

Mc
Graw
Hill
Education

Formative Assessment
Science Probes
Middle School



Inspire Science

Explore Our Phenomenal World



inspire-science.com/6-12

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.



Chris Keeley Photography

PAGE KEELEY, M.Ed.
Author and Educator

McGraw-Hill Education 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.

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.

LESSON 1 LAUNCH



What happened to the puddle?



Four friends noticed a large puddle on the sidewalk when they walked to school in the morning. When they walked home, the puddle was gone. They wondered what happened to the water that was in the puddle.

Desi: I think the water soaked into the cement.

Trudi: I think the water went up into the clouds.

Max: I think the water is in the air around us.

Carl: I think the Sun changed it into something else.

Circle the student you most agree with. Explain why you agree with that student.

Trudi is right. I think the water went up into the clouds.

You will revisit your response to the Science Probe at the end of the lesson.

SCIENCE PROBE Lesson 1 Water in the Atmosphere 3

Page Keeley 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.

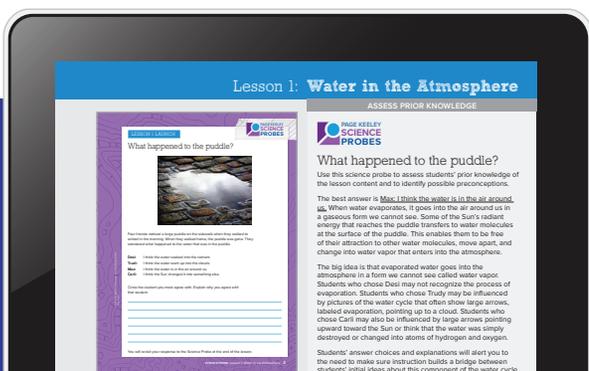
Getting Started With Formative Assessment Science Probes

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!



In your teachers edition and online you will find teacher support to help guide the conversation about the misconception as well as professional learning videos, and more.

Purpose

This probe is intended to uncover students' basic ideas about the water cycle. 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 water cycle. Examine students' written explanations or listen carefully as they discuss the probe to determine what the students think happened to the water in the puddle.

Throughout the Lesson

Students' answer choices and explanations will alert you to the need to make sure instruction builds a bridge between students' initial ideas about this component of the water cycle to the correct scientific description of what happens when water evaporates. It also points out the need to explicitly address what a representation, such as a water cycle diagram, is intended to show, as models are representations of reality but cannot always show the phenomenon exactly as it appears in nature.

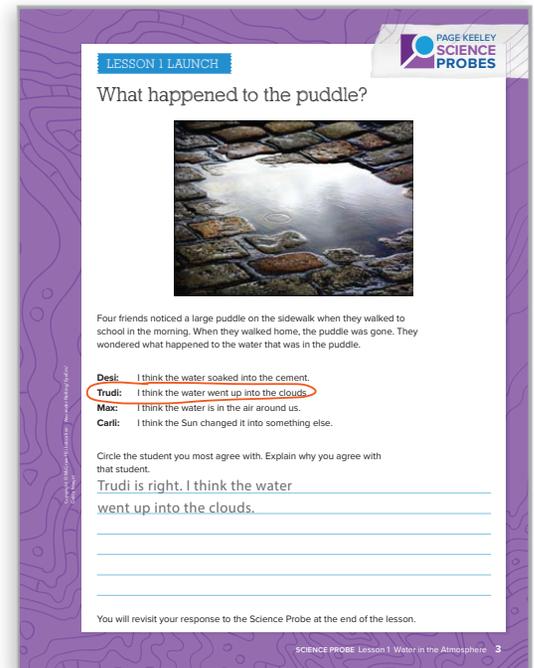
Science and Engineering Practices

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.

Teacher Explanation

The best answer is Max: I think the water is in the air around us. When water evaporates, it goes into the air around us in a gaseous form we cannot see. Some of the Sun's radiant energy that reaches the puddle transfers to water molecules at the surface of the puddle. This enables them to be free of their attraction to other water molecules, move apart, and change into water vapor that enters into the atmosphere.

