

# The Academy of Natural Sciences – Bicentennial in Google Earth

## Day 2: Areas of Scientific Research

The activity for day 2 is an exploration of natural science research areas. This provides students with the opportunity to see what scientific research entails: everything from the methods scientists rely on to specific procedures for conducting research in the field. Students will explore websites of various natural science-related organizations and will gain a better understanding of what skills are needed to conduct scientific research.

### ABCD Objective Summary

After exploring websites of various scientific organizations, students will be able to explain what scientific researchers do, by explaining the necessary training and skill-sets, the places where scientists work, and the types of interdisciplinary collaboration and cross-discipline research that occurs.

### Earth Science Literacy Initiative “Big Ideas”

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continuously changing.
9. Humans significantly alter the Earth.

### Materials needed:

- computer with projector/projected screen for the instructor
- computer lab with 1 computer per student (each computer must have Google Earth already downloaded)
- Google Earth file: “Bicentennial”

### First 10-15 minutes of class:

Lead a discussion with students about the areas of scientific study. Be sure to cover chemistry, biology, physics, environmental sciences, and Earth sciences.

Then, define the specific areas of study at the Academy’s Center for Systematic Biology and Evolution: <http://ansp.org/research/systematics-evolution/>

- Ichthyology
- Malacology
- Ornithology
- Invertebrates
- Invertebrate paleontology
- Vertebrate paleontology
- Entomology
- Herpetology

- Botany
- Mammalogy

And the Patrick Center for Environmental Research: <http://ansp.org/research/environmental-research/>

- Biogeochemistry
- Ecology
- Ecotoxicology
- Hydrology

Have students take notes during the discussion, defining each discipline in their own words.

**Next 15 minutes of class:**

Have students will peruse the Google Earth file and fill in a T chart, matching various expeditions with their corresponding scientific discipline:

Expedition (Title, Year)	Disciplines(s)

Students should fill in the chart for all of the detailed expeditions (each in their own folder under “Places”), as well as for 5-10 of the expeditions described in the “200 Stories” folder.

**Last 20 minutes of class:**

Provide students with an online list (you may want to post these on a class website or send in an email to make it easy for students to just click the link instead of having to type it out) of the following links. Have students explore five of the following websites and complete the attached worksheet.

- ANSP Research: <http://www.ansp.org/research/index.php>
- Society of Vertebrate Paleontology: <http://vertpaleo.org>
- American Society of Ichthyologists & Herpetologists: <http://www.asih.org/>
- American Malacological Organization: <http://www.malacological.org/index.php>
- Ornithology.com’s list of organizations: <http://www.ornithology.com/organ.html>
- BIRDNET: <http://www.nmnh.si.edu/BIRDNET/>
- Entomological Society of America: <http://www.entsoc.org/>
- Entomological Foundation: [http://www.entfdn.org/education\\_links.php](http://www.entfdn.org/education_links.php)
- The Bug Club: <http://www.amentsoc.org/bug-club/>
- Botanical Society of America: <http://www.botany.org/index.php>
- American Bryological & Lichenological Society: <http://www.abls.org/>
- American Society of Plant Biologists: <http://my.aspb.org/>

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## **Pennsylvania State Education Standards**

### **Standard Area - 3.1: Biological Sciences Organizing Category - 3.1.C: Evolution**

#### **Grade Level - 3.1.6.C: Grade 6**

- Standard - 3.1.6.C1: Differentiate between instinctive and learned animal behaviors that relate to survival.
  - Assessment Anchor - S6.B.2: Continuity of Life
    - Anchor Descriptor - S6.B.2.1: Explain how certain inherited traits and/or behaviors allow some organisms to survive and reproduce more successfully than others.
  - Assessment Anchor - S6.B.3: Ecological Behavior and Systems
    - Anchor Descriptor - S6.B.3.1: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

#### **Grade Level - 3.1.7.C: Grade 7**

- Standard - 3.1.7.C2: Explain why the extinction of a species may occur when the environment changes. Explain that mutations can alter a gene and are the original source of new variations in a population.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.
- Standard - 3.1.7.C3: CONSTANCY AND CHANGE Identify evidence drawn from geology, fossils, and comparative anatomy that provides the basis for the theory of evolution.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.
- Standard - 3.1.7.C4: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

### **Organizing Category - 3.1.A: Organisms and Cells**

- Standard - 3.1.8.A9: Compare and contrast scientific theories. Know that both direct and indirect observations are used by scientists to study the natural world and universe. Identify questions and concepts that guide scientific investigations. Formulate and revise explanations and models using logic and evidence. Recognize and analyze alternative explanations and models. Explain the importance of accuracy and precision in making valid measurements.
  - Assessment Anchor - S8.B.3: Ecological Behavior and Systems
    - Anchor Descriptor - S8.B.3.2: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

### **Standard Area - 3.3: Earth & Space Sciences**

#### **Organizing Category - 3.3.A: Earth Structure, Processes and Cycles**

#### **Grade Level - 3.3.6.A: Grade 6**

- Standard - 3.3.6.A1: Recognize and interpret various mapping representations of Earth's common features
  - Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.
- Standard - 3.3.6.A6: MODELS/SCALES Describe the scales involved in characterizing the Earth and its atmosphere. MODELS/SCALES Create models of Earth's common physical features.
  - Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

#### **Grade Level - 3.3.7.A: Grade 7**

- Standard - 3.3.7.A3: Explain and give examples of how physical evidence, such as fossils and surface features of glaciation support theories that the Earth has evolved over geologic time. Compare geologic processes over time.
  - Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
    - Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.
- Standard - 3.3.7.A7: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are

based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.

- Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources

- Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

### **Grade Level - 3.3.8.A: Grade 8**

- Standard - 3.3.8.A6: CHANGES Explain changes in earth systems in terms of energy transformation and transport. MODELS Explain how satellite images, models, and maps are used to identify Earth's resources.

- Assessment Anchor - S8.A.3: Systems, Models, and Patterns

- Anchor Descriptor – S8.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts