



# Get Your Students Talking About Science Phenomena!

## Lessons Begin With a Page Keeley Science Probe

One of the most effective ways to support conceptual learning is through formative assessment. That is why *Inspire Science* begins every lesson with a Page Keeley formative assessment science probe.

Science probes present a real-world phenomenon or core concept that is used to promote student thinking and discussion, revealing commonly-held misconceptions and initial ideas students bring to their learning so you can best inform your instruction.



**PAGE KEELEY, M.Ed.**  
Author and Educator



**PAGE KEELEY, M.Ed.**  
Author and Educator

## *Inspire Science* is Pleased to Have Partnered With Page Keeley, M.Ed.

Page Keeley, M.Ed. is a nationally-renowned expert on science formative assessment and teaching for conceptual change. She is the author of several award-winning books and journal articles on uncovering student thinking using formative assessment probes and techniques. She was the Science Program Director at the Maine Mathematics and Science Alliance for 16 years and a past President of the National Science Teachers Association.

Have the students do the talking, and let their discussion inform your instruction.

Keep students engaged and thinking by withholding the best answer until later in the lesson.

ASSESS LESSON READINESS Name \_\_\_\_\_ Date \_\_\_\_\_

## Energy and Speed



### When Does It Have Energy?



Four friends were playing kickball. They each had different ideas about the ball and energy. This is what they said:

Lily: The ball has to be on the ground, not moving, to have energy.

Mike: The ball has to be moving to have energy. It doesn't matter how fast it is moving.

Otto: The ball has to be moving very fast to have energy.

Ava: The ball has energy when it is both moving and not moving.

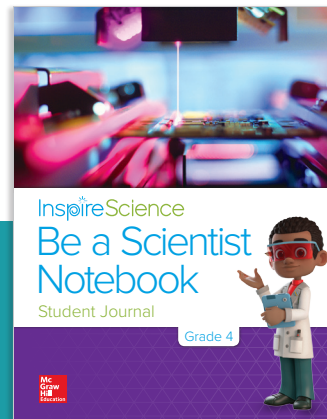
Who do you agree with most? Otto

Explain why you agree.

It takes a lot of energy to move very fast.

## Why are Science Probes so Powerful?

- ✓ **Relevant phenomena** with great explanatory power or core concepts are found in every science probe.
- ✓ **Answer choices** contain a best answer and distractors that are designed to uncover common misconceptions.
- ✓ **Explanatory answers** provide insight into students' thinking and preconceived notions.
- ✓ **Meaningful student conversations** provoke deeper thinking.
- ✓ **No grading** keeps students thinking over the course of the lesson.



She is the recipient of numerous awards and recognitions for her contributions in science education. Currently, she is an independent consultant providing professional development to school districts and science education organizations, as well as a frequent invited speaker at national conferences. McGraw-Hill Education is honored to have partnered with her and pleased to have had her write the science probes for every *Inspire Science* lesson.

## Getting Started With Formative Assessment Science Probes

Science comes with many misconceptions. As an instructor, you need to know what those are so you can get the most out of your science instruction. *Inspire Science* provides supportive lesson plans that ensure you have all the information you will need to elicit students' common misconceptions and uncover understanding so informed instructional decisions can be made.

### Teacher Support Includes:

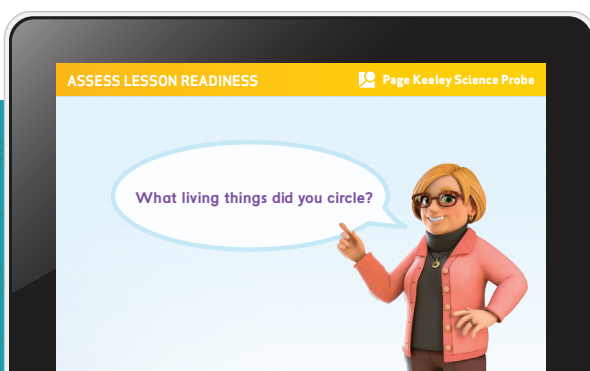
- ✓ A detailed account of the purpose and usefulness of each probe
- ✓ Teaching and learning implications that are clearly stated
- ✓ Scientific explanations that help clarify the specific content at hand
- ✓ Suggestions for combining the probe with science and engineering practices
- ✓ Research-based, common misconceptions that are identified to help build an understanding of the commonly held ideas that students have in science
- ✓ Explanations are provided that describe the best answer choice

Get the most out of every lesson with detailed teacher notes!



