Picture-Perfect Science Lessons

Using Children’s Books to Guide Inquiry

Grades 3–6

By Karen Rohrich Ansberry and Emily Morgan

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Foreword

I had the good fortune to meet the authors of Picture-Perfect Science Lessons, Karen Rohrich Ansberry and Emily Morgan, in the fall of 2003 at a workshop I facilitated on inquiry-based science. At that event, we had a lively discussion about the nature of science and how the teachers in attendance might impart their love of science to elementary-age children. The authors then took me aside and told me of their plans to write a book for teachers (and parents, too) using children’s literature to engage children in scientific inquiry. I have always believed that children in the elementary grades would experience more science if elementary teachers were provided better ways to integrate literacy and science. So, of course, I was intrigued.

As I reviewed this manuscript, I was reminded of one of my favorite “picture books” as an adult—The Sense of Wonder by Rachel Carson. In that book, Ms. Carson expresses her love of learning and how she helped her young nephew discover the wonders of nature. As she expressed,

I sincerely believe that for the child, and for the parent seeking to guide him, it is not half so important to know as to feel. If facts are the seeds that later produce knowledge and wisdom, then the emotions and the impressions of the senses are the fertile soil in which the seeds must grow. The years of early childhood are the time to prepare the soil. Once the emotions have been aroused—a sense of the beautiful, the excitement of the new and the unknown, a feeling of sympathy, pity, admiration or love—then we wish for knowledge about the object of our emotional response. Once found, it has lasting meaning. It is more important to pave the way for the child to want to know than to put him on a diet of facts he is not ready to assimilate. (Carson 1956)

Rachel Carson used the natural environment to instill in her nephew the wonders of nature and scientific inquiry, but I believe, along with the authors, that picture books can have a similar emotional effect on children and inspire their wonder and their curiosity. Then, when teachers and parents couple scientific inquiry experiences with the content of the picture books, science really comes to life for children. Picture-Perfect Science Lessons provides an ideal framework that encourages children to read first; explore objects, organisms, and events related to what they’ve read; discern relationships, patterns, and explanations in the world around them; and then read more to gather more information which will lead to new questions worth investigating.

In addition, Picture-Perfect Science Lessons is the perfect antidote to leaving science behind in the elementary classroom. As elementary teachers struggle to increase the basic literacy of all students, they often cannot find the time to include science in the curriculum, or they are discouraged from teaching science when literacy scores decline. Teachers need resources such as Picture-Perfect Science Lessons to genuinely integrate science and literacy.
There is no doubt that inquiry-based science experiences motivate children to learn. Through this book, teachers have the best of both worlds—they will have the resources to motivate children to read and to “do science.” What could be better?

As one of the developers of the BSCS 5E Instructional Model, I was gratified to learn that the authors intended to use the “5Es” to structure their learning experiences for children and teachers. These authors, as with many teachers across the country, had become acquainted with the 5Es and used the model extensively to promote learning in their own classrooms; however, they did not know the origin of the model until we had a conversation about BSCS and the 5Es. This book helps to set the record straight—the 5E Instructional Model was indeed developed at BSCS in the late 1980s in conjunction with an elementary curriculum project and thus is appropriately titled “The BSCS 5E Instructional Model” in this book. The authors’ iterative use of the BSCS 5Es is appropriate because the model is meant to be fluid where one exploration leads to a partial explanation that invites further exploration before a child has a grasp of a complete scientific explanation for a phenomenon. As the authors mention, the final E—evaluate—is applied more formally at the end of a unit of study, but the BSCS 5E model by no means implies that teachers and students do not evaluate, or assess, student learning as the students progress through the model. Ongoing assessment is an integral part of the philosophy of the BSCS 5Es and the authors appropriately weave formative assessment into each lesson.

Once you place your toe into the waters of this book, I guarantee that you will dive right in! Whether you are a teacher, a parent, or both, you will enjoy this inviting approach to inquiry-based science. If you follow the methods outlined in Picture-Perfect Science Lessons, you and the children with whom you interact will have no choice but to learn science concepts through reading and scientific inquiry.

