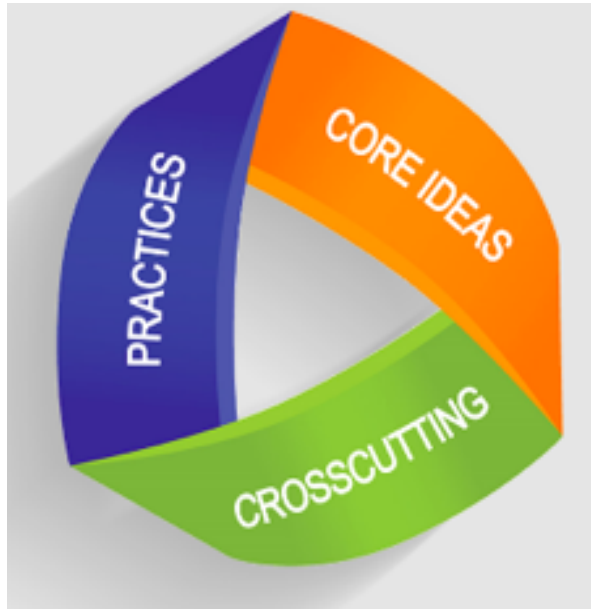


Examining the Next Generation Science Standards



Middle School



Disappearing Careers (Past)

Identify careers that have **disappeared** during your lifetime.



Disappearing Careers (Projected)



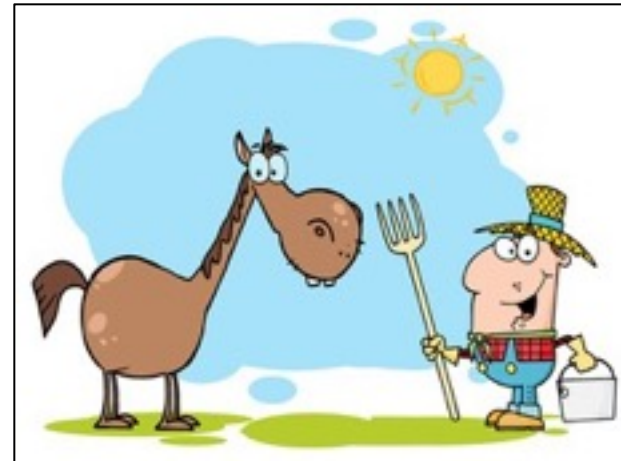
-28%



-19%



-19%



-13%

More children ages **3 to**
with home internet access know
how
to use **computers** and **smartphones**
than know how to



