

Enhancing the STEM Curriculum with Virtual Simulations

Why Teach STEM ?

“We are currently preparing students for jobs that don’t yet exist using technologies that haven't been invented in order to solve problems WE DON'T EVEN KNOW ARE PROBLEMS YET”

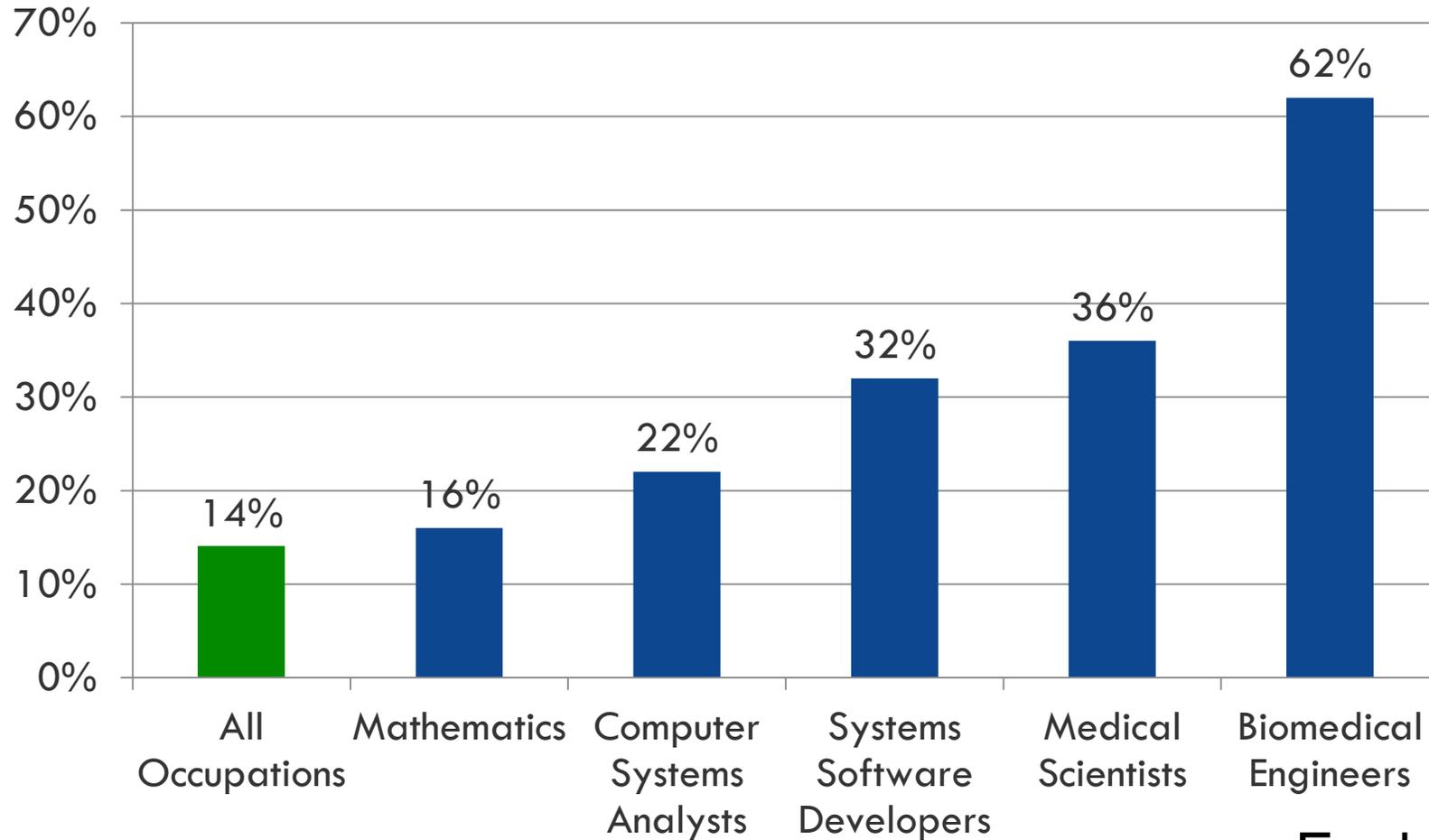
***“In the future, 75% of all jobs will be STEM related”
(US DEPT OF LABOR)***

Why Teach STEM ?

- In the next 10 years, STEM jobs will grow by 17% compared to 9.8% for all other occupations.
- Across the US, for example, for all occupations, there are 3.6 people for every 1 job. In STEM, there is 1 person for every 1.9 jobs.