HIRO  
Ocean Engineer

READY-TO-USE ePRESENTATIONS



In addition to the science probes and teacher lesson plans each lesson comes with digital content, including ePresentations, professional learning videos, and more.

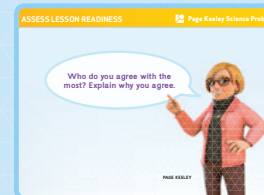
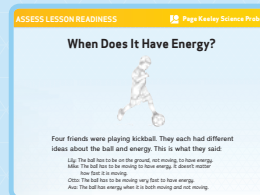


## ASSESS LESSON READINESS



BEGIN LESSON PRESENTATION

Go online to [connectED.mcgraw-hill.com](http://connectED.mcgraw-hill.com)



### Page Keeley Science Probe When Does It Have Energy?

**Purpose** This probe is intended to uncover students' basic ideas about energy. Use the probe to assess prior knowledge and uncover misconceptions that will drive lesson instruction. Do not give students the answer. Students will return to the probe after completing the lesson to see how their thinking has changed.

#### Using the Probe

Use this probe prior to introducing the idea that all objects have energy. Examine students' written explanations or listen carefully as they discuss the probe to determine whether students think there needs to be movement or activity in order for an object to have energy.

#### Throughout the Lesson

Use the students' explanations as a bridge between the students' initial ideas about energy and the scientific understanding of kinetic and potential energy they will develop through their learning opportunities. The probe can also be revisited after students have had an opportunity to develop a conceptual understanding of energy as a property

of all objects, both moving and not moving. It will reveal whether students are still holding onto a misconception or have gaps in conceptual understanding. You can use this information to decide if further instruction is needed.

#### Science and Engineering Practices

This probe supports the scientific practice of argumentation. In choosing a person to agree with, students must construct an argument, supported by evidence, to explain why they agree or disagree with the others.

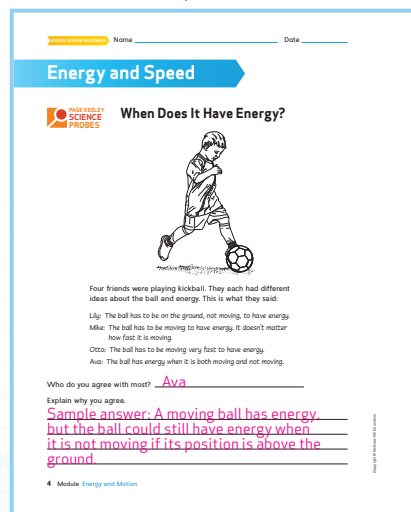
#### Common Misconceptions

A common misconception is that an object has to be active or moving in order to have energy. This misconception may come from our everyday use of the word *energy*. For example, when we are sluggish, and not moving, we are said to have no or little energy. Thus many students develop a preconception before they learn about energy in school that energy requires movement. Students often come to class with this strongly held preconception. Students who choose Lily may think energy needs to be stored in an object, and then when the object moves, the energy is released and used up. Students who choose Mike have the common misconception that an object must be active or moving to have energy. Students who choose Otto have a similar idea about movement as a requirement for having energy, but may think there has to be a certain amount of movement.

#### Teacher Explanation

The best answer is Ava. The ball has both potential and kinetic energy. It has kinetic energy when it moves under the pull of gravity. It has potential energy when it is not moving (energy of position or stored energy). Depending on the position of the ball, the amount of potential energy varies. For example, a stationary ball at rest on the top of a mountain is farther from sea level than a stationary ball at rest at the base of the mountain. Because it is farther from sea level (greater gravitational pull), the ball at the top of the mountain has more potential energy than the ball at the bottom of the mountain (at sea level).