I don’t know about you, but I’m rather curious about those sheep in a jeep. Enjoy!

Nancy M. Landes
Director
Center for Professional Development
Biological Sciences Curriculum Study

Reference
Preface

A class of fifth-grade students laughs as their teacher reads Jeanne Willis’s Dr. Xargle’s Book of Earthlets. Students are listening to the alien professor, Dr. Xargle, teaching his pupils about Earthlets (human babies): “Earthlets are born without fangs. At first, they drink only milk, through a hole in their faces called a mouth. When they finish the milk, they are patted and squeezed so they won’t explode.” The fifth grade class giggles at his outrageous lesson as Dr. Xargle continues to lecture. Students then begin sorting cards containing some of the alien professor’s “observations” of Earthlets. The teacher asks her students, “Which of Dr. Xargle’s comments are truly observations?” Students review their cards and realize that many of his comments are not observations but rather hilariously incorrect inferences. They re-sort their cards into two groups: observations and inferences. This amusing picture book and word sorting activity guide students into a hands-on inquiry lesson where they make observations about sealed mystery samples Dr. Xargle collected from Earth. Eventually students develop inferences about what the mystery samples might be. Through this exciting lesson, students construct their own understandings of the difference between an observation and an inference, how scientists use observations and inferences, and how to make good observations and inferences.

What Is Picture-Perfect Science?
This scenario describes how a children’s picture book can help guide students through an engaging, hands-on inquiry lesson. Picture-Perfect Science Lessons contains 15 science lessons for students in grades three through six, with embedded reading comprehension strategies to help them learn to read and read to learn while engaged in inquiry-based science. To help you teach according to the National Science Education Standards, the lessons are written in an easy-to-follow format for teaching inquiry-based science: the Biological Sciences Curriculum Study 5E Instructional Model (Bybee 1997, used with permission from BSCS). This learning cycle model allows students to construct their own understanding of scientific concepts as they cycle through the following phases: Engage, Explore, Explain, Elaborate, and Evaluate. Although Picture-Perfect Science Lessons is primarily a book for teaching science, reading comprehension strategies are embedded in each lesson. These essential strategies can be modeled throughout while keeping the focus of the lessons on science.

Use This Book Within Your Science Curriculum
We wrote Picture-Perfect Science Lessons to supplement, not replace, an existing science program. Although each lesson stands alone as a carefully planned learning cycle based on clearly defined science objectives, the lessons are intended to be integrated into a more complete unit of instruction in which concepts can be more fully developed. The lessons are not designed to be taught sequentially. We want you to use Picture-Perfect Science Lessons wherever appropriate within your school’s current science curriculum to support, enrich, and extend it. And we want you to adapt the lessons
to fit your school’s curriculum, the needs of your students, and your own teaching style.

Special Features

1. Ready-to-Use Lessons with Assessments
Each lesson contains engagement activities, hands-on explorations, student pages, suggestions for student and teacher explanations, opportunities for elaboration, assessment suggestions, and annotated bibliographies of more books to read on the topic. Assessments range from poster sessions with rubrics to teacher checkpoint labs to formal multiple choice and extended response quizzes.

2. Reading Comprehension Strategies
Reading comprehension strategies based on the book Strategies that Work (Harvey and Goudvis 2000) and specific activities to enhance comprehension are embedded throughout the lessons and clearly marked with an icon 🎨. Chapter 2 describes how to model these strategies while reading aloud to students.

3. Standards-Based Objectives
All lesson objectives were adapted from National Science Education Standards (NRC 1996) and are clearly identified at the beginning of each lesson. Because we wrote Picture-Perfect Science Lessons for students in grades three through six, we used two grade ranges of the Standards: K–4 and 5–8. Chapter 5 outlines the National Science Education Standards for those grade ranges and shows the correlation between the lessons and the Standards.