STEM Education:

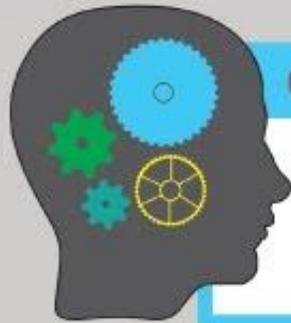
- An Important part of our global economic future



SO WHAT IS STEM ???

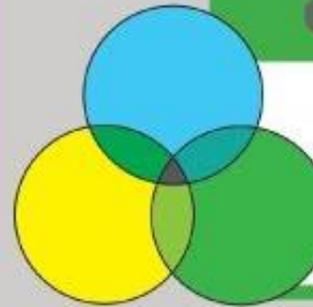
21st Century Skills

Metro 4Cs Rubric Performance Areas



Critical Thinking

- Information & Discovery
- Interpretation & Analysis
- Reasoning
- Constructing Arguments
- Problem Solving
- Systems Thinking



Collaboration

- Leadership & Initiative
- Cooperation
- Flexibility
- Responsibility & Productivity
- Collaborate Using Digital Media
- Responsiveness & Constructive Feedback

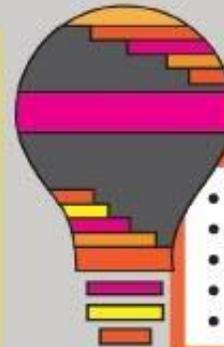


Communication

- Effective Listening
- Delivering Oral Presentations
- Communicate Using Digital Media
- Engaging in Conversations & Discussions
- Communicating in Diverse Environments

Writing to:

- Inform
- Support an Argument With Claims
- Engage and Entertain



Creativity

- Idea Generation
- Idea Design & Refinement
- Openness & Courage to Explore
- Work Creatively with Others
- Creative Production & Innovation



*Investigate
Your
Surroundings*

*Narrow
Your
Focus*

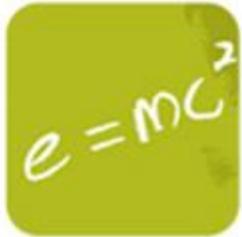
*Ask
Comparative
Questions*

*Uncover
Your
Prediction*

*Initiate
an
Action Plan*

*Research
and Data
Collection*

*Examine Results
and Communicate
Findings*



STEM

science • technology
engineering • math



Definition: A trans-disciplinary approach to inquiry and problem-based learning that fosters collaboration, creativity, and innovation in all students.

Goals of **STEM** Education

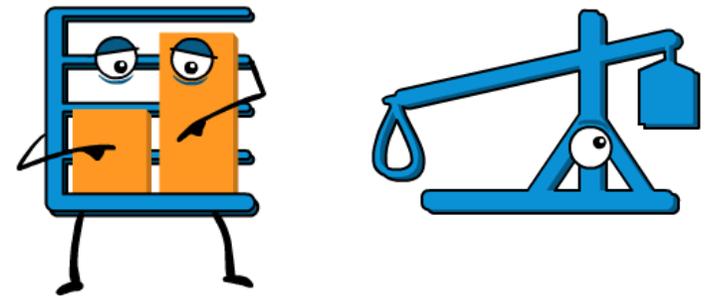
•STEM Education is designed to

- ✓ • increase student interest in STEM fields.
- ✓ • prepare students to pursue higher education.
- ✓ • educate all students to become 21st-century workers.



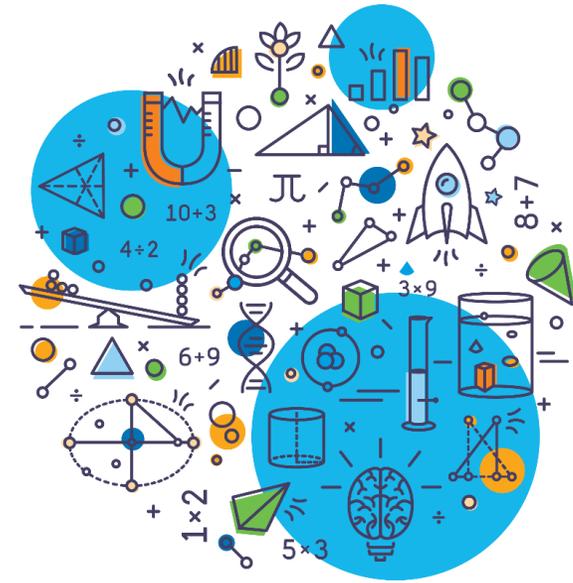
ExploreLearning designed a program that helps students develop critical thinking and problem solving skills and helps increase science and math literacy, to enable the next generation of innovators:

GIZMOS





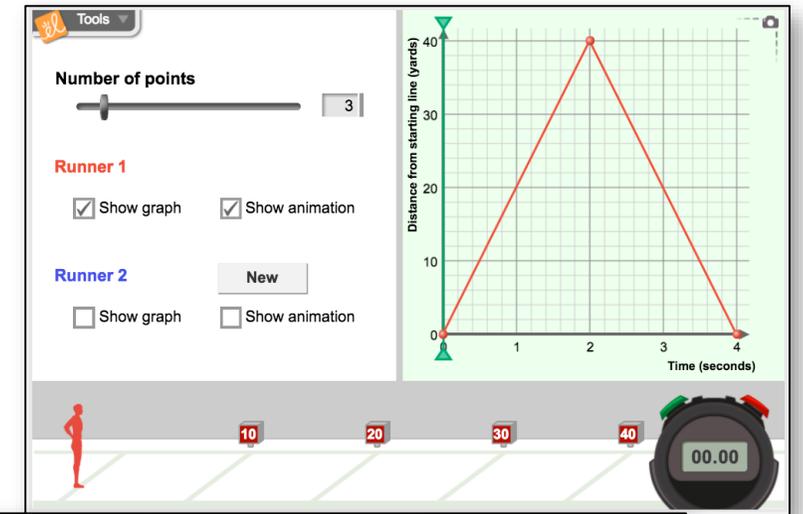
Simulations that
power
understanding



What are Gizmos®?

Gizmos are ...

- Interactive online simulations
 - For Mathematics and/or Science content and skills/processes
 - For students in grades 3-12
 - An engaging way to learn and build lasting knowledge
- ... And there are over 475 to choose from!



The screenshot shows a Gizmo interface for an algebraic expression challenge. At the top, it says 'Level 5 Challenge 18' and 'Junior Chef 259'. The main area displays an 'Expression Recipe' $\frac{1}{9} \cdot n + -13$ on a notepad. Below it, a wooden board shows the expression $\frac{1}{9} \cdot n + 3 + -16$. At the bottom, there are buttons for 'Add', 'Associate and Add', 'Associate', and 'Commute', and a 'Moves: 4' indicator.

Lesson Materials

- Correlated to the various Curricula
- Teacher Guides
- Student Exploration Sheets
- Vocabulary Sheets
- Assessment Questions

Manitoba Standards

Browse Gizmos / Province Correlations / Manitoba

Mathematics

Manitoba Curriculum

Adopted 2008:

- 3rd Grade
- 4th Grade
- 5th Grade
- 6th Grade
- 7th Grade
- 8th Grade
- 9th Grade
- Introduction to Applied and Precalculus Math
- Essentials of Mathematics: Grade 10
- Applications of Mathematics: Grade 11
- Essentials of Mathematics: Grade 11
- Pre-Calculus: Grade 11
- Applications of Mathematics: Grade 12
- Essentials of Mathematics: Grade 12
- Pre-Calculus: Grade 12

Science

Manitoba Curriculum

Adopted 1999:

- 3rd Grade
- 4th Grade
- 5th Grade
- 6th Grade
- 7th Grade
- 8th Grade
- 9th Grade
- 10th Grade
- 11th Grade Chemistry
- 12th Grade Chemistry

Explor^{el}earning
Teacher Guide: Digestive System
 Learning Objectives

Explor^{el}earning Gizmos®
 Name: _____ Date: _____
Student Exploration: Growing Plants
Vocabulary: compost, fertilizer, mass, seed, soil, variable
Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
 1. What do you think plants need to grow and stay healthy?

 2. **Soil** is a combination of tiny rock fragments and decayed plant materials. How do you think soil helps a plant?

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?

of the digestive system: digestion, absorption, and an digestive system using available organs and cells. of mechanical digestion by the mouth, stomach, and bile. cal digestion for carbohydrates, proteins, and fats. sorbed into the body.

ite, chemical digestion, chyme, complex carbohydrate, sion, enzymes, fat, fatty acid, fiber, food calorie, mechanical peristalsis, protein, starch, sugar, villus

which a s to break ly, absorb pucts.

ld happen if this sequence were changed? The Digestive p do just that! Students can arrange the organs of the measure the results. While designing their ideal system, tanding of how digestion occurs.

tains four activities:
 n their own digestive systems and measure the results.
 re mechanical and chemical digestion.
 mine how different nutrients are absorbed.
 their learning to the human digestive system.

