LESSON DESCRIPTION

Students will discuss big questions that need to be answered in order to help us solve problems we face today. Students will explore the ways in which scientists at The Field Museum are actively seeking answers to big questions and working to positively impact our understanding of and relationship to the world. Students will then examine big questions that inspire them to positively affect change in their community.

COMPELLING QUESTIONS

• What are big questions The Field Museum scientists have about the world?
• What is the impact The Field Museum scientists make through their research?

OBJECTIVES

Students will
• Identify investigable questions that scientists ask in order to research the biodiversity found in the natural world and the impact humans make on Earth’s environments.
• Obtain information to determine how scientists at The Field Museum use the scientific collection in their active pursuit of answers to questions about the natural world.
• Communicate ways in which scientists at The Field Museum make a positive impact through their research.

KEY WORDS

SPECIMEN – an individual animal, plant, or piece of mineral used for scientific study
COLLECTION – a group of objects or specimens used for the study of nature or human history
RESEARCH – a well thought-out inquiry or examination
CONNECTIONS TO STANDARDS

Next Generation Science Standards

DISCIPLINARY CORE IDEA

• LS2.C-Ecosystem Dynamics, Functioning, and Resilience: Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

• ESS3.C-Human Impacts on Earth Systems: Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.

SCIENCE AND ENGINEERING PRACTICE

• Asking Questions and Defining Problems: Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources, and when appropriate, frame a hypothesis based on observations and scientific principles.

• Obtaining, Evaluation, and Communicating Information: Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).

CROSSCUTTING CONCEPT

• Science Addresses Questions About the Natural and Material World: Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

• Stability and Change: Small changes in one part of a system might cause large changes in another part.

APPROXIMATE TIME

Three 40-minute class periods

PREPARATION NOTES

This is a three-part lesson (pre-field trip, during the field trip, and post-field trip). Plan out the timing of the lesson to best fit your teaching schedule and your students' learning styles.

MATERIALS

• Student Resource A (per group)  
• Writing Utensils  
• Student Resource B and C (per student)  
• Clipboards (optional)

VIDEO RESOURCES

The Brain Scoop: “The Chicago Peregrine Program”

EXHIBIT AREA OF FOCUS

All
PROcedures

Engage (in the classroom)

1. On the board or a piece of butcher paper, write the following question: What should we wear to be warm when it snows? Use the prompts below to discuss the question with students.
   - Do we have an answer to this question? What is it?
   - Why was this question originally asked? Why was it an important question?
   - Do we still ask this question? Does it mean something different to us today?

2. Repeat this procedure with the following questions:
   - How can we cook our food?
   - Can we communicate with someone on the other side of the world?

3. Tell students that the answers to these questions may seem obvious to us today, but at one point in history people worked to answer these big questions.

4. Ask students: Why do you think people had these big questions? Where did they come from? Listen for students to recognize that questions like these arise from people trying to meet their needs or solve a problem.

5. Encourage students to think about what need or problem the questions address (e.g., “How can we cook our food?” addresses our need to eat and the problem that eating raw meat causes sickness). Then ask: How did we answer these questions? Guide students to the idea that people conducted experiments or investigations in order to discover solutions to these questions.

6. Ask students: Do you think these are the same big questions that we ask today in our society? Or do we have different big questions? What needs are we trying to meet or problems are we trying to solve today?

7. Lead students in brainstorming a list of big questions that we as a society are struggling to answer today. The list may include questions such as: Will we ever go to Mars? Can we stop the polar bears from going extinct? Will we be able to cure cancer? Can we make the Internet faster?

8. Explain that just like we have had big questions throughout history, we also have big questions today that need to be solved. Tell students they will read a short article about a big question facing our world today. Explain that in small groups, students will read their article and then prepare to present the big question to the rest of the class.

9. Place students into five groups and distribute one article from Student Resource A: Scientific Articles to each group. Encourage students to select a reader, recorder, and presenter.

10. When the groups are finished, encourage each group to present their article and the big question.

11. After the presentations, tell students that these are very big questions and as they noted in their presentations have a serious impact on us. Ask students: Do you think anyone is working on answers to these questions? Who? Student responses may include: Local leaders, the government, educators/students, non-profit agencies, scientists, engineers, etc.

12. Tell students that people from different backgrounds work together to solve these questions and, as they may have guessed, scientists are usually a part of this work. Explain that often scientists look at the past in order to understand our current world, and in doing so they find answers or create solutions.

13. Provide students with the following example of how scientists often use the past to find solutions for the future:
   - In the 1960’s scientists noticed that the peregrine falcon population was declining rapidly. By using peregrine falcon eggs collected over many decades, scientists discovered that the eggshells had become thinner over time. Thinner eggshells meant that they are more likely to break before the falcons could hatch, thus creating a population decline. Through further research on the eggs, scientists determined that a chemical called DDT caused the thinning eggshells. The government ended up banning DDT, and since the 1980’s scientists have been working to support the recovery of peregrine falcon populations.
14. Ask: Where do you think scientists went to study peregrine falcon eggs collected over time? Where do collections like this exist? Guide students to the idea of museums as places where objects from the past are collected and used to study the present.