Be a Scientist Notebook, p. 4



HOW SCIENCE PROBES WORK:

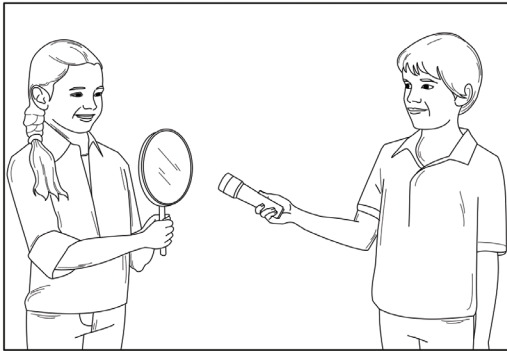
# The Anatomy of Formative Assessment Science Probes

ASSESS LESSON READINESS Name \_\_\_\_\_ Date \_\_\_\_\_

## How Light Travels



### Mirrors and Light



What will happen when the boy shines the flashlight on the mirror?

- The light will go through the mirror.
- The light will bounce off the mirror.
- The mirror will stop the light.

Explain your thinking.

\_\_\_\_\_

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\_\_\_\_\_

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\_\_\_\_\_

#### Simple Illustration or Scenario

Science Probes present students with familiar real-world phenomena or a core concept. These could be in the form of simple illustration or scenario.

#### Real-world Phenomena

Relevant phenomena have great explanatory power. The situations presented are designed to draw out deeper thinking and elicit more thoughtful responses from students.

#### Best Versus Right Answer

Students are more motivated to learn in a non-judgmental environment. By referencing the “best answer” to explain thinking, rather than the “right answer”, students feel safe in sharing their thinking.

#### Explanatory Answers Reveal Students’ Thoughts

Students are required to provide an explanation for their answer which helps uncover preconceived notions that may be clouding students’ thought process.

## The Powerful, Instructional Value of Formative Assessment Science Probes



### Engage Students

- ✓ Science Probes are engaging and intrinsically interesting.
- ✓ By not providing the best answer up front, students feel a natural desire to know why and gather the conceptual pieces.



RILEY  
Auto Engineer



### Encourage Student Discourse

- ✓ Through a variety of Page Keeley Science Probe discussion strategies, the probes get students talking, exchanging, and examining each others' ideas.



MARISOL  
Paramedic/EMT



### Argue With Evidence

- ✓ Science probes provide students the opportunity to use the scientific and engineering practice of engaging in argument from evidence.
- ✓ A student's change in thinking based on the collection and understanding of new information mirrors the practice of real scientists and engineers.



NOAH  
Nurse

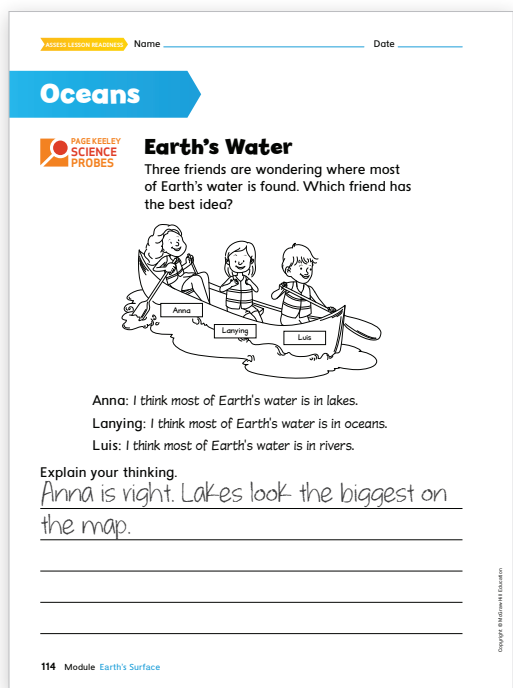
## Science Probe Sharing and Discussion Strategies

Getting students sharing their ideas and talking about science is fun and easy with Page Keeley sharing techniques and productive discussion strategies. Over 20 strategy and technique videos come with Inspire Science — try these two sharing and discussion strategies in your classroom today.

### Sticky Bar Graph Sharing Strategy

The Sticky Bar Graph Strategy is ideal for Page Keeley Science Probes with multiple choice answers. See below for a step-by-step example of how the Sticky Bar Graph Strategy works.