4. Science as Inquiry
As we said, the lessons in Picture-Perfect Science Lessons are structured as guided inquiries following the 5E model. Guiding questions are embedded throughout each lesson and marked with an icon 🎨. The questioning process is the cornerstone of good teaching. A teacher who asks thoughtful questions arouses students’ curiosity, promotes critical thinking skills, creates links between ideas, provides challenges, gets immediate feedback on student learning, and helps guide students through the inquiry process. Each lesson includes an “Inquiry Place,” a section at the end of the lesson that suggests ideas for developing open inquiries. Chapters 3 and 4 explore science as inquiry and the BSCS 5E instructional model.

References

Children’s Book Cited

Editors’ Note: Picture-Perfect Science Lessons builds upon the texts of 27 children’s picture books to teach science. Some of these books feature animals that have been anthropomorphized—sheep crash a jeep, a hermit crab builds his house. While we recognize that many scientists and educators believe that personification, teleology, animism, and anthropomorphism promote misconceptions among young children, others believe that removing these elements would leave children’s literature severely under-populated. Further, backers of these techniques not only see little harm in their use but also argue that they facilitate learning.

Because Picture-Perfect Science Lessons specifically and carefully supports scientific inquiry—“The Changing Moon” lesson, for instance, teaches students how to weed out misconceptions by asking them to point out inaccurate depictions of the Moon—we, like our authors, feel the question remains open.
Acknowledgments

We would like to give special thanks to science consultant Carol Collins for sharing her expertise in teaching inquiry-based science, for giving us many wonderful opportunities to share Picture-Perfect Science Lessons with teachers, and for continuing to support and encourage our efforts.

We would also like to express our gratitude to language arts consultant Susan Livingston for opening our eyes to the power of modeling reading strategies in the content areas and for teaching us that every teacher is a reading teacher.

We appreciate the care and attention to detail given to this project by Claire Reinburg, Betty Smith, and Linda Olliver at NSTA Press. And these thank you’s as well:

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- To Michelle Gallite and Erica Poulton for help in “cleaning up” our Oil Spill! lesson.
- To Theresa Gould and the research staff at RiccTec for their advice on growing rice in the classroom.
- To our husbands, families, and friends for their moral support.
- And to our parents, who were our very first teachers.

The contributions of the following reviewers are also gratefully acknowledged: Mariam Jean Dreher, Nancy Landes, Christine Anne Royce, Carol Collins, Lisa Nyberg, and Chris Pappas.
About the Authors

Karen Rohrich Ansberry is the elementary science curriculum leader and a former fifth- and sixth-grade science teacher at Mason City Schools, in Mason, Ohio. She has a Bachelor of Science in Biology from Xavier University and a Master of Arts in Teaching from Miami University. Karen lives in historic Lebanon, Ohio, with her husband, Kevin, and their two dogs and two cats.

Emily Morgan is an elementary science lab teacher at Mason City Schools in Mason, Ohio, and a former seventh-grade science teacher at Northridge Local Schools in Dayton, Ohio. She has a Bachelor of Science in Elementary Education from Wright State University and a Master of Science in Education from the University of Dayton. Emily lives in West Chester, Ohio, with her husband, Jeff, and their dog and cat.

Karen and Emily, along with language arts consultant Susan Livingston, received a Toyota Tapestry grant for their Picture-Perfect Science grant proposal in 2002.

They share a passion for science, nature, animals, travel, food, and children’s literature. They enjoy working together to facilitate Picture-Perfect Science teacher workshops.
The Picture-Perfect Science program originated from Emily Morgan’s and Karen Ansberry’s shared interest in using children’s literature to make science more engaging. In Emily’s 2001 master’s thesis study involving 350 of her third-grade science lab students at Western Row Elementary, she found that students who used science trade books instead of the textbook scored significantly higher on district science performance assessments than students who used the textbook only. Convinced of the benefits of using picture books to engage students in science inquiry and to increase science understanding, Karen and Emily began collaborating with Susan Livingston, the elementary language arts curriculum leader for the Mason, Ohio, City Schools, in an effort to integrate literacy strategies into inquiry-based science lessons. They received grants from the Ohio Department of Education (2001) and Toyota Tapestry (2002) in order to train all third-grade through sixth-grade science teachers, and in 2003 also trained seventh- and eighth-grade science teachers with district support. The program has been presented both locally and nationally, including at the National Science Teachers Association national conventions in San Diego and Philadelphia.