15. Explain to students that one such museum is The Field Museum. Tell students that there are hundreds of scientists who work at The Field Museum, and they actively use the huge collection of plant, animal, and mineral specimens in their research in order to answer big questions.

16. Refer back to the example from before. Explain that today, The Field Museum scientists use the collection of peregrine falcons and their eggs in order to better understand how to support the survival of these birds in Chicago. Because of the efforts of Field Museum scientists, the peregrine falcon was removed from the Illinois State Endangered and Threatened Species List in 2015.


18. Tell students that they will get the chance to visit The Field Museum in order to learn more about The Field Museum scientists and how their work is contributing to answering the big questions that face us today.

19. Prepare for any field trip procedures.

EXPLORE (AT THE FIELD MUSEUM)

1. On the bus or at the Museum, ask students to recall what they discussed in the previous lesson. Listen for students to remember talking about big questions we have about our world and the scientists who are working to find answers or solutions that address these questions.

2. Remind students they learned about how scientists work at The Field Museum and use the collection to support their understanding of the past as they work to answer questions that face us today.

3. Take students to the Specimens: Unlocking the Secrets of Life exhibit. Explain that the exhibit highlights how scientists at The Field Museum use the collections as they research the answers to big questions. Instruct students to explore the exhibit and use Student Resource B: Scientist Collector Cards to document the work of two scientists. Tell students they will present the two scientists of their choosing when they return to the classroom.

4. Distribute Student Resource B to students, and encourage them to begin exploration of the exhibit. If possible, have students select different scientists from one another so there is a wide representation throughout the class.

5. When students have finished, collect all completed student work and save for use back in the classroom.

EXPLAIN & EVALUATE (IN THE CLASSROOM)

1. Ask students to share what they remember from their visit to The Field Museum. As they are sharing, distribute completed Student Resource B to each student.

2. Pass out a pair of scissors to each student and instruct them to cut on the dotted line between the two scientist collector cards.

3. Remind students that they collected information about two different scientists and the work they are doing to answer a big question. Tell students, that when instructed, they should each move around the room trading one of their scientist collector cards for someone else’s scientist collector card. The goal is to end up with two scientist collector cards but at least one is different than their original set of cards.

4. Instruct students to begin trading. When each student has at least one new scientist collector card, and they are no longer interested in trading, have them sit down.
PROCEDURES (continued)

5. Once students have all returned to their seats, tell students they will have one minute to present the following information to the class:
   - The name of their scientist
   - Their big question
   - The impact (or possible impact) of their research

6. On the board or butcher paper, write down the big questions as students present.

**Teaching Tip:** Student presentations may also be conducted in small groups or pairs instead of the larger class. Encourage a student to record the big questions from each of the scientists and facilitate a share-out of those questions as a large group.

7. After all the presentations, refer students to the list of big questions. Begin a discussion by asking the following questions:
   - *Are any of these big questions ones that we also asked when brainstorming?*
   - *Did any of the scientists’ questions surprise you?*
   - *Looking at all of these questions, what kind of impact do you think the scientists at The Field Museum will make on our world?*

8. Then ask: *What big question do you want to help answer? What kind of impact do you want to make?* Distribute **Student Resource C: Student Collector Card** to each student. Explain that they will create a collector card for themselves, imagining the positive impact they will make on their school, community, family, larger world, etc.

9. Give students time to create their collector card. Have students partner up and share their collector cards with one another. Post the student collector cards up around the room and discuss as a large group some ideas for how to answer the big questions and create a positive impact.

ENRICHING THE LESSON

- To give students additional opportunities in generating questions from scientific collections, consider renting from the *N. W. Harris Learning Collection* ([harris.fieldmuseum.org](http://harris.fieldmuseum.org)). Possible rentals may include:
  - “Bite, Tear, Chew” Experience Box
  - “Fossils” Experience Box
  - “Snowy Owl with Prey” Exhibit Case

IMAGE CREDITS

**TITLE IMAGE**

124862_Euphaedra_cyparissa @ Allie Stone, 2014 (©The Field Museum)
WHAT LIVES AT THE BOTTOM OF THE OCEAN?

Scientists have long been curious about hydrothermal vents that are found on the ocean floor. These vents spew sulfur and other toxic chemicals from beneath the ocean. It seems impossible, but lots of life can be found near these vents including tubeworms, clams, and blind crabs. Just recently scientists on a scuba dive observed that, at certain times, thousands of brown crabs would come out of hiding and swarm the hydrothermal vents. Scientists wondered what the crabs were doing, and through research they noticed that the crabs were eating tiny creatures called plankton. Scientists discovered that the toxic plume from the vents kill the plankton, and then the crabs feast off the plankton.

Although it’s extremely difficult to get to the bottom of the ocean floor, scientists think that environments like these may give them clues to the origins of life on earth. Scientists continue to conduct research in the hopes they can learn even more about what lives, & thrives, at the bottom of the ocean.