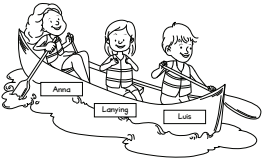
#### BEGINNING OF THE LESSON



ADDED: LESSON REQUIRED Name \_\_\_\_\_ Date \_\_\_\_\_

### Oceans

**Earth's Water**  
 Three friends are wondering where most of Earth's water is found. Which friend has the best idea?



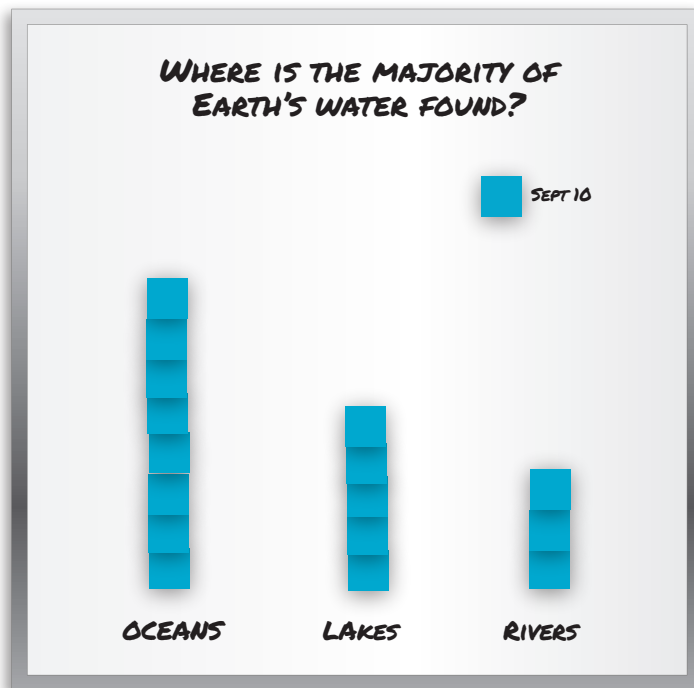
Anna: I think most of Earth's water is in lakes.  
 Lanying: I think most of Earth's water is in oceans.  
 Luis: I think most of Earth's water is in rivers.

Explain your thinking.  
*Anna is right. Lakes look the biggest on the map.*

114 Module Earth's Surface

BE A SCIENTIST NOTEBOOK, GRADE 2

At the beginning of the lesson, students are asked to select the best answer for the question at hand and explain their thinking.



**WHERE IS THE MAJORITY OF EARTH'S WATER FOUND?**

SEPT 10

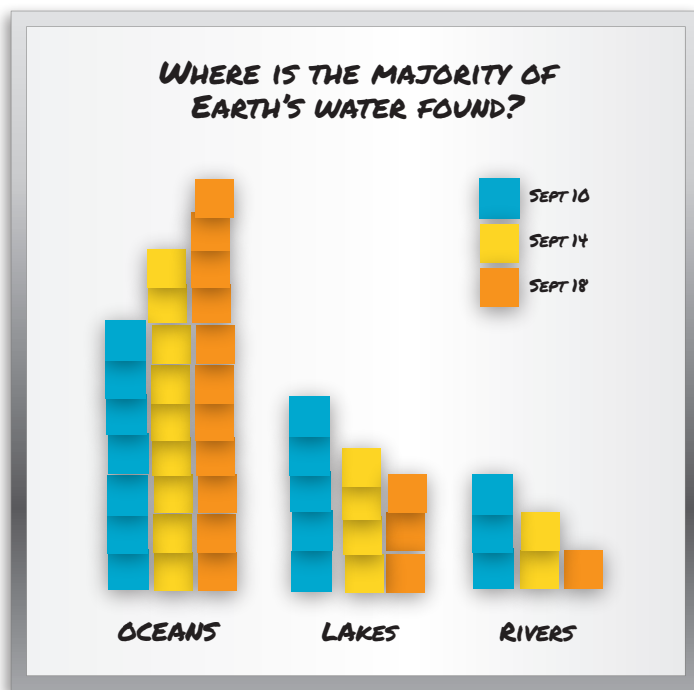
Location	Number of Sticky Notes
OCEANS	7
LAKES	4
RIVERS	3

STICKY BAR GRAPH IN ACTION

Students share their early theories about why things are the way they are and chart their thinking via sticky notes.

This strategy provides a safe, anonymous way for students to share their thinking at the beginning of the lesson before engaging in productive discussion about their choices.

## THROUGHOUT THE LESSON



STICKY BAR GRAPH IN ACTION

As students progress through the lesson, they will revisit their original answers and have an opportunity to change their answers.

This allows the students to see how their thinking has evolved based on what they've learned and helps to inform instruction.