For more information on Picture-Perfect Science teacher workshops, go to: www.pictureperfectscience.com
Earthlets

Description
Learners develop understandings of the differences between observations and inferences by analyzing Dr. Xargle’s comical, yet misguided, attempts to teach his students about human babies. Learners then make observations and inferences of “mystery samples” collected from Earth by Dr. Xargle.

Suggested Grade Levels: 3–6

Lesson Objectives

Content Standard A: Science as Inquiry

K–4: Employ simple equipment and tools to gather data and extend the senses.

5–8: Develop descriptions, explanations, predictions, and models using evidence.

Content Standard B: Physical Science

K–4: Understand that objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances, and thermometers.

Featured Picture Books

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<th>Author</th>
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<th>Publisher</th>
<th>Year</th>
<th>Genre</th>
<th>Summary</th>
</tr>
</thead>
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<td>Dr. Xargle’s Book of Earthlets</td>
<td>Jeanne Willis</td>
<td>Tony Ross</td>
<td>Andersen Press</td>
<td>2003</td>
<td>Story</td>
<td>Dr. Xargle, a green, five-eyed alien, teaches a lesson about that most mysterious of creatures: the human baby.</td>
</tr>
<tr>
<td>Seven Blind Mice</td>
<td>Ed Young</td>
<td>Ed Young</td>
<td>Penguin Putnam Books for Young Readers</td>
<td>2002</td>
<td>Story</td>
<td>Retells the fable of the blind men discovering the different parts of an elephant and arguing about its appearance</td>
</tr>
<tr>
<td>Earthlets as Explained by Professor Xargle</td>
<td></td>
<td></td>
<td>Dutton Children’s Books</td>
<td>1988 (reprinted 1994 by Puffin)</td>
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Time Needed

This lesson will take several class periods. Suggested scheduling is as follows:

Day 1: **Engage** with read aloud of *Dr. Xargle’s Book of Earthlets*, **Explore** with word sorts, and **Explain** with observation versus inference and Inference Frayer Model

Day 2: **Explore** and **Explain** with mystery samples from Planet Earth

Day 3: **Elaborate** with *Seven Blind Mice*, **Evaluate** with Observation and Inference Practice

Day 4: **Evaluate** with review and Observation and Inference Quiz

Materials

- Black film canisters with lids (1 per student) to make mystery samples: Before the mystery sample from Planet Earth activity, prepare one film canister for each student. Put in items that make distinctive sounds, such as water, a paper clip, rice, a marble, or a penny. Make the mystery samples in pairs so you can randomly distribute two of each kind: two canisters with rice in them, two with marbles in them, and so forth. (Make sure you put in equal amounts, such as 1 tsp. rice in each and one of the same-sized marble in each.) Number the canisters, and make a key so you can determine whether students have found a matching sample.
- Magnets for testing magnetic properties
- Balances for measuring mass

Student Pages

- Earthlets Word Sort Cards
- Inference Frayer Model
- Mystery Sample from Planet Earth Data Sheet
- Observation and Inference Practice
- Observation and Inference Quiz
Engage

Read Aloud
Introduce the author and illustrator of Dr. Xargle’s Book of Earthlets. If you are using the version published under the title Earthlets as Explained by Professor Xargle, refer to the alien teacher as professor rather than doctor. All other information in the book is the same.

Making Inferences
Show students the cover of the book, and ask the following questions:
? Who do you think Dr. Xargle is?
? What do you think Earthlets are?
Then read Dr. Xargle’s Book of Earthlets to the class.

