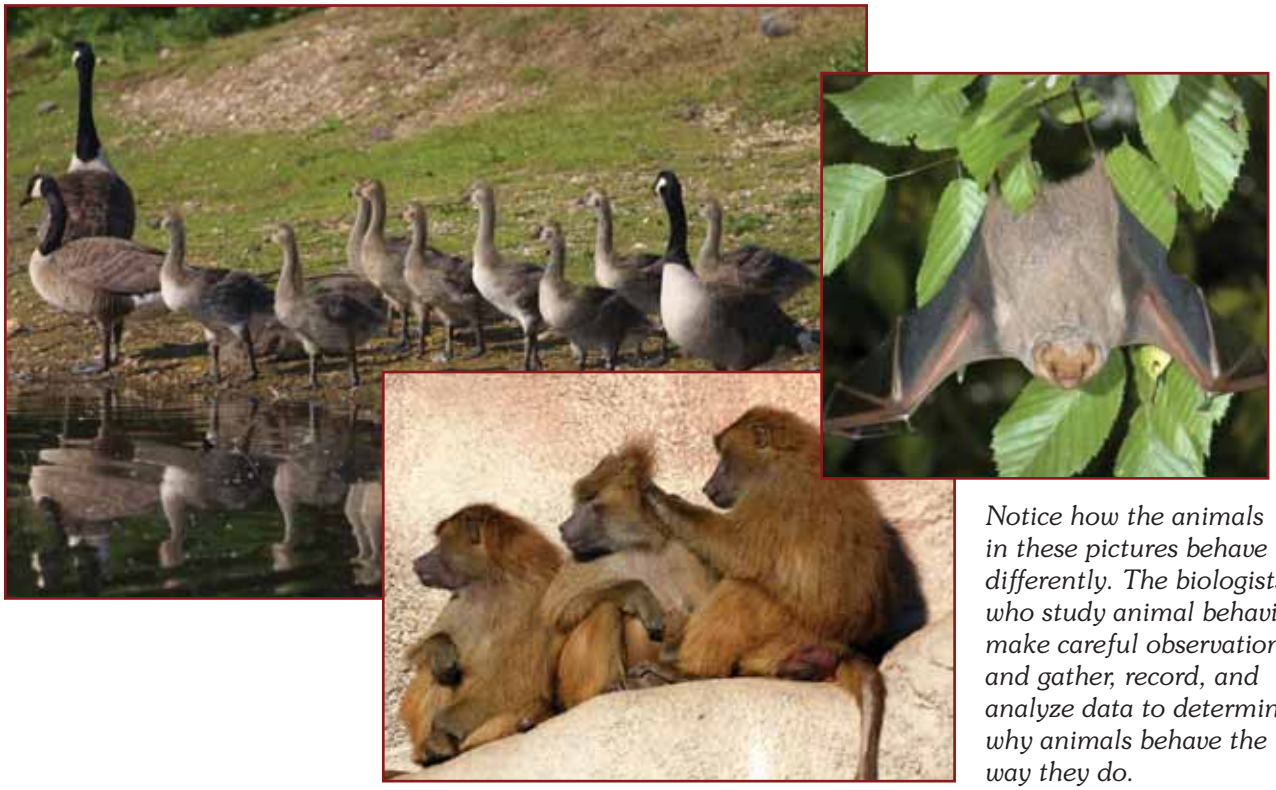
Learning Set 1

How Do Biologists Study Animal Behavior?

Animals are interesting to people. Humans work hard to understand why animals behave the way they do. People have been observing animals for hundreds of years. The *Big Question* for this Unit is: *How do scientists answer big questions and solve big problems?* You will answer this question in the context of the science question: *Why do animals behave the way they do?* You will apply what you are learning to designing a zoo enclosure. Before you start your observations, you need to break the *Big Question* into smaller questions. The smaller question you will answer in this *Learning Set* is: *How do biologists study animal behavior?* To answer this question, it will be important to work as biologists work, by making careful observations. You will be thinking about how to gather, record, and analyze data about animals in a way biologists do.



Notice how the animals in these pictures behave differently. The biologists who study animal behavior make careful observations and gather, record, and analyze data to determine why animals behave the way they do.