ride a bike

OR



tie their shoes

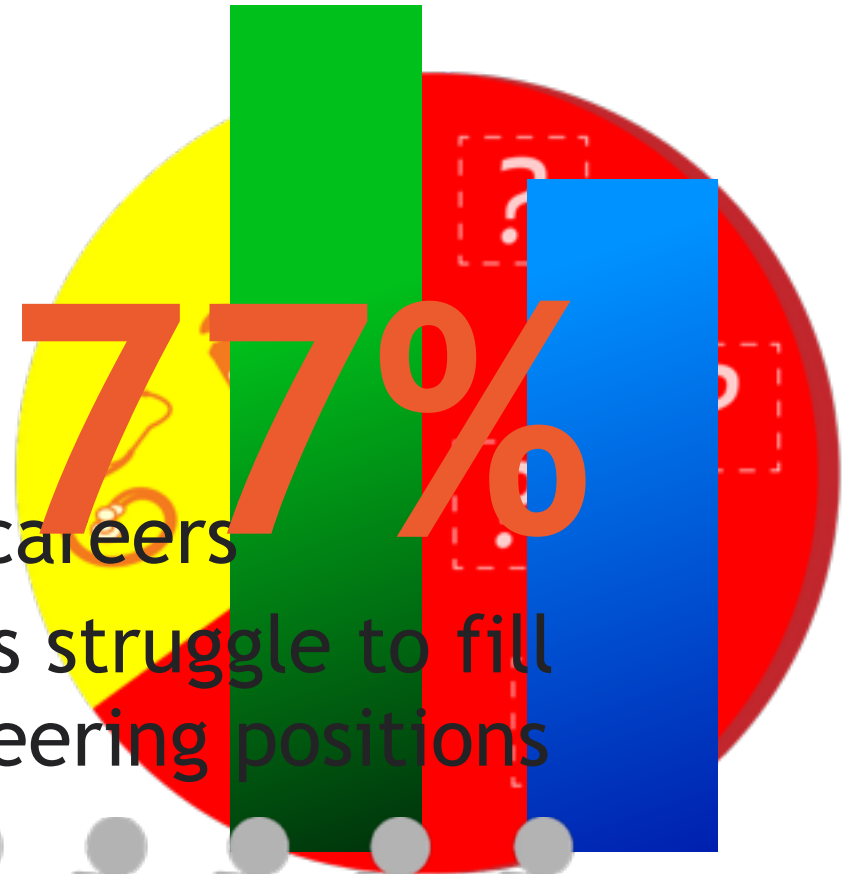
Statistics about STEM Careers

Careers in STEM
earn an average of

65% more than
non-STEM careers

Of graduate
students who
more than
career not yet
invented

Of hiring managers struggle to fill
science and engineering positions



Conceptual Shifts in the Next Generation Science Standards

Disciplinary Core Ideas

Science and
Engineering Practices

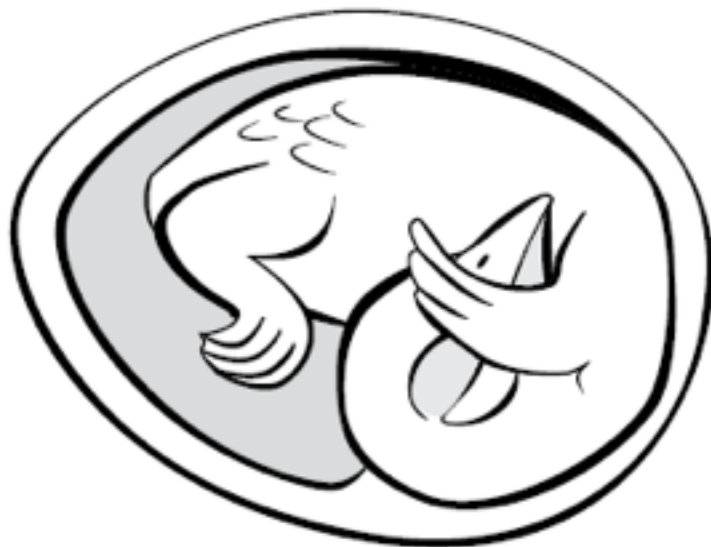
Crosscutting Concepts



Performance
Expectation

Chicken Eggs

The students in Mrs. Bartoli's class were studying how chickens develop from an egg. The students put a dozen freshly laid, fertilized chicken eggs in an incubator. They wondered what would happen to the mass of an egg as the chick inside developed. This is what the students thought:



Group A: "We think an egg will gain mass. An egg's mass is more just before hatching than when the egg was laid."

Group B: "We think an egg will lose mass. An egg's mass is less just before hatching than when the egg was laid."

Group C: "We think the mass of an egg stays the same as the chick develops inside."

Which group do you most agree with? Explain your thinking.

The Mitten Problem

Sarah's science class is investigating heat energy. They wonder what would happen to the temperature reading on a thermometer if they put the thermometer inside a mitten.

Sarah's group obtained two thermometers and a mitten. They put one thermometer inside the mitten and the other thermometer on the table next to the mitten. An hour later they compared the readings on the two thermometers. The temperature inside the room remained the same during their experiment.



What do you think Sarah's group will discover from their investigation? Circle the response that best matches your thinking.