Explore
Ask students the following questions after reading the book:
? Who is Dr. Xargle? (a teacher or professor from another planet)
? What are Earthlets? (human babies)
? What observations did Dr. Xargle make about human babies? (responses will vary)
? What is an observation? (information taken in directly through the senses)

Word Sorts
Word sorts help learners understand the relationships among key concepts and help teach classification.
Open Sort: Pass out the Earthlets Word Sort Cards student page to each pair of students. Have them cut out the cards containing several statements made by Dr. Xargle about Earthlets. Then ask them to sort the cards any way they wish. At this point, it should be an open sort, in which students group the cards into categories of their choice and then create their own labels for each category. As you move from pair to pair, ask students to explain how they categorized the cards. Then ask
? Do you notice any differences among the kinds of statements Dr. Xargle makes on the cards?
? Which statements are truly observations: information Dr. Xargle got directly through his eyes or ears?

Closed Sort: Tell students that now you want them to classify the cards into only two groups: statements that are observations and those that aren’t. Give them time to sort the cards.
Next, make a T-chart on the board. Don’t label it yet. Discuss the statements the students have identified as observations. As students give answers, write them on the left side of the T-chart if they are truly observations with the corresponding (incorrect) inferences on the right. Then ask
? Does anyone know what the statements on the right-hand side of the T-chart are called? (inferences)
Next, label the T-chart with “Observations” on the left and “Inferences” on the right.

Sample T-Chart

<table>
<thead>
<tr>
<th>Observations</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthlets are patted and squeezed.</td>
<td>Earthlets are patted and squeezed so they won’t explode.</td>
</tr>
<tr>
<td>The parent Earthling mashes food.</td>
<td>Earthlets are fed through the mouth, nose, and ears.</td>
</tr>
<tr>
<td>The parent Earthling dries the Earthlets.</td>
<td>Earthlets are dried so they won’t shrink.</td>
</tr>
<tr>
<td>Earthlets are sprinkled with dust.</td>
<td>Earthlets are sprinkled with dust so they won’t stick to things.</td>
</tr>
</tbody>
</table>
**Explain**

**Observation versus Inference**

Discuss the differences between observations and inferences using the following explanation: “Making an *observation* involves using one or more of the senses to find out about objects or events. Making an *inference* involves logical reasoning—drawing a conclusion using prior knowledge to explain our observations. A problem Dr. Xargle has is that he makes incorrect inferences to explain his observations. Dr. Xargle observes people patting their babies. Dr. Xargle infers that people pat babies so the babies won’t explode.”

? Why do people really pat babies? How do you know? (People pat babies so they will burp or to calm them. We know this from our past experiences with babies.)

Use the following example to further illustrate the concept of inference: “Inferences are always based on observations. When you make an inference, you use your observations combined with your past experiences to draw a conclusion. Think about this example: You are walking on the grass barefoot. It is a warm, sunny day. You reach the end of the grass and have a choice between walking barefoot on blacktop or on a sidewalk. You notice heat waves rising from the blacktop. You choose to walk on the sidewalk, because you *infer* from the heat waves and your prior knowledge about dark surfaces that the blacktop is too hot. This is an inference because you did not directly observe the temperature of the blacktop by stepping on it, but your observations, combined with past experience, lead you to the conclusion that the blacktop is hotter than the sidewalk.

“Dr. Xargle, being from another planet, doesn’t have any past experiences with human babies. So, he makes inferences that are incorrect. For example, Dr. Xargle makes an incorrect inference about the babies exploding if they are not patted. He does not base his inference on past experience with Earthlets (perhaps babies from his planet explode if not patted!). Sometimes scientists have to reject their first inferences when observations later disprove them. If Dr. Xargle went back to Earth to make more observations, he would be able to revise his incorrect inferences.”

Lead students to more examples of inferences by asking the following questions:

? Your dog comes in from outside and you observe its fur is wet. What inferences could you make from your observation? (It is raining outside, your dog jumped in a creek, someone gave it a bath.)