1.1 Understand the Question

Observing Animal Behavior

data: (singular, datum) recorded measurements or observations.

ethologist: a biologist who studies the behavior of animals in their natural environment.

Whether you are observing animals, people, machines, or stars, observation is a critical science skill. Without careful observations, scientists could not explain the way the world works. When scientists make observations, they gather a lot of **data**. The data serve as a record of what the scientists observed. By making a record, a scientist can return to the data often and for different purposes. Without a record, the scientist would just be working from memory, and memory is not always reliable.

Ethologists are biologists who study how animals behave. They observe animals to explain why animals behave the way they do in their natural environment. Ethologists usually observe animals to answer the following questions:

- How do different behaviors help an animal survive?
- How do the animal's environment and learning affect different behaviors?
- How do behaviors change as the animal grows?
- How do animals that are similar to each other act in similar or different ways?

To answer these four questions, ethologists observe very carefully and for long periods of time. Ethologists collect a lot of information, or data. To make sense of all the data they collect, ethologists use specific rules to describe and classify what they observe.

You, too, can be an ethologist as you investigate the behavior of animals. In this Unit, you will think about some of these questions. In this *Learning Set*, you will develop some of the tools and observation methods ethologists use when they observe animal behavior. You will work by yourself, with your group, and with your class to record and analyze your observations. You will then use those observations and what you know about the animals to explain why they are behaving the way they are.

Get Started

You will begin your investigations of animal behavior by observing familiar animals: middle-school students. Your teacher has asked a small group of

your classmates to act as middle-school students usually act. They will show you about three minutes of behavior. They will try to act as they would in their natural environment. Your goal is to accurately observe and record the details of the students' behavior. Be sure to watch carefully and record your observations as specifically as you can.

Communicate

Three minutes of behavior might have seemed short when you first started watching it, but it is amazing how much there is to see in three minutes. Share your observations with your class. Describe what you saw as carefully as you can. Listen carefully so you can decide if all of you saw the same things or if you saw different things. Listen to the details of each observation so you can decide if the observation was accurate.

Discuss with your class the challenges of making observations. Describe the way you made your observations. Did you focus on one person or the whole group? Perhaps you listened more than you watched. Tell your class how you made your observations. Tell your class how confident you are of your observations.

Reflect

You probably saw many of the same things as your classmates. But you might have described them a little differently. Details are very important. Details help you tell the difference between accurate observations and inaccurate ones. Answer these questions to help you think about making observations and how you might improve on making observations.

1. After you listened to others' descriptions, how confident were you about your observations?
2. The next time you make observations, what will you do to make your observations as detailed as possible?
3. How important was the amount of detail people included in their observations? How did the level of detail help you know what happened in the middle-school scene?
4. Look back at your observations. If someone else read them, could they sketch a picture of what you saw? What could you do to help someone be able to sketch a picture?

What's the Point?

Scientists make observations to help them find out more about the world. When scientists make observations, they include as much detail as possible. When they include details, other scientists can read their descriptions and understand them. Then other scientists are able to decide if the observations are accurate. An ethologist is a scientist who studies how animals behave.

Eastern bongo antelope calves in their natural habitat. Their coats are reddish brown with bright white strips, which help provide camouflage from their enemies.

1.2 Explore

How Can You Improve Your Data Collection?

Plan Your Data Collection

ethogram: a table used to record observations of animal behavior.

Ethologists need to record what they see in a way that will allow them to remember it later. One way to record behavioral data is by using an **ethogram**, a table that describes behavior. Scientists also need to agree with each other about what they saw. They might want to compare what they saw one time to what they saw another time. They need good records to do that. They also need to record what they saw well enough so other scientists can use their data. In the previous section, you discussed some of the things that make it difficult to make good records of your observations. In this section, you will use a type of ethogram to keep records.

You will have another chance to observe and record the behaviors of middle-school students. This time you will use a type of ethogram to keep records. Work together with your group to plan how to keep good records of what you see. Tell each other what you think you saw the first time. Pay attention to where you agree and disagree with each other. Then, think about what you will have to watch and what you will have to record to be able to make detailed observations that you agree about. The questions below can be used to help you think about issues that might affect your observations. To make accurate and detailed observations, you might also think about whether others could draw a picture based on your description.
If they can, your description is very detailed. Consider the following questions:

- Will you watch an individual or all the students in the small group?
- How will you make sure you have observed all the members of the group?
- How will you make sure you have observed all the different behaviors?
- Will you each watch the whole scene or will it help to divide the observation task among all the members of your group?
- How will you record what you see?
- Will you take notes on everything you see?