Saliva (15 – 30 minutes)
 ractions that push food through the digestive system are rinate peristalsis, students can take turns squeezing compressing the tube from bottom to top, toothpaste is just as food is squeezed through the digestive system.

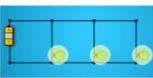
plunteers. One volunteer should stand on his or her head, is the first student's feet. Challenge the upside-down student e fact that the student can swallow water against gravity peristalsis to move food through the digestive system.

1. In the series circuit shown below, what would happen if one of the light bulbs and its attached wire segment were removed?



A. The remaining lights would go out.
 B. The remaining lights would shine with the same brightness.
 C. The remaining lights would shine less brightly.
 D. The remaining lights would get brighter.

2. In the parallel circuit shown below, what would happen if one of the light bulbs and its attached wire segment were removed?



A. The remaining lights would go out.
 B. The remaining lights would shine with the same brightness.
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 D. The remaining lights would get brighter.

GIZMOS IN ONTARIO

- Ministry funded for grade 7-12 educators
- Special STAO access during COVID-19 crisis for other grades

<http://pdblog.explorelearning.com/Ontario/>

Science and Engineering Practices

1. Asking questions and defining problems
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 and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

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

Standards for Mathematical Practices

The students will:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments.
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

How do Gizmos support your STEM curriculum?

With Gizmos, students are engaged in the practices of scientists, mathematicians and engineers in a technology-enabled learning platform.

Gizmos support the development of critical STEM Competencies including Science and Engineering practices

www.explorelearning.com



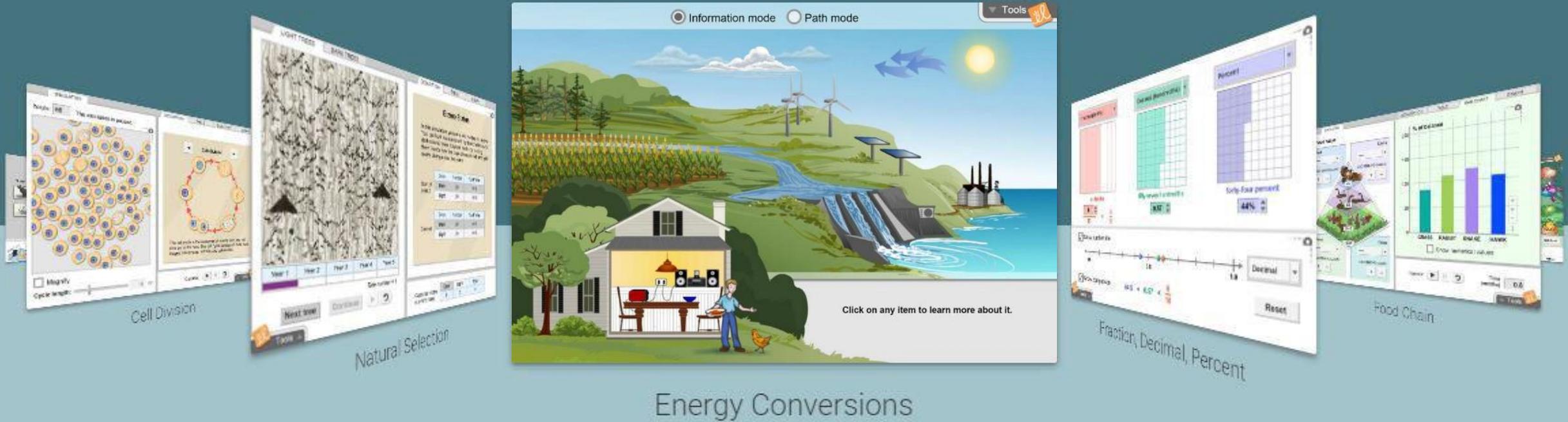
Online simulations that power inquiry and understanding

What Are Gizmos?

