change is demonstrated by Gizmos in chemistry, life science, earth science, physics, and engineering:

Chemistry: Equilibrium and Concentration

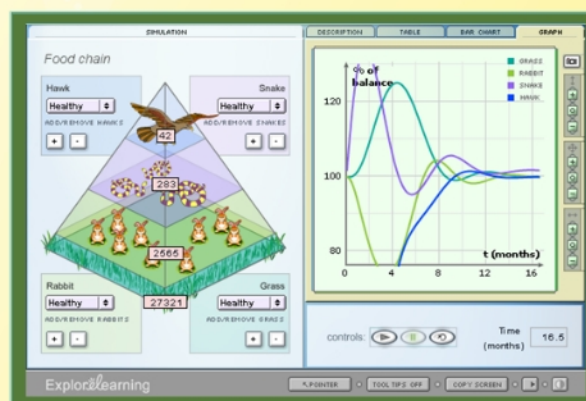


Students explore reversible chemical reactions and resulting chemical equilibria.

Targets the following Disciplinary Core Ideas:

- PS1: Matter and its interactions
- PS3: Energy

Life Science: Food Chain

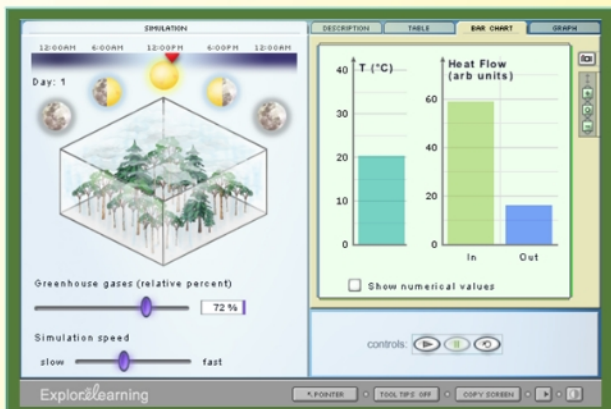


Students see how populations of producers and consumers fluctuate in an ecosystem.

Targets the following Disciplinary Core Ideas:

- LS1: From molecules to organisms
- LS2: Ecosystems: Interactions, energy and dynamics

Earth and Space Science/Engineering: Greenhouse Effect

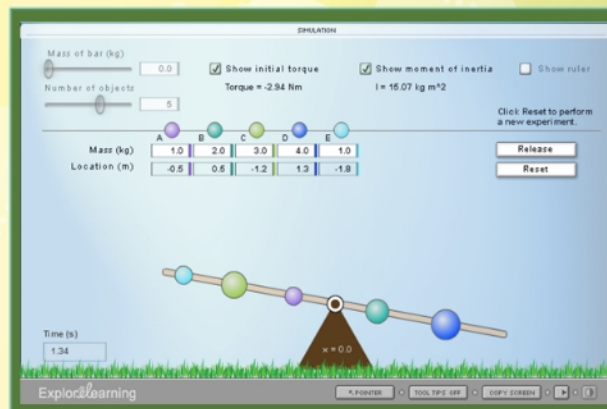


Students vary amounts of greenhouse gases and measure effects on heat flow and global temperatures.

Targets the following Disciplinary Core Ideas:

- ESS2: Matter and its interactions
- ESS3: Energy
- ETS2: Links among energy, technology, and society

Physical Science/Engineering: Torque and Moment of Inertia



Students adjust masses and a fulcrum to balance the forces on a see-saw.

Targets the following Disciplinary Core Ideas:

- PS2: Motion and stability
- ETS1: Engineering design