- How can you record quickly enough so you don't miss anything? Can you write key terms and not full sentences?
- Will you draw a picture?
- Will you keep track of the amount of time each behavior lasts? If so, how will you do this?

After you have discussed your ideas with your group, develop a plan you will use to make your observations. Use the questions to help you decide on your plan. Make sure all members of your group agree on the plan and know how to follow through on it.

Observe

category: a set or class of things with similar characteristics, properties, or attributes.

trend: something that occurs over and over again.

As you watch your classmates, pay careful attention to the details of the situation. Make sure you record all your observations accurately. Follow the plan you made in your group as closely as possible.

Analyze Your Data

The next step after collecting observational data is to make sense of it. You need to analyze it to understand what was going on. When scientists analyze observational data, they first check to see if their observations are the same as those of others. They discuss anything different and try to come to agreement. Next, they work to organize the data in a way that will let them see **categories** and **trends**. They identify the trends in the data—sequences of behaviors that they see over and over. You will do that with the observations you and your group have made. After you have completed the steps below, you will present your analysis to the class.

1. Determine what everyone saw.

   Allow each group member to describe the behaviors they saw. Listen carefully to the observations of other group members. Decide if all of you saw the same things or if some of the observations were different. Think about why the observations might be different, and share your ideas with your group. Be sure to report any difficulties you might have had using the observation procedures your group decided on. It is important that you describe not only what you observed but also how you made each observation. This will help other students understand the data.

2. Organize your data into categories.

   The first step in analyzing your data is organizing it. You probably have many notes. You cannot understand your data with disorganized

notes. Begin by copying each observation onto a sticky note. Put only one observation on each note. Your entire group will also copy their observations. If some are repeated, you can make just one sticky note for that observation.

Once each observation is on a separate sticky note, read through them and discuss how they might be grouped into categories by behavior. Combine observations of similar behaviors. If you disagree with the categories, ask others why they think a behavior fits into that category. Sometimes it is necessary to reorganize categories as more observations are read. Once you have each observation in a pile, use index cards to label the categories.

3. Identify trends.

As a group, prepare a description of the behaviors in each category. The description needs to be specific enough that other students in your class can recognize it. This will help you describe your groupings to the rest of your class.

Communicate

Each group will now share the categories they created and the reasoning behind their categories. Listen carefully to see if others made the same observations you made. Also, listen as each group describes their category labels. Think about whether they used the same labels as your group. Consider whether each group's labels would be understandable by other scientists.

Reflect

Each group probably did not create exactly the same categories, but each group had reasons for creating its particular categories. You will be learning more about observing animals and creating categories during this *Learning Set*. To prepare for that, answer the following questions and discuss the answers with your class. Listen carefully as other groups share their

Feeding is one category of behavior common to all animals, including humans.

ideas. By working together, you may hear ideas that can help you improve your work. You will use the answers to improve your procedures, observations, and analyses.

1. What are the main categories of behaviors you found in your observations of the middle-school students?
2. How difficult was it to stick to the procedure you decided on in your planning?
3. What were the issues in your procedure that affected how you made your observations? Were your observations more complete or less complete because of your procedure?
4. What will you do to improve your procedure the next time you make this type of observation?
5. What will you do to improve your observations and analysis for the next time?
6. Why do you think different groups made different observations and identified different categories?

reliable data: data that is the same when collected many times or by different people.

Be a Scientist

Reliable Data

In this Unit, you will be collecting a lot of information. Most of the information will come from your observations of animals. This information is called **data**. Data can be collected in a lot of different ways. In some Units, you will collect data made up of numbers. You may set up an experiment and measure time, distance, or temperature. In this Unit, you will collect and analyze *observational* data.

Making good scientific decisions requires **reliable data**. Observational data is more reliable when the same procedure is used each time the data is collected. The same procedure also means that another person could use the procedure and collect similar data.

In this Unit, you will use the data from your observations to develop interpretations. Scientists use data to develop their interpretations. If the data are very reliable, then the interpretations are more reliable as well.

What's the Point?