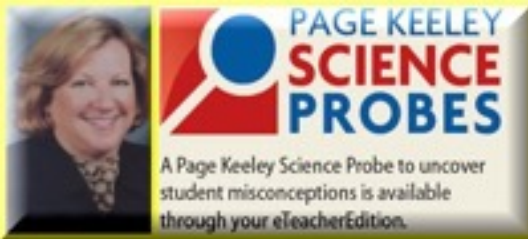
The Mitten Problem

What do you think Sarah's group will discover from their investigation? Circle the response that best matches your thinking.

- A** The thermometer inside the mitten will have a lower temperature reading than the thermometer on the table.
- B** The thermometer inside the mitten will have a higher temperature reading than the thermometer on the table.
- C** Both thermometers will have the same temperature reading.

Describe your thinking. Provide an explanation for your answer.





PAGE KEELEY PROBES



- Formative assessment tool
- Allows teachers to understand the knowledge or preconceptions students bring to their learning
- Informs pathways needed to build a bridge for conceptual understanding of science
- Found in Engage of every 5E lesson

Five Innovations for Teaching the Next Generation Science Standards

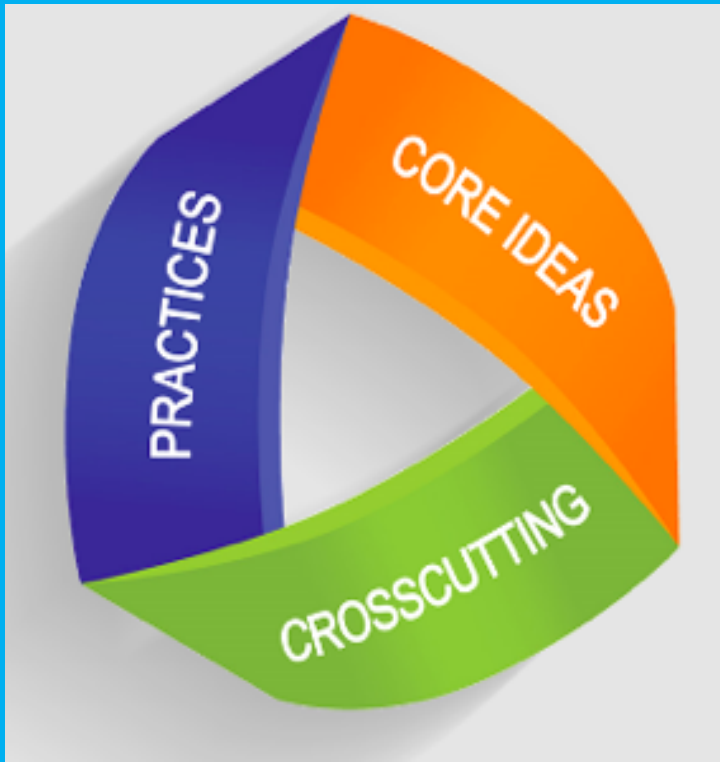
1-Three Dimensional Learning

2-All three dimensions build coherent learning progressions

3-Students engage with phenomena and design solutions

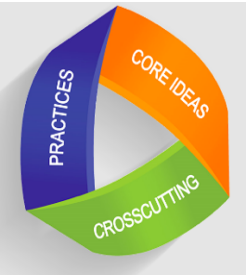
4-Engineering and the Nature of Science is integrated into science

5-Science is connected to math and literacy



Practices are the processes of using **Core Ideas** to make sense of the natural and designed world, and **Crosscutting Concepts** hold the disciplines together.