Sign Up Free

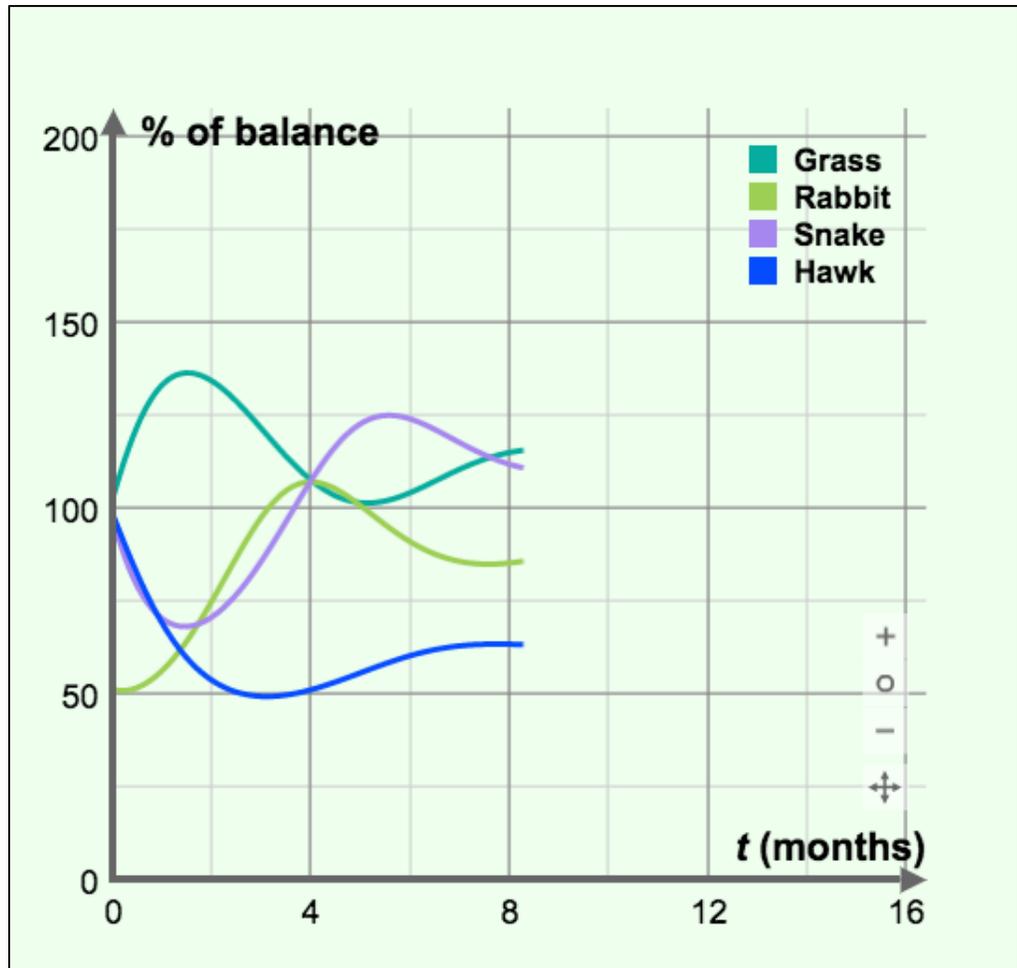


Explore a Gizmo!



www.explorelearning.com

Food Chain Task – Construct Your Argument



- What is happening to the ecosystem depicted in this graph?
- What evidence supports your answer?
- Can you predict what will happen in the next 6 months?

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HOW GIZMOS SUPPORT STEM

- Allows students to collect more data points in less time so they can be engaged in a better analysis and interpretations.
- They can run experiments under conditions that are not possible even in the most sophisticated laboratories and explore ideas and possibilities (ex: Change the gravity and start looking at how equations are affected by those changes)
- Allows students to visualize the invisible and hence better understand it (and believe it)
- Making STEM fun and interactive. Changing students Mindsets
- Allows students to interact with Math and Science and start getting a deeper understanding at the intuitive level through repetition and observation.
- With simulations, you can change misconceptions and simplify complex systems in order to better understand them

Gizmos use and reinforce the technical language of math and science which is embedded in each lesson and supports English language learners:

- ❑ Visual and experiential support connects to students' background and prior knowledge
- ❑ Varied activity levels scaffold and differentiate learning: provide students the opportunity to engage in inquiry to learn content using multiple modes of representation (e.g. discussions, pictures, models, writing, graphs, etc.)
- ❑ Connects concepts and vocabulary to real-world experiences providing a bridge to learning between languages.

Gizmos have been successfully implemented in hundreds of special education classrooms to empower students with the skills and the concepts needed to master increasingly rigorous content.

- ❑ Students work at their own pace, allowing students to repeat manipulations until they have mastered the concepts, including from home.
- ❑ participate in inclusion classrooms. Teacher resources provide teachers various levels at which to engage all students in an inclusion classroom, easily enabling modifications for students with special needs.

