



## K-2: Search for Life Beyond Earth

### Curriculum Connections

#### Physical Sciences Concepts

- Observe, investigate, describe, and classify materials based on their physical properties, including physical changes, such as the changes in water when the temperature rises and falls (change of state).

#### Life Sciences Concepts

- Begin to observe and describe characteristics of plants and animals, and distinguish between living and nonliving things.
- Understand that plants and animals need air, water, and food in order to live and thrive.
- Observe and explain how adaptations help plants and animals survive in their differing environments.
- Begin to explain how plants and animals depend upon each other, and how their characteristics help them survive in their differing environments (adaptations and interdependence).

#### Earth and Space Sciences Concepts

- Examine, describe, investigate, and measure Earth materials including water, rocks, soils, and sands.

#### Scientific Connections and Applications

- Become aware of and describe the importance of science and scientists in their world.
- Begin to develop an understanding and appreciation of the natural world.

#### Scientific Thinking

- Begin to ask questions and construct explanations based on observations of objects and events.
- Scientific Tools and Technologies
- Use technology and tools such as magnifiers, thermometers, balances, and computers.

#### Scientific Communication

- Acquire information from observation, experimentation, print and non-print sources.

*\* Based on the New York State Elementary Science Core Curriculum and the New York City New Standards™*

### National Standards

#### Content Standard A: Science as Inquiry

- Understanding about scientific inquiry

#### Content Standard C: Life Science

- The characteristics of organisms
- Organisms and environments

#### Content Standard D: Earth and Space Science

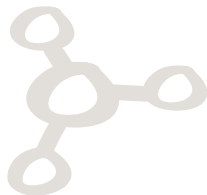
- Properties of earth materials

#### Content Standard E: Science and Technology

- Understanding about science and technology
- Abilities to distinguish between natural objects and objects made by humans

#### Content Standard G: History of Nature and Science


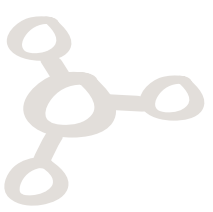

- Science as a human endeavor





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### K-2 Exhibits List



Atacama Video  
Control a Rover  
Hot and Cold Worlds  
Mars Meteorite  
Rock Samples  
Cloud Chamber  
Yellowstone Video  
Simulated Mud Pot  
Observe Yellowstone Microbes  
Smells of Living Things  
Gold Mine Video  
Sterile Sample Collection  
Observe Rio Tinto Microbes  
Deep Sea Vent Specimen  
Submersible Simulator  
Europa Surface Puzzle  
Europa Model  
Ice Flows  
Icy Bodies  
Life Under Ice  
Methane Ice Mounds Video  
Observe Methane Microbes  
Searching the Night Sky  
Visitor Feedback  
Murchison Meteorite  
How Much of Me is Water?  
Is this Alive Display?  
Definitions of Life Video  
Winogradsky Column


### Guide Theme

The theme of these guides are based on popular crime and detective show investigations on TV; a mystery unfolds, questions are asked, evidence is gathered, conclusions are drawn. This process is similar to what scientists go through with the inquiry method. For more details see About the Guides.

### Begin the Investigation At School

#### A mystery unfolds, questions are asked...

There are several ways you can introduce the topic and start the investigation. Here are some ideas that will help students start thinking about the topic and generate questions:

- 
- Create a mystery about whether there is life on other planets.
  - Create a mystery about finding living organisms in some of the hottest places on earth. (Mystery solved at Atacama Desert exhibits)
  - Create a mystery about a deep sea dive where scientists discover life where no known life was thought to exist. (Mystery solved at Deep Sea exhibits)
  - Demonstrate one of the Laboratory Activities with no explanation-let the questions begin



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- Do one of the Laboratory Activities and facilitate a probing discussion

### **Prepare for Investigation at the New York Hall of Science**

Once students have generated questions around the topic tell them they are going to continue the investigation at the New York Hall of Science.

At this point you may want to begin one of the Continuum Activities. These activities have the following features:

- Vary in length and depth
- Provide continuity and purpose for the visit
- Provide a way of assessing student understanding

### **Orientation and Planning: If you do nothing else, do this!**

Here are five reasons to conduct student orientation and planning before going on a field trip:

1. Students focus on exploring and investigation versus the novelty of the location
2. Students don't have to worry about logistics like restrooms, schedule, eating etc.
3. Students who understand the plan and purpose of the visit are more likely to stay focused
4. Students who have clear goals for their visit are less likely to race from one exhibit to another with little understanding
5. Students who get involved in the planning of the visit, take ownership and are less likely to misbehave

Read more about the Orientation and Planning Process

### **Investigation at the New York Hall of Science**

#### **Evidence is gathered...**

Okay. The class has arrived at the next phase of the investigation. The students have questions and seek answers. Everyone knows what exhibits they should visit and why. Everyone knows the schedule for the day. Students have materials to record findings or work on a Continuum Activity if required.