Article Citation: Science News for Students, “A Fallout Feast for Crabs” by Emily Sohn

After reading the article, answer the following questions:

1.) What is the big question? ____________________________________________________________

2.) How does this or could this big question affect us? ________________________________________

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HOW IS OUR EARTH CHANGING?

In the past 100 years, scientific research has shown that temperatures on Earth have risen an average 0.6 degrees Celsius. That doesn’t seem like it would make a big difference, right? Scientists think that even such a small increase can lead to a big impact on life.

Because of this warming, plants and animals have been forced into new habitats and many can’t survive the change and are going extinct. The pika for example, is having a tough time handling the heat. These furry, little creatures live high up on mountains because they can’t survive in warm weather. Since 1999, scientists have studied the pika population to see if the warming Earth has had any impact. They have discovered that many of the populations have disappeared because it’s been too hot.

Scientists believe that human activity, like burning coal and oil, are largely to blame. These activities release heat-trapping gases, like carbon dioxide into the atmosphere. The more that these gases accumulate, the hotter it gets on Earth.

Article Citation: Science News for Students, “A Change in Climate” by Emily Sohn

After reading the article, answer the following questions:

1.) What is the big question? __________________________________________

2.) How does this or could this big question affect us? _______________________

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HOW DOES DEFORESTATION EFFECT THE ENVIRONMENT?

Deforestation is when a massive amount of trees in a forest are cut down or cleared from the land. Deforestation is happening so frequently that scientists are concerned that the world’s rain forests could completely vanish in a hundred years at the current rate. Deforesting usually occurs when farmers cut down trees to make room for planting or when logging companies cut down trees to make paper products.

Eighty percent of the Earth’s plants and animals live in forests, and many of these species cannot survive the deforestation that destroys their homes. In addition to massive habitat loss, deforestation also contributes to the warming temperature of our planet. Trees play an important role in absorbing a gas called carbon dioxide. Carbon dioxide traps heat from escaping our atmosphere. Fewer forests mean that larger amounts of carbon dioxide remain, and so Earth gets warmer and warmer.

Article Citation: National Geographic, “Deforestation”

After reading the article, answer the following questions:

1.) What is the big question?

2.) How does this or could this big question affect us?
WHAT DISCOVERIES CAN BE MADE FROM THE AMAZON?

Over the last ten years, scientists average that one new species has been discovered in the Amazon rainforest every three days. The rainforest is home to plants and animals not found anywhere else in the world, and scientists still have much more to learn more about this unique environment.

In addition to the diverse plant and animal populations, millions of people also make their home in the Amazon. By learning from and working with people in the Amazon, scientists have developed medicines from plants that grow in the Amazon. These medicines are used to treat many different illnesses and diseases, and in fact one in four prescriptions sold at pharmacies come from plants. Of those, one in three are rainforest plants!

The rainforests are in danger of disappearing as people cut down the forests to make room for farms. Scientists have joined forces with local people in the Amazon to save the rainforest for future generations and future discoveries.

Article Citation: Scholastic, “Inside the Rainforest” by Karen Fanning

After reading the article, answer the following questions:

1.) What is the big question? __________________________________________________________

2.) How does this or could this big question affect us? ____________________________________

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CAN WE SLOW DOWN OR STOP EXTINCTION?

Polar bear populations have decreased over time, causing concern among scientists. Warming temperatures in the Artic, where polar bears live, have caused the sea ice to melt. Polar bears depend on the sea ice to provide them with shelter, a way to hunt seal for food, and pathways to travel from one area to another. Without the sea ice, scientists predict that polar bears will become extinct.

Working with scientists to understand the impact of melting sea ice, the United States government officially listed the polar bear as “threatened” under the Endangered Species Act. Placing polar bears on the threatened list will mean that more attention will be paid to the issue of melting sea ice and a recovery plan to support polar bear population growth will be developed.

While scientists agree that this is a good first step to preventing polar bear extinction, they argue that the real problem is how to address the warming temperatures in the Artic.

Article Citation: Scholastic, “Polar Bear Protection Program” by Laura Leigh Davidson

After reading the article, answer the following questions:

1.) What is the big question? ____________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

2.) How does this or could this big question affect us? ____________________________________________________________________________

__________________________________________________________________________

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__________________________________________________________________________
Select two scientists from the Specimens: Unlocking the Secrets of Life exhibit. Create a Scientist Collector Card for each of the scientists and include the following information:

- Name
- What is the big question they are working to answer?
- How will their work affect or impact us?
- What would you say is their scientist super strength?

### SCIENTIST COLLECTOR CARD

Name: __________________________

Big Question: __________________________

Impact: __________________________

Super Strength: __________________________

Name: __________________________

Big Question: __________________________

Impact: __________________________

Super Strength: __________________________
Create your own collector card! Think about the big questions that The Field Museum scientists are working to answer and the impact they are making on our world.

- What is your big question?
- What do you want your impact to be?
- What is the super strength you can share with the world?

**DIRECTIONS:**

1. Fill out the card below.
2. Draw a picture of yourself in action on the other side of the card.
3. Cut along the dotted lines.
4. Fold along the solid line, and then tape or glue the sides together so you have one card.

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