

ActionBioscience.org lesson

To accompany the article by Robert M. Hazen, Ph.D.:

Why Should You Be Scientifically Literate? (Nov. 2002)

<http://www.actionbioscience.org/newfrontiers/hazen.html>

Why? (June 2007)

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Description

The lesson is titled "Why?" because students are full of wonder about the world. However, for curriculum purposes, the lesson is really about the nature of science through the spirit of inquiry. Students have the opportunity to use scientific inquiry and develop the ability to think scientifically. This includes asking questions, investigating, gathering data, thinking critically about how evidence and explanations are related, and communicating scientific information. Two of the activities are designed as a game where students share their inquiry about nature through photographs.

Grades & Levels:

- **Handout 1:** middle school
- **Handout 2:** grade 7-10

Time Recommendations:

- Up to two weeks for activities that involve taking photographs and research
- One to three class periods for group presentations and discussion

NSES (USA) Content Standards:

- NSES 2.2. Science as Inquiry: Understanding about scientific inquiry
- NSES 8.1. History & Nature of Science: Science as a human endeavor
- NSES 8.2. History & Nature of Science: Nature of scientific knowledge
- NSES 8.3. History & Nature of Science: Historical perspective

Note: View the NSES content standards on this site to choose other curricular applications for additional activities at <http://www.actionbioscience.org/educators/correlationcharts.html>

Lesson Objectives: Engaging students in scientific inquiry using photographs and research that supports the photographs helps students develop:

- Understanding of the nature of science.
- Awareness of the scientific method.
- Appreciation of "how we know" what we know in science.
- Skills necessary to become inquirers about the natural world.
- A desire to use the skills, abilities, and attitudes associated with science.

Key Words Include:

Lesson: *Why?* By Oksana Hlodan

Source: <http://www.actionbioscience.org/newfrontiers/hazen.html>

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Aesthetics, civics, citizen scientist, literate, science, scientific literacy, scientific method

Preparation

Article Discussion: Several approaches are possible for the questions on page 3:

1. Have students read the article on their own, or distribute questions to groups.
2. Give students copies of the questions and have them do the reading and complete the content questions on their own, perhaps as a short-answer writing assignment. Have them discuss their answers and the more complex questions either as a large group or in small groups.
3. For younger students, you may wish to have them read only the introductory section of the article, that is, up to "What is scientific Literacy?"

Materials Needed: Computer with digital photography importing and editing software, digital camera(s), screen and projector with computer connectivity.

Resources: See the "Useful links for educators" for resources ranging from instruction in photography to basics about the nature of science. The "Useful links for students" will help students with the activities in this lesson.

Assessment rubric for activities involving photography

Note: The quality of student photos is not assessed. Students at this age are not expected to be professional or even amateur photographers. Basic photography skills are the only requirement.

Process	Below Average	Satisfactory	Excellent
Has clear vision of final product.	1, 2, 3, 4	5, 6, 7	8, 9, 10
Project well planned and organized.	1, 2, 3, 4	5, 6, 7	8, 9, 10
Conducted research wisely.	1, 2, 3, 4	5, 6, 7	8, 9, 10
Exhibited strong inquiry skills.	1, 2, 3, 4	5, 6, 7	8, 9, 10
Exhibited basic photography skills.	1, 2, 3, 4	5, 6, 7	8, 9, 10
Communicated efforts to others.	1, 2, 3, 4	5, 6, 7	8, 9, 10
Product	Below Average	Satisfactory	Excellent
Creativity	1, 2, 3, 4	5, 6, 7	8, 9, 10
Scientific research	1, 2, 3, 4	5, 6, 7	8, 9, 10
Organization	1, 2, 3, 4	5, 6, 7	8, 9, 10
Presentation skills	1, 2, 3, 4	5, 6, 7	8, 9, 10

For Educators: Article Discussion

About the article by Robert M. Hazen, Ph.D.: Why Should You Be Scientifically Literate?

<http://www.actionbioscience.org/newfrontiers/hazen.html>

Article Content Questions

1. What is different about scientific discovery today?
2. Why do we need to know some science to read newspapers?
3. What is meant by scientific literacy?
4. If you're an expert on whale migration, are you scientifically literate?
5. If you understand computers, are you scientifically literate?
6. Are students graduating from college usually scientifically literate?
7. How does scientific literacy help you become a good citizen?
8. What's the connection between everyday life and science?
9. Does science help society be more productive?
10. How can ordinary people become scientifically literate?

Article Extension Questions

1. In your opinion, how does scientific literacy help people in general?
2. Which invention in this century has made an impact on you? Why?
3. If you were an inventor, what would you invent to make the world a better place?
4. If you were a scientist, what would be your specialty? Why?
5. What do you think is the greatest invention of all time? Why?

Why? Handout 1



WHY?

How to prepare for the quiz:

Why does the sun rise in the East? Why does your dog hear sounds you can't? Why is lightning attracted to tall trees? Are there things in nature that make you wonder "Why?" Take time to take a good look at Nature around the school, outside your home, or anywhere outdoors. Find **ten things in nature** that make you ask "Why?" Take pictures of these things and write a "Why?" question for each picture. Then research the answer to your question on the Internet or in the library. Write a short answer of about two to four sentences that answers each of your "Why?" questions.

How to play the quiz game:

In two weeks, the entire class will play the "Why?" quiz. All photos taken by every student will be presented in class. One student at a time will ask the other students if they can answer his or her "Why?" questions. When it's your turn to show your photos, ask the question you prepared for each photo. When another student guesses the answer, you can only say "yes" if the answer is correct or "no" if the answer is wrong. After a few minutes, if nobody in the class can guess the answer, you will provide the answer. So be prepared to answer by doing good research.

How to take photographs:

- Think about the "Why?" question before you take a photograph.
- Take photographs of things in nature, not things made by people.
- If you can't take a photograph of the exact thing for your question, take one of something that is related to or is a good symbol for the thing. For example, if you can't take a photo of the rising sun for "Why does the sun rise in the East?" take one of a weathervane.
- You can edit your photos in any way to make the answer to your question evident.
- As a last resort, you can scan or take a photo of a picture in a book, magazine, or personal photo album.

How to choose "Why?" Questions:

- Some things will inspire many "Why?" questions. For example, clouds may make you wonder: "Why do clouds move across the sky?" or "Why are some clouds dark?" or "Why are clouds so high in the sky?" But you are allowed only one question for each photo. You may want to pick your question based on how easy it is to research the

answer. Or, you may want to pick a question that you think your classmates will never guess the answer to easily.

- Think like a scientist. Scientists always want to know "Why?" because the answer may help them invent something or arrive at a brilliant idea.

Some examples:



Q: Why do earthquakes happen?

A: The Earth has a crust beneath the surface where the earth moves and shifts. When the force of this movement is strong enough, it causes the crust to crack and earthquakes happen.



Q: Why do alligators eat rocks?

A: The stones sit in their stomach, probably for many years, and help the alligator to break down food in its stomach by a grinding action.



Q: Why does a cat have whiskers?

A: A cat's whiskers are so sensitive that they can detect the slightest breeze. At night, for example, they help a cat walk around and not bump into anything.



Q: Why are glaciers blue?

A: When the sun shines on a glacier, the red part of sunlight is absorbed by the ice and the blue light is transmitted out. The longer the path of sunlight in ice, the bluer the glacier appears.

photos by O. Hlodan

Have Fun!

Why? Handout 2

Hmmmmmm ! ?

Why does your dog hear sounds you can't? Why is lightning attracted to tall trees? These may be questions about nature that scientists have asked before they arrived at their theory. "Why?" is a basic question in the universal scientific method that may lead to inventions and ideas that have benefited humanity.

Task: Your task is to research famous scientists or scientific breakthroughs throughout time in books, magazines, or on the Internet. Choose **five** (5) of these as your inspiration for photography. Then consider which "Why?" question may have been asked to arrive at the breakthrough, idea, or theory. You may photograph something in nature or something made by humans to represent the "Why?" question.

Quiz: All photos taken by every student will be presented in class. One student at a time will ask the other students if they can guess the invention or inventor that may have asked each "Why?" questions. When it's your turn to show your photos, ask the question you prepared for each photo. When another student guesses the incorrect answer, give a hint to the next student. After a few minutes, if nobody in the class can guess the answer, you will provide the answer. Or you may have to explain to the class why a student's answer was correct. So be prepared by doing good research.

Here are three examples:



Why does an apple fall from the tree to the ground?

Sir Isaac Newton, 1642-1727, upon observing an apple fall from a tree, began to think of gravity. Newton's 2nd Law, The Universal Law of Gravitation, is about the force that acts on the apple to cause its acceleration towards the ground.



Why does wind make some things move faster?

About 3,000 B.C., Egyptians started using cotton-made sails to help their boats go faster and with less work by oarsmen. They noticed that cloth trapped wind, which helped push the boats along the water. Then they made ships with sails large enough to cross the oceans.



Why does the sun rise and set in the sky?

Nicolaus Copernicus, 1473 - 1543, proposed the Heliocentric Theory, that is, the Earth is in daily motion about its axis and in yearly motion around a stationary sun. His idea made everyone change their view of the universe -- that everything revolved around Earth. During his lifetime, many people rejected his theory because they were worried that it contradicted religious teachings.

photos by O. Hlodan

Have Fun!