If all of the above is true, congratulations on a successful Orientation and Planning.

If you are curious about what teachers can do on site, we've put together a little piece called Teacher Role.

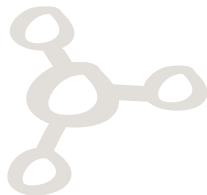
### **Finish the Investigation Back at School**

#### **Conclusions are drawn...**

There are several ways you can complete the investigation. Some require less time than others.

Here are some ideas:

- Student or group oral or written reports on investigation questions and answers
- Student or group illustrations of visit with answers to questions or mystery
- Do one of the Laboratory Activities
- Complete the Continuum Activity





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### Investigation Map

Description: Detectives will often map out related events, evidence and suspects during an investigation. This helps them get an overall picture. Students can map out their investigations with a concept map. The concept map will help you assess what students learn.

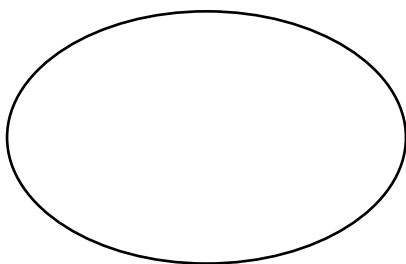
**Time:** (3)15-30 min. Sessions

*Materials Needed:*

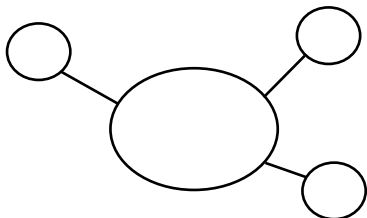
- Blank paper
- Pencils, crayons

*Procedure:*

1. Begin with a center circle and write in the name of the main topic. (Students who have difficulty with writing can have an adult assist or draw a representation of the main topic)



2. As students generate questions about the topic, they can add offshoot circles. They can also add circles for facts they know about prior to the visit to the New York Hall of Science.



3. When students return from their investigation at the New York Hall of Science they add additional circles of information. Their final map should reflect everything they know about the topic. Teachers can easily assess what is learned based on how the map develops.

### Investigation Journals

Description: Investigation journals provide a way for students to record their questions and findings throughout the investigation.

**Time:** (3)15-30 min. Sessions

*Materials Needed:*

- Blank or lined paper
- Pencils or crayons
- On-Site Investigation Handout (print out from this web site and make copies)
- Zip-lock bags (for on-site handout only)
- Soft yarn or thick soft string (for on-site handout only)

*Procedure:*

1. Ask students if they have ever seen a detective take notes when trying to solve a mystery. Tell stu-



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dents that as “science detectives” they too will make a record of the mystery.

2. Have students begin their journal or report with questions that are generated when they Start the Investigation at School.
3. Students who do not have writing skills can make a large question mark and draw representations of their questions. If an experiment or demonstration is done, non-writing students can sketch what they observe.
4. Older students with writing skills can list their own and other students questions in their journal.
5. We strongly advise students not bring journals to the New York Hall of Science where they can get lost. We have provided an On-Site Investigation Handout that can be copied if students want to record observations or make sketches.
6. When students return from their investigation at the New York Hall of Science have them write answers to questions or draw what they observed.



### Become an Explainer

Description: Student science detectives investigate one exhibit with the goal of being able to explain it when they return to the classroom. Students can choose a variety of methods to explain and make presentations.

**Time:** (1) 15 min. Session (right before going on Field Trip)  
(2) 45 min. Sessions (for in-class presentations)

#### Materials Needed:

- Interesting object (used for student observation)

#### (optional suggestions)

- Variety of craft materials (string, paints, glue, tape, colored paper, scissors, etc)
- Variety of clean, household recyclables (meat trays, cardboard tubes, aluminum foil, plastic wrap)
- Any other odds and ends students can construct with
- Poster board or paper
- Markers, crayons

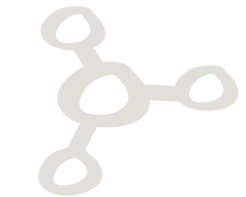
#### Procedure:

##### First Session

1. Tell students as “science detectives” they will investigating exhibits at the New York Hall of Science and will choose one exhibit to explain to the class when they return. (students can work in groups or individually)
2. Help students prepare for careful observation of exhibits by showing them an interesting object. (make sure all students can see object)
3. Now ask students to verbally describe what they see. Encourage details.
4. After students have described the object in great detail, tell them they will need to use these same observation skills when they are investigating their chosen exhibit.
5. Go to the New York Hall of Science. (encourage observation and verbal descriptions)

##### Second Session

1. Upon return to class from the trip, tell students they will spend time preparing to explain one of the exhibits they saw.



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2. Here are some suggestions for student presentations:

- Verbal explanation (with or without picture)
- Group or individual poster showing how an exhibit worked
- Group or individual model using materials to represent exhibit (materials can be used to substitute and represent real materials from exhibit— ex. Clear plastic wrap simulates glass, cardboard tube becomes a rocket etc.)