Ethologists look for reasons why animals behave the way they do. They try to answer four different questions:

- How do different behaviors help an animal survive?
- How do the animal's environment and learning affect different behaviors?
- How do behaviors change as the animal grows?
- How do animals that are similar to each other act in similar or different ways?

To answer these questions, scientists need to make and analyze observations. Accurate, detailed observations are essential to understanding animal behavior. When you record your data, you can better analyze your data, share your work with others, and answer scientific questions. Ethologists share their observations and analyses with others who can help decide if the observations are accurate and detailed enough to help determine why animals behave as they do. They can do this only if they make careful observations, support their reasoning, and analyze their data to correctly identify categories of behaviors.

The behavior of these ducks could be in the category of parenting.

1.3 Explore

Observing and Interpreting Animal Behavior

You have made some observations of animal behavior by watching your classmates. While you were making your observations, you might have thought about how difficult it was to make accurate observations of animals. Observing animals' behavior can be difficult. Many things happen in a short time. Not only do you have to watch the animals themselves, but you have to be aware of what is happening around them.

You may have had difficulty sticking with your group's plan. You may have noticed that when you discussed your observations with your group, you had each made different observations. All these experiences show the importance of designing good plans for making observations if you want to understand animal behavior. Ethologists work hard to make accurate observations and use them to support their interpretations of animal behavior.

In this section, you will apply the observation methods you used in the last section to observe some animal behavior. It would not be possible to bring a lot of animals to your classroom, so you are going to observe pictures of animals to determine what the animals are doing.

You might observe that this dog is brown and has long ears. But, if you say that this dog looks guilty, you are interpreting the dog's behavior.

As you make your observations, be sure to look at all parts of the picture. Describe what the animal is doing in the picture. Pay attention to whether the animal is with others or alone. Take note of the animal's environment. Keep in mind the questions ethologists investigate, especially how the animal's environment affects its behavior.

Observe

Pictures of Human Behavior

Begin this investigation by looking at one of the pictures of people below. Use the same techniques you learned in the last section. Pay attention to the details in the picture. What is happening around the people? What knowledge can you gain from the picture? On your own, write a description of the picture. Record at least two behaviors you observe in the picture.

Picture #1

Picture #2

Picture #3

Picture #4

Conference

When you have completed your observations, discuss them with your group. Discuss what is happening in your picture and why you think the details you recorded are important. Could someone draw a picture based only on your description? If not, return to your picture and, with your group, write more descriptive observations. As you discuss your observations, work with your group to write descriptions on which you all agree. Make a list of these observations.

Communicate

Share your descriptions with the class. As you listen to one another's descriptions, notice where you agree and disagree. Think about how you might have described some of the pictures differently. Perhaps the class can identify some reasons why it is so hard to come to agreement about how to describe what you see.

interpretation: a description of the meaning of something.

Be a Scientist

Observation and Interpretation

When people say that animals are smiling, laughing, or talking to each other, they are giving animals human traits. Sometimes when people observe animal behavior, they describe the animal behavior as if the animals were people. Many people believe animals think and feel the way people do. It is natural for people to think animals have human feelings and emotions. They are interpreting the animals' behavior as though it is similar to human behavior. Thinking about animals as having human behaviors can become a problem when you study the behavior of animals scientifically. In a scientific study of animal behavior, it is important to observe what animals are actually doing. When ethologists record their observations, they work hard to separate observations and **interpretations**. They also make sure any interpretations they make are supported by many observations.

You make observations all the time. You notice that your best friend has a yellow shirt. You observe the teacher showing you how to do something. You look at a picture in a newspaper. You see the freckles on your arm. Descriptions of things you can see are observations. When you write accurate and detailed observations, someone else could almost draw a picture from your observations.

Interpretations are different from observations. When you make an interpretation, you take what you see, add what you know from previous experience, and decide what is happening. Interpretations are essential in science. Interpretations can help scientists better understand animal behavior. They can then use this understanding to predict what similar animals might do or what an animal might do in a particular situation. Scientists share their interpretations with other scientists and check to see if other scientists agree with the way the interpretations have been made.

Analyze Your Data

Use *Observing and Interpreting Animal Behavior* pages as you analyze your data. It will help you separate observations from interpretations. The page will also provide you with space to record details about the animals you are observing and their environments. These other details may help you interpret and answer the question about how the animal's environment affects its behavior.