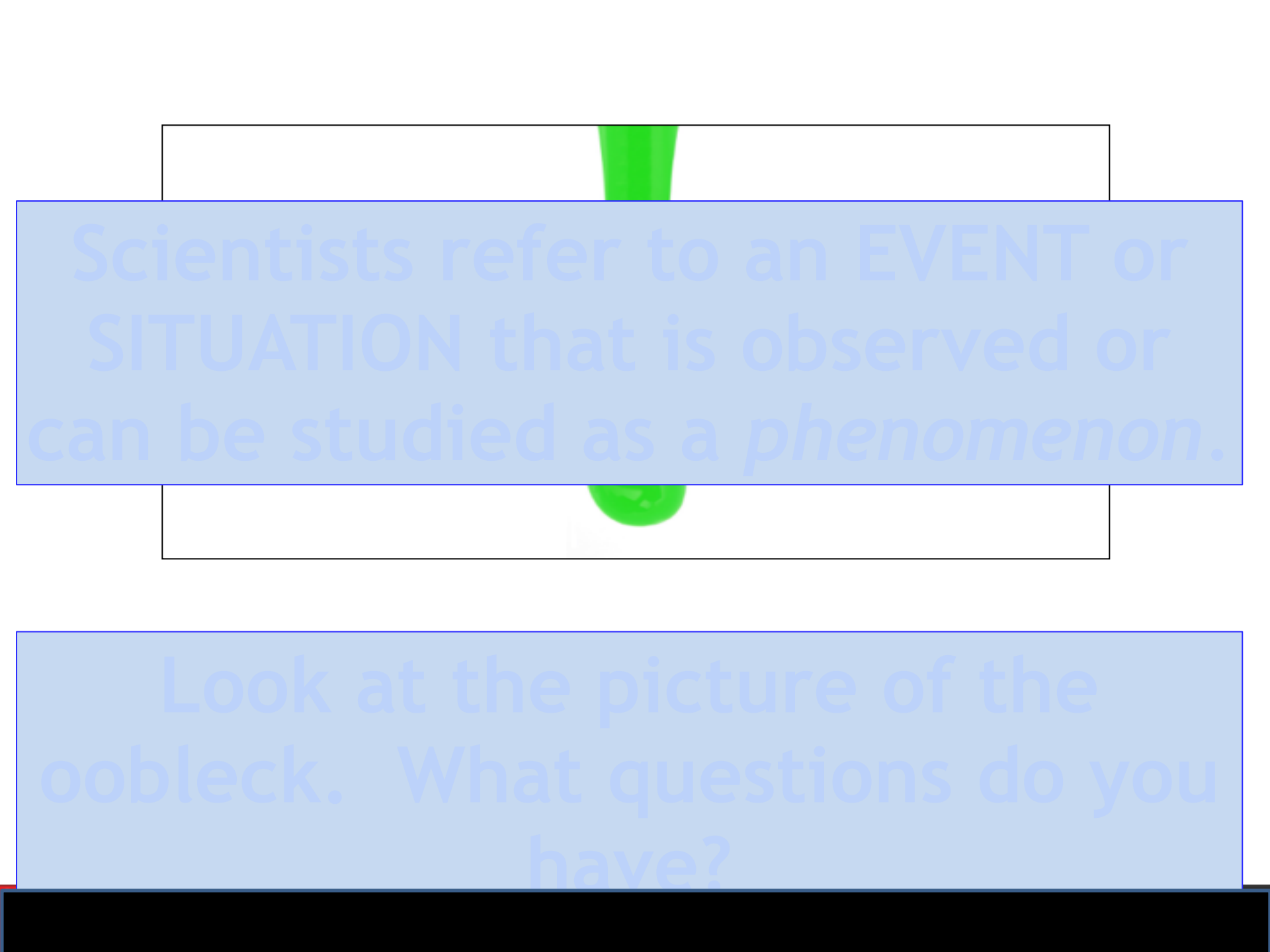
THE THREE DIMENSIONS OF SCIENCE LEARNING



Crosscutting
Concepts =
*Themes and
applications
across all
disciplines of
Science*

DCI =
Content Areas

Practices =
*Skills and
Behavior
scientists
engage in as
they
investigate
design and
build models*

A green, thick, gooey substance (oobleck) is being poured from a white container at the top into another white container at the bottom. A blue text box is overlaid on the middle of the image.