? You walk into your backyard and you observe feathers all over the ground. What inferences could you make from your observation? (An animal caught a bird, someone had a pillow fight, birds were fighting.)

? A paleontologist observes a fossil of a fish in the desert. What inferences could she make from her observation? (The desert was covered with water at one time, someone dropped the fossil there.)

**Explain**

**Inference Frayer Model**

The Frayer Model is a tool used to help students develop their vocabularies. Students write a particular word in the middle of a box and proceed to list characteristics, examples, nonexamples, and a definition in other quadrants of the box.

Give each student an Inference Frayer Model student page. Explain that the Frayer Model is a way to help them understand the meaning of concepts like *inference*. Have students formulate a definition for inference in their own words in...
Sample Frayer Model for “Inference”

<table>
<thead>
<tr>
<th>Definition</th>
<th>Characteristics</th>
</tr>
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</table>
| Conclusion you draw to explain your observations | - Uses your past experiences
| | - Always based on observations

<table>
<thead>
<tr>
<th>Examples</th>
<th>Nonexamples</th>
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</thead>
</table>
| I inferred that it was raining outside because people came in carrying wet umbrellas | I saw an umbrella

Explore

Mystery Samples from Planet Earth

Tell students that they are scientists from Dr. Xargle’s planet and that he has asked for their help in identifying certain samples that have been collected from Planet Earth. The problem is that students cannot look directly at the samples to make observations. The samples must be kept sealed in small black containers because Dr. Xargle believes they could contain radiation or harmful microorganisms. Tell students that under no circumstances can they open the containers. Discuss the properties of the objects that they might be able to observe without looking at them (sound, mass, and magnetic properties). Then pass out the Mystery Sample from Planet Earth Data Sheet and the sealed mystery samples.

Procedure for Mystery Samples from Planet Earth Activity

1. Before the lesson, prepare one film canister for each student. Put in items that make distinctive sounds, such as water, a paper clip, rice, a marble, or a penny. Make pairs of canisters so that you can randomly distribute two of each kind: two canisters with rice in them, two with marbles in them, and so forth. Make sure you put equal amounts of materials in each pair of canisters, such as 1 teaspoon rice in each, and one of the same-sized marble in each. Number the canisters and make a key so you will know whether students have found a matching sample.

2. Students can calculate the mass of the samples in their canisters by subtracting the mass of an empty canister from the mass of their full canisters.

3. Ask students to make observations of the sounds the samples make. Walk around and check their descriptions. Are they making observations or inferences? They may find it difficult to make an observation of sound without inferring based on past experience. Accept observations such as “swishy,” but do not accept inferences such as “It is water” at this point. Students should be using their senses to describe the top left box of the Inference Frayer Model student page. Then have students write some characteristics of inferences in the top right box. Have students work in pairs to come up with examples and nonexamples from their own lives. Encourage them to use their previous experiences as a basis for their inference examples. Refer back to the blacktop example and encourage them to think of similar experiences from their lives. For nonexamples, encourage students to think of direct observations they have made using their senses. Students can then present and explain their models to other groups. As they present to each other, informally assess their understanding of the concept and clarify as necessary.
what they hear without making inferences as to the identities of the samples.

4 Students can slide a magnet against the side of the film canister to observe whether the contents move with the magnet.

5 Have students make an inference about the contents of their canisters. “I think the mystery sample is __________ because__________________________.”

FINDING THE MASS OF A “MYSTERY SAMPLE”

Explain

After they have finished the Mystery Sample from Planet Earth student page, and before they open their containers, discuss how scientists use observations from their data to make inferences. For example, biologists collect evidence from scat (animal droppings) to make inferences about the diet and habits of animals they are studying. Forensic scientists examine evidence from crime scenes to infer what happened during a crime. Archaeologists make observations of artifacts to infer how people lived long ago. Paleontologists study fossils to make inferences about ancient life forms. And very often, scientists have to make inferences without ever knowing for sure if those inferences are correct.