### *Third Session (optional)*

Use this time for students to make their class presentations if they made posters, drawings or models.

### Laboratory Activities

Laboratory Activities are designed for the classroom and generally require simple materials. These activities can be done before or after a visit to the New York Hall of Science. To help students use higher-level thinking and generate questions, facilitate discussion with these types of questions:

- What do you notice here?
- Tell me about this.
- What do you see?
- Why do you suppose this happens?
- What can you conclude from the evidence?

### Deep-sea Vent Demonstration

Description:

Students listen to stories of deep-sea-vent exploration while observing a colorful model of a deep-sea-vent or underwater smoking chimney.

**Time:**

(1) 20 minute session

*Materials Needed:*

- 1 large glass container that will fit the small bottle allowing it to be completely submerged in water
- 1 small bottle with neck
- Food coloring
- A piece of string
- Hot and cold water

*Procedure:*

1. Begin the session by telling this short story:

Imagine you are a scientist in a small submarine, going on an expedition to the bottom of the ocean floor, two miles down. As your submarine slowly goes down into the depths the light disappears and the water becomes very cold. When you reach the bottom you turn on your search lights and peer out into the murky water. Slowly maneuvering the submarine around, you wonder what life could there possibly be down here? No light, freezing water...but wait! What's this? A rock formation? It looks like dark smoky water coming from a chimney. The water temperature rises. And look! What is that moving over there by the chimney? It's a group of eight foot long red worms coming out of a milky-white tubes. And over there...a giant clam and yellow jellyfish that look like dandelions hanging by strings. Suddenly a blind fish swims by. It looks like a giant tadpole! Who would have thought there could be such fantastic life at these depths?

2. Tell students you are going to show them what the underwater smoking chimney might look like.



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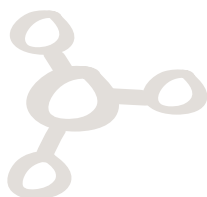
3. Fill the large glass container with very cold water.
4. Tie one end of the piece of string around the neck of the small bottle.
5. Fill the small bottle with hot water and add a few drops of food coloring.
6. Keeping the small bottle upright, carefully lower it into the glass container until it rests on the bottom. Watch what happens!
7. While watching the model deep-sea vent, tell this short story:



The story of the submarine expedition and mysterious smoking chimneys is actually true. The red worms, giant clams and blind tadpole fish are real. Not too long ago researchers visited the depths of the ocean in a deep-diving submarine called Alvin. They discovered the chimneys or deep-sea-vents and the incredible variety of life around them. They also learned that the temperature inside the vents is 570 degrees Fahrenheit and microscopic animals live inside!!

How do animals survive in this remarkable environment?

On land, energy from the sun helps plants grow. Some animals eat plants, some animals eat other animals, and some eat both. The sun is important to all life on land. BUT... there is no sunlight in deep ocean depths so how can food be produced? Scientists discovered that deep-sea-vent animals called bacteria, use chemicals in the water, rather than sunlight for energy. Other animals eat the bacteria as a food source. And of course some animals eat the other animals. So even in the depths of the ocean where there is no sunlight, life is able to thrive.



Adapted from Source: <http://www.neaq.org/scilearn/kids/seavent.html>

### Book List

Books you can use throughout the investigation are:

#### Water

- Barkan, Joanne. *Water, Water Everywhere*, Silver Press, 1989.  
Cole, Joanna. *The Magic School Bus: At the Waterworks*, Scholastic, 1986.  
Edom, Helen. *Science with Water*, Edc Publishing, 1990.  
Fowler, Allan. *It Could Still Be Water*, Children's Press, 1992.  
Jeunesse, Gallimard. *Water*, Cartwheel Books, 1990.  
Seixas, Judith S. *Water: What It Is What It Does*, Greenwillow Books, 1987.



#### Microbiology

- Anderson, Lucia. *The Smallest Life Around Us*. New York, Crown Publishers, Inc., 1978.  
Cobb, Vicki. *Lots of Rot*. J.B. Lippincott, 1981.  
Cole, Joanna. *The Magic School Bus: In a Pickle – Microbes*. Scholastic, Inc., 1997.  
Simon, Seymour. *Hidden Worlds: Pictures of the Invisible*. William Morrow & Co., 1983.

#### Mars

- Fradin, Dennis B. *Mars*, Children's Press, Chicago, 1989.  
Seymour, Simon. *Mars*, William Marrow & Co. 1987.

#### Other Planets

- Bardin, Cindy. *Easy Theme Readers – Science: Our Solar System*, Teacher Created Materials, 1997.  
Branley, Franklyn M. *The Planets in Our Solar System*, Harper Collin Publishers, 1981.  
Fowler, Allan. *The Sun's Family of Planets*, Children's Press, 1992.





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