The big idea is that evaporated water goes into the atmosphere in a form we cannot see called water vapor. Students who chose Desi may not recognize the process of evaporation. Students who chose Trudy may be influenced by pictures of the water cycle that often show large arrows, labeled evaporation, pointing up to a cloud. Students who chose Carli may also be influenced by large arrows pointing upward toward the Sun or think that the water was simply destroyed or changed into atoms of hydrogen and oxygen.



LESSON 1 LAUNCH

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SCIENCE PROBE Lesson 1 Water in the Atmosphere 3

ANATOMY OF A FORMATIVE ASSESSMENT SCIENCE PROBE

HOW SCIENCE PROBES WORK:

The Anatomy of Formative Assessment Science Probes

LESSON 1 LAUNCH

PAGE KEELEY SCIENCE PROBES

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SCIENCE PROBE Lesson 1 Water in the Atmosphere 3

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

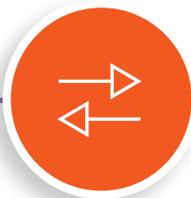
Students are required to provide an explanation for their answer which helps uncover preconceived notions that may be clouding students’ thought process.

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.



Encourage Student Discourse

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



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.

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

LESSON 1 LAUNCH

PAGE KEELEY SCIENCE PROBES

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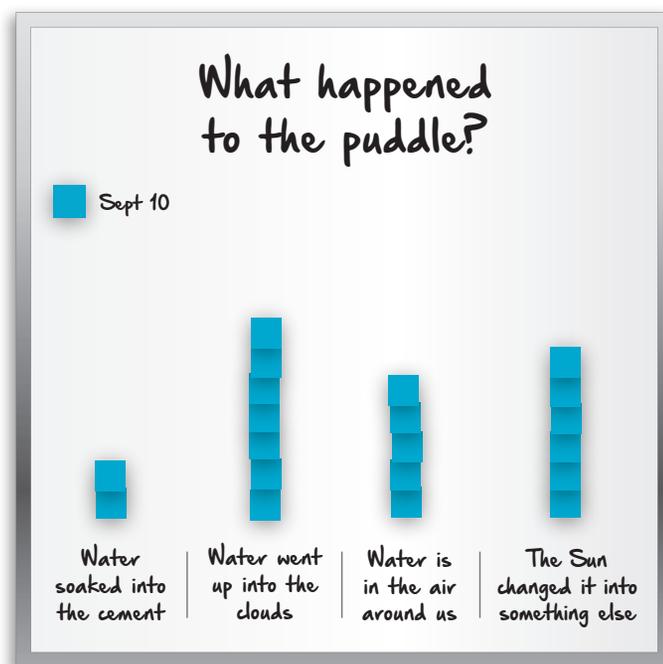
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SCIENCE PROBE Lesson 1 Water in the Atmosphere 3

GRADE 6, LESSON 1, THE WATER CYCLE

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

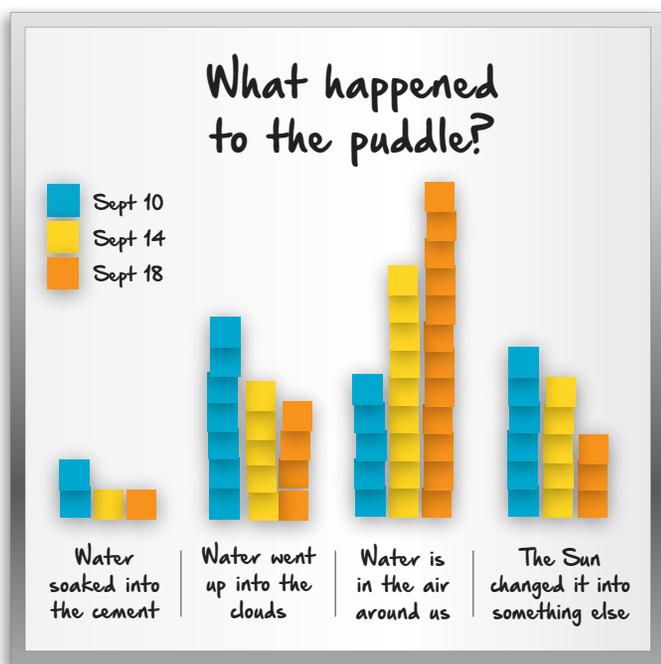


STICKY BAR GRAPH IN ACTION

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.



LESSON 1 LAUNCH

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Trudi is right. I think the water
went up into the clouds.

Max is right! The water from the puddle is in the air
around us.

You will revisit your response to the Science Probe at the end of the lesson.

SCIENCE PROBE Lesson 1 Water in the Atmosphere 3

GRADE 6, LESSON 1, THE WATER CYCLE

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.

SCIENCE PROBE DISCUSSION STRATEGIES

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.

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.

The screenshot shows a worksheet for 'Lesson 2: Water on Earth's Surface' with a section titled 'Groundwater'. It features a diagram of a glass of water and a paragraph of text. Below the text are several student responses (Mom, Jack, Annie, Philip) with their own explanations. A 'SCIENCE PROBE' logo is visible in the top right corner of the worksheet.



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.

Professional Learning Resources

Use the Professional Learning resources to prepare for the lesson.

Page Keeley Science Probe: Fishbowl



Video

- Add to student page
- Include in presentation

Preconceptions: Hot Summer, Cool Winter



Video

- Add to student page
- Include in presentation

Dinah Zike Foldables



Video

- Add to student page
- Include in presentation

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 Keely 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.

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Coaching Videos

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



Supporting videos help you maximize instruction.

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

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! →

Lesson 1: Water in the Atmosphere

ASSESS PRIOR KNOWLEDGE

LESSON 1 LAUNCH

PAGE KEELEY SCIENCE PROBES

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You will revisit your response to the Science Probe at the end of the lesson.

SCIENCE PROBES Lesson 1 Water in the Atmosphere 3



What happened to the puddle?

Use this science probe to assess students' prior knowledge of the lesson content and to identify possible preconceptions.

The best answer is Max: I think the water is in the air around us. When water evaporates, it goes into the air around us in a gaseous form we cannot see. Some of the Sun's radiant energy that reaches the puddle transfers to water molecules at the surface of the puddle. This enables them to be free of their attraction to other water molecules, move apart, and change into water vapor that enters into the atmosphere.

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GO ONLINE

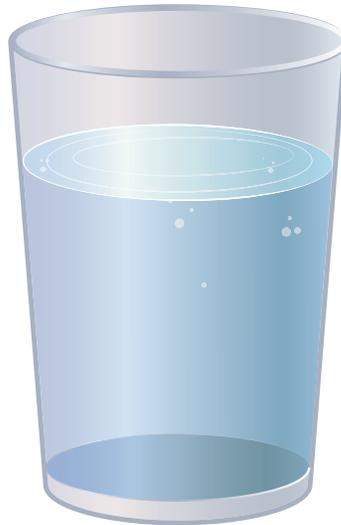
INTERACTIVE PRESENTATION

Science Probe: What happened to the puddle?



LESSON 2 LAUNCH

Groundwater



Jane was drinking a glass of water. She asked her father where the water came from. Her father said it was groundwater that was pumped up by their well. Jane wondered what the water looked like underground. This is what her family said:

Mom: I think it looks like a huge ocean underground.

Dad: I think it looks like a small lake underground.

Jack: I think it seeps into little holes or spaces between the soil and the rocks.

Annie: I think it looks like a long, underground tube filled with water.

Philip: I think it looks like an underground volcano with water spurting out of the top.

Which person do you agree with the most? Explain your ideas about groundwater.

You will revisit your response to the Science Probe at the end of the lesson.

Inspire Science



Inspire Curiosity



Inspire Investigation



Inspire Innovation