Students will want to open their samples to see if their inferences were correct, but don’t let them yet. Instead, have them take turns quickly sharing the unseen, but observable, properties of their objects, such as

- “My object has a mass of 18 grams.”
- “My object makes a rattling sound.”
- “My object is magnetic.”

Then, have each student get up and sit next to the person he or she thinks has the same sample based on the mass, sound, and magnetic properties of the sample. Use the key to check whether or not each student located his or her matching sample.

Have students explain what properties their objects may have that can’t be observed, such as:

- shape
- color
- temperature
- ability to react with other substances

Discuss the following: “Think about some things in the world that cannot be directly observed using the senses. For example, atoms, which are the building blocks of all matter, are much too small to be seen, even with the most powerful microscopes. How, then, do scientists learn about the structure of atoms? Just about everything known about atoms has been learned from indirect evidence. This evidence is gathered by studying how matter behaves in all kinds of chemical reactions. Scientists have to make inferences about the structure of atoms based on this indirect evidence rather than by directly observing them. These inferences help develop various models of atoms. Does anyone know for sure what an atom looks like? No. Just as you can’t be sure about what is inside your containers.”

Let students open their containers now, or make them wait until the next class period—or the end of the year. Or, if you really want to make your point, never let your students open them!
Elaborate

Seven Blind Mice

Questioning
Introduce the author and illustrator of the book, Seven Blind Mice. Show students the cover of the book.

? What do you think this book might be about?

Then read the book aloud. Ask the following questions:

? What did the first mouse observe? (He felt the elephant’s foot.)

? What did he infer from his observation? (He thought it was a pillar.)

? What did the seventh mouse do before making an inference? (She ran from one end of the elephant to the other and made observations of each part.)

? Why is it a good idea to make multiple observations before making an inference? (When you base your inference on more observations, you are less likely to make an incorrect inference.)

? The mouse moral is, “Knowing in part may make a fine tale, but wisdom comes from seeing the whole.” How does this apply to making good observations and inferences? (Making only one observation may allow you to make an inference, but it is not likely to give you the big picture. Making multiple observations is more likely to give you the wisdom to draw an accurate conclusion about something.)

Making Connections: Text-to-Text

? What advice could White Mouse give Dr. Xargle about his study of Earthlets? (Dr. Xargle should go back to Earth to make more observations, reject his original ideas about Earthlets, and make new inferences.)

Evaluate
Observation and Inference Practice
Have students practice making observations and inferences using the Observation and Inference Practice. Check for understanding by having students explain their thinking.

Review and Observation and Inference Quiz
After reviewing the differences between observations and inferences, have students complete the Observation and Inference Quiz. Answers are below:

1. Answers will vary, but should be based on what can be directly observed in the picture. Responses may include the following: water or another liquid is dripping from the fish bowl, water or another liquid is on the floor, there is no fish in the bowl, the cat is “smiling.”

2. Answers will vary, but should be based upon the observation in question number 1. Responses may include the following: the cat put its head in the fishbowl, the cat ate the fish, the cat is happy.

3. b.

4. b.

5. d.

6. c.

7. Answers will vary, but should indicate an understanding of the difference between an observation and an inference.
Inquiry Place

Have students investigate animal tracks in a natural area. A good time to do this is when the ground is wet or snow-covered. Students can place food in the area to attract animals. A cast of a track can be made by encircling it with a dam made of a strip of poster paper taped together at the ends, and then pouring plaster of paris into the track.

If a natural area is not available, you can construct a simulation by placing two or more different kinds of animal footprints made of paper on the floor of the classroom. Arrange them in a pattern that suggests how the animals interacted. For example, place rabbit and fox footprints in a pattern that implies there was a chase. When students enter the room, they can try to figure out what happened. As they work to solve the mystery, assess their ability to distinguish observations from inferences.

? What observations can you make about the footprints?
? What inferences can you make from your observations?

Students can present their findings in a poster session.