NAME \_\_\_\_\_ DATE \_\_\_\_\_

### Oceans

**Earth's Water**  
 Three friends are wondering where most of Earth's water is found. Which friend has the best idea?

Anna: I think most of Earth's water is in lakes.  
 Lanying: I think most of Earth's water is in oceans.  
 Luis: I think most of Earth's water is in rivers.

**Explain your thinking.**  
 Anna is right. Lakes look the biggest on the map.  
 Lanying is right oceans have the most water because they are the largest on earth.

114 Module Earth's Surface

BE A SCIENTIST NOTEBOOK, GRADE 2

After students have engaged in a variety of learning opportunities their thinking will evolve and they will develop a more evidence-based explanation for the best choice.



## Argumentation Line Discussion Strategies

Another Page Keeley Discussion Strategy that works well for probes with two answer choices is the Argumentation Lines Strategy.

### BEGINNING OF THE LESSON

At the beginning of a lesson, students select their answer and construct their explanations.

Then, students form two lines, facing one another — a line for answer choice A and another line for answer choice B.

One student starts the discussion by framing his/her argument and providing an explanation.

Students who don't actively participate are listening and learning from other students.



**MALIK**  
Photonics Engineer

ASSESS LESSON READINESS Name \_\_\_\_\_ Date \_\_\_\_\_

## Adaptations

### Adaptations

Polar bears live in the cold Arctic. They grow a coat of thick fur to stay warm.

Two friends were at a zoo in Florida. The zoo had a polar bear exhibit. They wondered how the polar bear could live in Florida where it is very warm. This is what they said:

Suzanne: *The polar bear will try to adapt by growing less fur.*  
 Milo: *The polar bear will not try to adapt by growing less fur.*

Who do you agree with the most? Suzanne

Explain why you agree.  
My dog sheds his fur in the summer. I think the polar bear does something similar.

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186 Module Survival

BE A SCIENTIST NOTEBOOK, GRADE 3

### THROUGHOUT THE LESSON

Other students from both opposing and agreeing sides can add to the conversation by offering more supporting thoughts or rebuttals they have gathered from evidence.

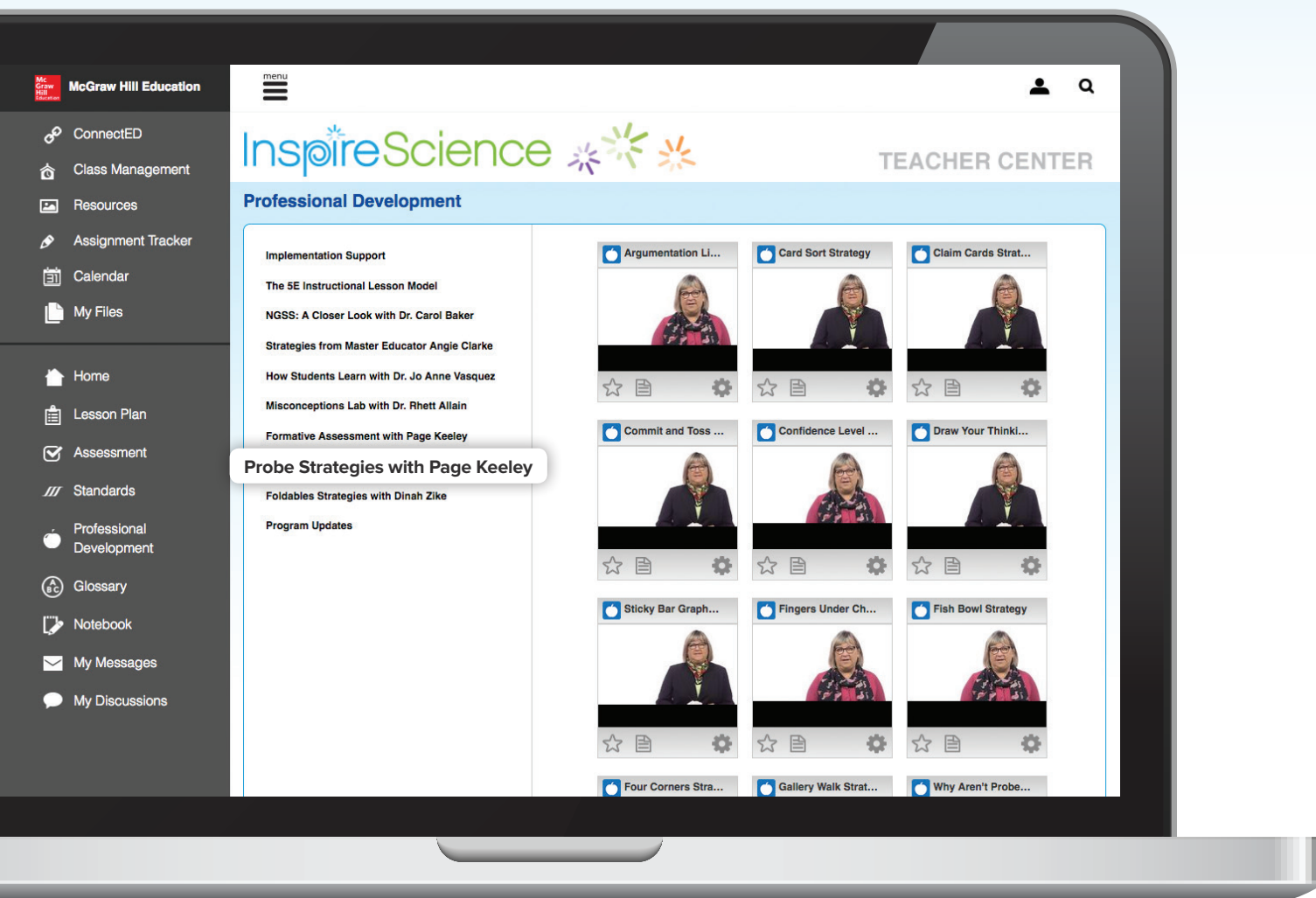
Students can switch sides if they feel like compelling evidence exists.