Gizmos can be assigned to individual students and completed independently. For gifted learners, additional Gizmos can be assigned to expand and extend learning and provide challenge.

□ A large number of lesson material include optional “Challenge” questions and extension activities targeted toward gifted learners. Additional discussion questions and follow-up activities are described in the Teacher Guides.

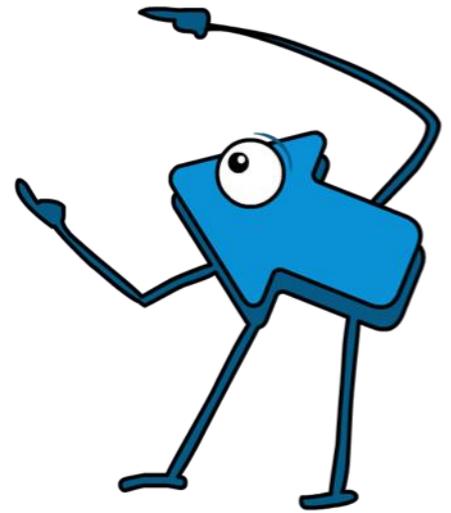
□ Gizmos allow students to discover concepts on their own rather than memorize and recall formulas. This type of learning is stimulating for all students and especially appropriate for students that seek out challenges and love to make their own discoveries. Gizmos enable students to have limitless exploration of math and science content to help enrich and challenge students performing at even the highest levels.

Best Practices for Teaching with Gizmos

- ❑ **Foster Inquiry and Discovery**
 - Permit students to ask “What if...” questions
 - Challenge students to predict outcomes
 - Use leading, probing questions to spur thinking
 - Have students construct arguments to justify their answers
- ❑ **Incorporate opportunities for thinking through writing**
 - Customize lesson materials as needed
 - Include vocabulary as part of the Gizmo lesson
- ❑ **Develop higher level thinking skills**
 - Provide scaffolding for problem solving
 - Require that students support explanations with evidence
 - Guide students to find patterns
- ❑ **Share the classroom dynamics**
 - Utilize a variety of instructional settings
 - Allow students to control the Gizmo

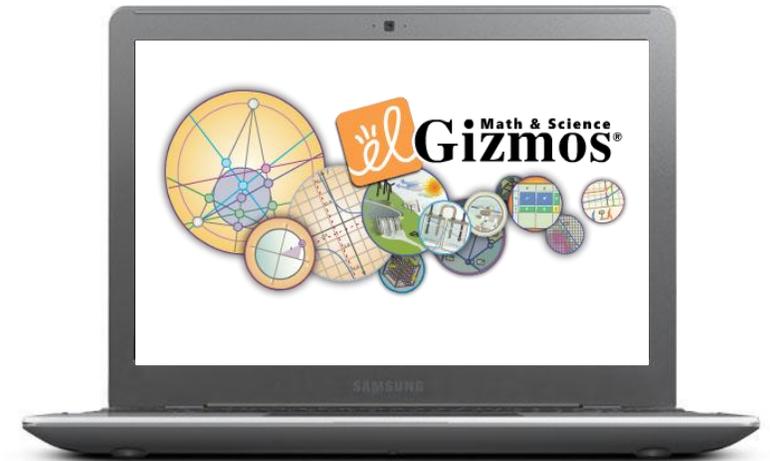
Top 3 Things to Remember

1. Use 1 activity at a time. Start small, but start! Use one Gizmo in the next two weeks. And then...
2. Collaborate!
3. Enroll your students as soon as possible.



Gizmos Technology Integration

- Whole-class instruction
 - Warmup / Bell ringer
 - Review activities
 - Introduce / debrief a lab
- Individual or group work
- Teacher website: hyperlinked access
- Online courses, blended eLearning
- Remediation, Test Prep, Credit Recovery
- Self-directed homework



About ExploreLearning



Designed *by* educators, *for* educators

ExploreLearning Reflex

Online math fact fluency solution for students in grade 2 and above

ExploreLearning Gizmos

Online math and science simulations for students in grades 3-12



GIZMOS HAVE EARNED EVERY
MAJOR ED TECH AWARD

//CODiE//
SIIA CODIE WINNER
5 Time Winner

AWARDS
EXCELLENCE
TECH & LEARNING
4 Time Winner

REVEREawards
AAPJ
6 Time Winner

ExploreLearning®

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Thank you!