More Books to Read


Summary: This book for upper elementary students provides a wealth of information about how scientists study the world using powerful electron microscopes. The book features the work of microscopist Dennis Kunkel, who has examined and photographed objects ranging from a mosquito’s foot to a crystal of sugar to the delicate hairs on a blade of grass. It describes how he became interested in microscopes as a boy, how he prepares specimens for study, and how different kinds of microscopes work. The description of how he worked on Mount St. Helens in 1980 in order to study the effect of volcanic ash on algae is an exciting example of how scientists do their jobs.


Summary: A detailed painting of an animal’s skull represents each letter of the alphabet. The name of the animal isn’t revealed, but visual tips to its identity are given in the background and through clues in the text. Readers will enjoy using their observational skills and prior knowledge to make inferences about the identity of the animals.


Summary: This picture book for lower elementary students leads readers through the process of identifying animals and animal activities by their tracks. Explaining that scientists use clues to investigate the natural world, the book tells readers to make observations of a set of tracks, collect information about the animals that left those tracks, and finally infer what happened based on information revealed by the tracks.
Earthlets
Word Sort Cards

| The parent Earthling dries the Earthlets. | Earthlets are sprinkled with dust. |
| Earthlets are fed through the mouth, nose, and ears. | Earthlets are dried so they won’t shrink. |
| The parent Earthling mashes food. | Earthlets are patted and squeezed. |
| Earthlets are patted and squeezed so they won’t explode. | Earthlets are sprinkled with dust so they won’t stick to things. |
Name: __________________________

Mystery Sample From Planet Earth

Data Sheet

| Mass          | Sample + Container = _____ g |
|              | Empty Container = _____ g    |
|              | Sample = _____ g             |

| Sound        | Make an observation of the sound your sample makes when you shake the container: |
|              | __________________________________________ |
|              | __________________________________________ |

| Magnetic Property | Use a magnet against the side of the container to determine if the sample is attracted to a magnet. |
|                   | _____ YES    _____ NO            |

| Inference     | I think the mystery sample is |
|               | because______________________ |
|               | ____________________________ |
Look at the picture. List in the chart below three observations and three inferences that can be made from those observations. An example of each is given for you.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>The man is sitting by a fireplace.</td>
<td>The man is warm.</td>
</tr>
</tbody>
</table>

Name: ___________________________
Look at the picture above. Write one observation about the picture. Then write one inference based upon that observation.

1 Observation: ______________________________________________________________________

2 Inference: ______________________________________________________________________

3 Scientists must be able to tell the difference between observations and inferences. Which of the following is an inference?

   a The bird has blue feathers and a yellow beak that measures 3 cm long.
   b The rodent might be nocturnal, because it has large eyes and long whiskers.
   c The snake is wrapping its body around its prey.
   d The leaf measures 12.4 cm long.
A scientist discovers the body of an unknown species of frog in the rainforest of Brazil. She writes several statements in her journal about the animal shown above. Which of the following is an observation about the frog?

a. The frog might be poisonous because it is very brightly colored.

b. It has a mass of 22.4 grams.

c. The frog is probably a tree climber because it has large, round toe pads.

d. I think the frog is a species of poison dart frog because of its size and color.
A student placed 50 mealworms in the middle of an aquarium containing a light, a cardboard tube, and a water dish. He waited 5 minutes and then recorded the data in the table above. Analyze the data. Which of the following is the best inference that could be made from the data?

a. One mealworm went to the water dish in Trial 1.
b. 44 mealworms went to the cardboard tube in Trial 2.
c. Mealworms seem to prefer light places.
d. Mealworms seem to prefer dark places.
A scientist finds the skeleton of an animal that lived long ago. He observes that the animal had broad, flat teeth and feet with hooves. What is the best inference he could make from his observations?

a. The animal lived in an area with few trees.
b. The animal was a good swimmer.
c. The animal was probably a plant eater.
d. The animal was probably a meat eater.

Write about a time you made an incorrect inference. What observations led to your incorrect inference? What observations made you realize your inference was incorrect? Use the back of this sheet if you need more space.

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