Scientists refer to an **EVENT** or **SITUATION** that is observed or can be studied as a *phenomenon*.

Look at the picture of the oobleck. What questions do you have?

Student performance expectations



TASKS to evaluate student's knowledge

PROPERTIES OF MATTER

THREE DIMENSIONAL LEARNING

Three dimensional learning in science engages students through the following strands:

Disciplinary Core Ideas

Science and Engineering Practices

Crosscutting Concepts

These three strands support Performance Expectations, which require students to apply Science and Engineering Practices to content knowledge.

In this module, **Properties of Matter**, students will plan and conduct investigations and analyze data to explore types, properties, and purposes of matter.

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

Science and Engineering Practices

As students explore the content in this module they will use the following **Science and Engineering Practices**:

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data

Crosscutting Concepts

As students explore the content, they will also use the following **Crosscutting Concepts**:

- Patterns
- Cause and Effect

Performance Expectations

2-PS1-1

Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

2-PS1-2

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

More detailed information about Next Generation Science Standards can be found on page xxx.

Crosscurricular Connections

ELA/Literacy

RI.2.8 Describe how reasons support specific points the author makes in a text.

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

W.2.8 Recall information from experiences or gather information from provided sources to answer a question.

Mathematics

MR.2 Reason abstractly and quantitatively.

MR.4 Model with mathematics.

MR.5 Use appropriate tools strategically.

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

Conceptual Shifts

Science concepts build coherently from K-12

K-2 → 3-5 → 6-8 → 9-12



Practices Handbook



Table of Contents

Introduction Defining STEM

Practice 1 Asking questions (for science) and
defining problems (for engineering)

Practice 2 Developing and using models

Practice 3 Planning and carrying out investigations

Practice 4 Analyzing and interpreting data

Practice 5 Using mathematics and
computational thinking

Practice 6 Constructing explanations (for science)
and designing solutions (for engineering)

Practice 7 Engaging in argument from evidence

Practice 8 Obtaining, evaluating, and
communicating information



STEM Projects

Unit 3
ENERGY AND MATTER

Really? What comes next, professor?

Over it, Loretta. I'm demonstrating "potential energy!"

But this is only a professor to the rescue...

Who-boo!

...and as it springs back to its original slope, we get a final dose of "static potential energy!"

Who-boo!

Don't cry

1950

1945
American-led atomic bomb attacks on the Japanese cities of Hiroshima and Nagasaki bring about the end of World War II.

1975

1954
Obninsk Nuclear Power Plant, located in the former USSR, begins operating as the world's first nuclear power plant to generate electricity for a power grid. It produces around 5 megawatts of electric power.

2000

2015
Eleven percent of the world's electricity now comes from nuclear power.

Visit Connected for this unit's **STEM** activity.

STEM Projects

- Do you see Crosscutting Concepts embedded? (Themes)
- Which Science and Engineering Practices (Skills/Behaviors) do you see?
- Are there any Disciplinary Core Ideas (Content)? Which ones?

❖ Eight Practices

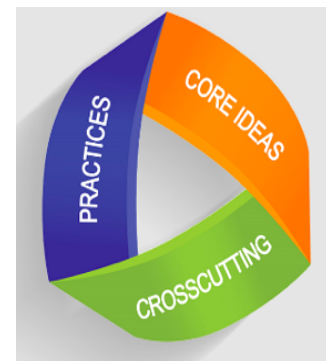
- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing Explanations and Designing Solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

➤ Seven Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

• Four Disciplinary Core Ideas:

- ✓ Life Science,
- ✓ Physical Science
- ✓ Earth and Space Science
- ✓ Engineering



Disciplinary Core Ideas (Content)	Science and Engineering Practices (Skills)	Crosscutting Concepts (Themes)

Talk About It



Project - Based Learnin

Finish Up!