The instructor can monitor the dialogue and use student rationale to inform subsequent instruction.



## Inspire Science Professional Development Video Library

The Sticky Bar Graph and Argumentation Line strategies are just two examples of the many strategies that come with *Inspire Science*. See all 19 of Page Keeley's formative assessment strategy training videos as well as additional support videos in the *Inspire Science* Professional Development Library.



### Formative Assessment Strategies Videos

The *Inspire Science* Professional Development Library includes training videos for the following formative assessment strategies that are used with the probes:

- Augmentation Line
- Card Sort
- Claim Cards
- Commit and Toss
- Confidence Level Assessment
- Draw Your Thinking
- Fingers Under Chin/Five Fingers
- Fish Bowl
- Four Corners
- Gallery Walk
- I Used to Think, but Now I Know
- Our Best Thinking so Far
- Partner Speak
- Response Cards
- Sticky Bar Graph



## Additional Coaching Videos from Page Keeley

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### How-to Videos

Instruct with confidence by watching Page Keeley explain how to implement strategies within your classroom.



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### Probe Philosophy Videos

Gain a deeper understanding of the science behind Page Keeley Science Probes.



Supporting videos help you maximize instruction.

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### Coaching Videos

Coaching videos help you learn advanced techniques, such as redirecting conversations.


- Think-Pair-Share
- Traffic Lighting Cards
- Two or Three Before Me
- Volleyball Not Ping Pong

MAYA  
Geologist



## Try a Page Keeley Science Probe Today

Copy and use the Page Keeley science probe in your classroom today and let *Inspire Science* help you change your students' science misconceptions.

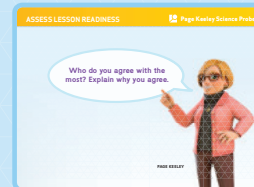
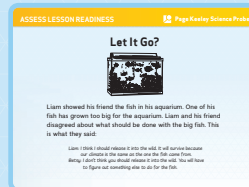
*Make a Copy and Try This Science Probe Today!* 

### ASSESS LESSON READINESS



BEGIN LESSON PRESENTATION

Go online to [connectED.mcgraw-hill.com](http://connectED.mcgraw-hill.com)



### Page Keeley Science Probe Let it Go?

**Purpose** The purpose of this formative assessment probe is to uncover students' ideas about introducing non-native species to an environment (invasive species).

#### Using the Probe

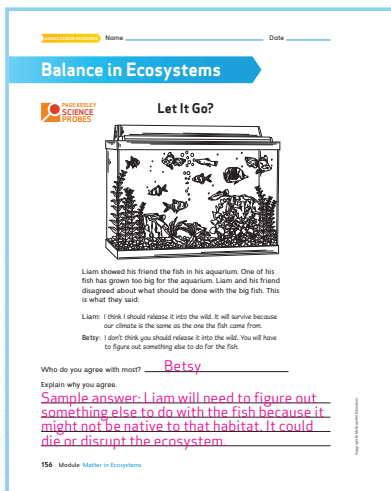
This probe can be used as an elicitation prior to introducing the concept of invasive species and disruptions to an ecosystem.

#### Throughout the Lesson

Examine students' written explanations or listen carefully as they discuss the probe to determine whether students recognize that the fish is a newly introduced species that may disrupt the ecosystem. You can use the students' explanations to build a bridge between the students' initial concept of the balance between organisms and their environment and the lesson content.

The probe also can be revisited after students have had an opportunity to develop a conceptual understanding of invasive species in order to determine whether they are still holding onto a misconception. You can use this information to determine if further instruction is needed.

Be a Scientist Notebook, p. 156



158 Module **Matter in Ecosystems**

### Science and Engineering Practices

The format of this probe supports the scientific practice of argumentation. In choosing a person to agree with, students must construct an argument supported by evidence to explain why they agree with one person and disagree with the other.

#### Common Misconceptions

Students who choose Liam fail to recognize how newly introduced species can disrupt an ecosystem. They focus on the needs of the organism. So if the environment fits the organism's needs, then they think it is okay to release the organism.

#### Teacher Explanation

The best answer is Betsy: I don't think you should release it into the wild. You will have to figure out something else to do for the fish. The fish may not be a species that is found in that habitat. Introduced species that are not native to an area are called invasive species. Invasive species compete with other species, disrupting the ecosystem.



Inspire Science  
Teacher's Edition

Grade 5

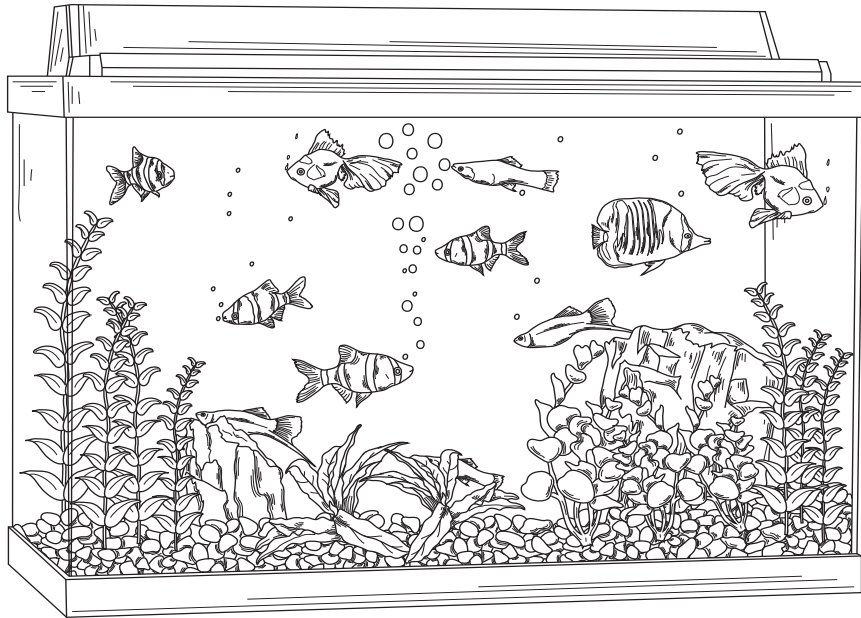




# Balance in Ecosystems



## Let It Go?



Liam showed his friend the fish in his aquarium. One of his fish has grown too big for the aquarium. Liam and his friend disagreed about what should be done with the big fish. This is what they said:

Liam: *I think I should release it into the wild. It will survive because our climate is the same as the one the fish came from.*

Betsy: *I don't think you should release it into the wild. You will have to figure out something else to do for the fish.*

Who do you agree with most? \_\_\_\_\_

Explain why you agree.

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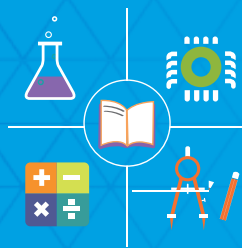
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# InspireScience

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