Once your group has optimized your solution, prepare a



Local Ecosystem Dynamics

Introduction

Think about a park or natural habitat (such as a lake or forest) found near your neighborhood. What type of ecosystem is it? What types of organisms live there? The organisms that live in this ecosystem depend on this environment to maintain a stable population size. This local ecosystem provides habitat, food, and a place to hide from predators.

Maintaining a stable population of organisms in an ecosystem is a result of complex interactions. This stability becomes difficult to maintain when the environment is continuously disrupted or changed. What happens to the population size of these organisms if they are unable to get what they need?

PBL (Project Based Learning)

- Do you see Crosscutting Concepts embedded? (Themes)
- Which Science and Engineering Practices (Skills/Behaviors) do you see?
- Are there any Disciplinary Core Ideas (Content)? Which ones?

Disciplinary Core Ideas (Content)	Science and Engineering Practices (Skills)	Crosscutting Concepts (Themes)

Talk About It



Skill Lab

Skill Activity

Classifying

Background

Classifying is the process of sorting objects or events into groups based on their common features. You may not think you use this skill, but if you stack the books in your locker in a certain order, you are classifying them. When you classify, you are grouping objects together for a specific reason.

The activities that you do every day can also be classified. Some activities are learned, and must develop through practice and experience. Other activities don't need to be learned, you are born with them. They are innate behaviors. In this activity, you will classify your daily activities as learned or innate.

Procedure

- 1 Below is a list of 20 activities that you do every day.
- 2 Make a copy of the Classifying Behaviors table shown and classify each activity as learned or innate.
- 3 Put an X in the box that best describes the type of activity.

Daily Activities	
blink	yawn
walk	get dressed
sneeze	read
breathe	write
talk	brush your teeth
take a shower	comb your hair
your heart beats	smile

Classifying Behaviors		
Activity	Learned	Innate

Types of Birds	
Rhea flightless bird	Bald Eagle bird of prey
Great Blue Heron wading bird	Pelican water bird
Cardinal seed-eating bird	Kiwi flightless bird
Emu flightless bird	Downy Woodpecker insect-eating bird
Gold finch seed-eating bird	Blue Jay seed-eating bird
Wood duck water bird	Owl bird of prey
Nuthatch insect-eating bird	Robin insect-eating bird
Osprey bird of prey	Ostrich flightless bird

Practicing the SKILL

- 1 Look at the Types of Birds table above.
- 2 Describe ways you could classify the birds.

Skill Lab

- Do you see Crosscutting Concepts embedded? (Themes)
- Which Science and Engineering Practices (Skills/Behaviors) do you see?
- Are there any Disciplinary Core Ideas (Content)? Which ones?

Disciplinary Core Ideas (Content)	Science and Engineering Practices (Skills)	Crosscutting Concepts (Themes)

Talk About It



EVERY LESSON OPENS WITH A PHENOMENA!

- Science often begins when someone makes an observation about a situation or an occurrence.
- Spark your students' curiosity about the world around them!
- Keep students “figuring out” rather than “learning about”.

Phenomena

Page Keeley Science Probes



Chicken Eggs



The students in Mrs. Bartoli's class were studying how chickens develop from an egg. The students put a dozen freshly laid, fertilized chicken eggs in an incubator. They wondered what would happen to the mass of an egg as the chick inside developed. This is what the students thought:



The Mitten Problem

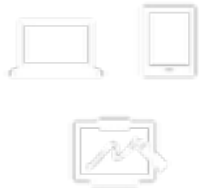


**PAGE KEELEY
SCIENCE
PROBES**

A Page Keeley Science Probe to uncover student misconceptions is available through your eTeacherEdition.

The complex block contains a small portrait of a woman with blonde hair on the left. To her right is the logo for 'PAGE KEELEY SCIENCE PROBES', which features a blue circle and a red square. Below the logo is a line of text: 'A Page Keeley Science Probe to uncover student misconceptions is available through your eTeacherEdition.'

Phenomena Images with Guided Questions



Chapter 2

Cell Structure and Function



How do the structures and processes of a cell enable it to survive?

Inquiry Alien Life?

You might think this unicellular organism looks like something out of a science-fiction movie. Although it looks scary, the hairlike structures in its mouth enable the organism to survive.

- What do you think the hairlike structures do?
- How might the shape of the hairlike structures relate to their function?
- How do you think the structures and processes of a cell enable it to survive?

Get Ready to Read

What do you think?

Before you read, decide if you agree or disagree with each of these statements. As you read this chapter, see if you change your mind about any of the statements.

1. Nonliving things have cells.
2. Cells are made mostly of water.
3. Different organisms have cells with different structures.
4. All cells store genetic information in their nuclei.
5. Diffusion and osmosis are the same process.
6. Cells with large surface areas can transport more than cells with smaller surface areas.
7. ATP is the only form of energy found in cells.
8. Cellular respiration occurs only in lung cells.

ConnectED Your one-stop online resource
connectED.mcgraw-hill.com

- Video
- Audio
- Review
- Inquiry
- WebQuest
- Assessment
- Concepts in Motion
- Multilingual eGlossary

Phenomena ABC



Inquiry

Launch Lab

10 minutes

What's in a cell?



Most plants grow from seeds. A seed began as one cell, but a mature plant can be made up of millions of cells. How does a seed change and grow into a mature plant?

- 1 Read and complete a lab safety form.
- 2 Use a **toothpick** to gently remove the thin outer covering of a **bean seed** that has soaked overnight.
- 3 Open the seed with a **plastic knife**, and observe its inside with a **magnifying lens**. Draw the inside of the seed in your Science Journal.
- 4 Gently remove the small, plantlike embryo, and weigh it on a **balance**. Record its mass in your Science Journal.
- 5 Gently pull a **bean seedling** from the soil. Rinse the soil from the roots. Weigh the seedling, and record the mass.



Think About This

1. How did the mass of the embryo and the bean seedling differ?
2. **Key Concept** If a plant begins as one cell, where do all the cells come from?

Tip
Fold a sheet of paper to make a four-door book. Label it as shown. Use it to organize your notes on the macromolecules and their uses in a cell.



like ihk) acid (DNA) and ribonucleic (ri boh noo KLEE ihk) acid (RNA) are nucleic acids. **Nucleic acids** are macromolecules that form when long chains of molecules called nucleotides (NEEW klee uh tid) join together. The order of nucleotides in DNA and RNA is important. If you change the order of words in a sentence, you can change the meaning of the sentence. In a similar way, changing the order of nucleotides in DNA and RNA can change the genetic information in a cell.

Nucleic acids are important in cells because they contain genetic information. This information can pass from parents to offspring. DNA includes instructions for cell growth, cell reproduction, and cell processes that enable a cell to respond to its environment. DNA is used to make RNA. RNA is used to make proteins.

Assessment Performance Expectations

- Tasks to evaluate Students' Knowledge
- Each Performance Expectation is correlated to an Applying Practices activity written specifically for the purpose

Performance Expectations Labs



Performance Expectations

PBL



NEXT GENERATION SCIENCE STANDARDS*

This project supports the following items in the Next Generation Science Standards:

Introduction

Think about a pa
What type of ec
this ecosystem d
ecosystem provic
Maintaining a sta
interactions. This
continuously dis
if they are unabl

Performance Expectation:

HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. *[Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]*

hborhood.
at live in
is local
:
rganisms

5E LESSON PLANS

- Engage
- Explore
- Explain (vocabulary instruction happens here)
- Elaborate
- Evaluate

Not necessarily linear, sometimes you have to move students back to explore for additional understanding.

<https://www.youtube.com/watch?v=G4J4Am8vLrY>



MIDDLESCHOOL SCIENCESERIES

Interactive Science for 21st-Century Learners