Using this new page, separate your original list of observations into two lists, one of observations and one of interpretations. Put observations in the first column and interpretations in the last. Remember that an interpretation provides the meaning of or reason for an action. In the picture of the dog at the beginning of this section, the interpretation might be that the dog is guilty of something because of how it looks. Look through your group's observations. See if any of the observations you wrote were actually statements that show meaning or describe reasons for behavior. If so, write these in the *Interpretations* column.

Observing and Interpreting Animal Behavior

Name: _____ **Date:** _____

Animal I am observing: _____

Observations	What about the environment and animal allows that behavior?	Interpretations

You can pick out interpretations because they do not describe the picture, but instead describe an emotion, a look, or a reason why a person or animal is doing what they are doing.

Use the middle column to record information about why you think your interpretations are good ones. If you have made observations about the environment in the picture, list those in this column. If you know something about parents, teams, children, or anything else that helped you interpret, that goes into the middle column, too.

You will use the *Observing and Interpreting Animal Behavior* page many times in this Unit. It will help you track what you are observing, interpreting, and learning about animal behavior. The *Big Challenge* of this Unit is to develop a new enclosure for an animal using what you learn about the animal's behavior. The *Observing and Interpreting Animal Behavior* pages you create throughout this Unit will be helpful in keeping your observations and interpretations organized. You will then use this information to support your design for the final challenge.

Stop and Think

1. How difficult was it for you to support your interpretations of people in the picture you looked at? What knowledge did you use for those interpretations?

2. When you discussed one another's observations, what was confusing? What were your disagreements about the observations? About the interpretations? Why do you think these happened?

These baby birds are waiting for food.

Be a Scientist

Keeping Records

It is very important that scientists record their work carefully. To record means to write, sketch, or diagram what is being done. This allows scientists to accurately report their findings to others and helps them answer scientific questions.

You have probably kept records of your work in science class before. Keeping records is also important for you as a student scientist. Recording your work helps you:

- share your work with others,
- remember what you did and decided along the way,
- remember what you saw and the environment surrounding your observations, and
- answer scientific questions.

Throughout this Unit, you will be collecting a lot of observational data. Because of the amount of data you will collect, you will need to keep it well organized. Scientists frequently use tables to record and organize their data. Tables help scientists keep track of what they are seeing. The information in the table may include length of time a behavior happened, the surroundings of the animals, and perhaps even some interpretations.

Observe

Pictures of Other Animal Behavior

Now you will use what you have learned about making good observations to observe and interpret what is happening in pictures of other animals. Again, you will look carefully at one picture.

Recording Your Data

Describe the picture using good descriptive words. Record as many details as you can. Record your descriptions of each behavior on the *Observing and Interpreting Animal Behavior* page. This time, be aware of the difference between observation and interpretation. Use the correct column on the *Observing and Interpreting Animal Behavior* page to show which of your comments about the picture are observations and which are interpretations.

Picture #5

Picture #6

Picture #7

Picture #8

Conference

When you have completed your observations, discuss them with your group. Explain why you think details are important. Could someone sketch a picture based only on your description? If not, return to your picture and, with your group, write more descriptive observations. As you discuss your observations, work with your group to write descriptions you all agree upon.

Next, discuss your interpretations. Have group members read their interpretations. As you listen to others' interpretations, consider how their ideas might be different from yours. Together with your group, determine why the interpretations are similar or different.

Communicate

You will now share your observations and interpretations with the class. As you look at your classmates' pictures, think about whether you would have made the same interpretations. If you have a different interpretation or you do not understand a group's interpretation, you should ask questions to help you understand. Then discuss these questions.

1. You observed and interpreted two pictures, one of a human and one of another animal. Which of the two pictures did you find easier to observe? In which picture was it easier to interpret the behavior? Why do you think this is?
2. How did using the *Observing and Interpreting Animal Behavior* page make it easier to record your observations?
3. What is the difference between observation and interpretation? You might use a new example of both to show the difference.
4. Why is it important for scientists to think about the difference between observation and interpretation?
5. Why do you think it is sometimes easy to confuse observation and interpretation?

What's the Point?

Ethologists observe animal behavior. They watch and record what animals do. During their observations, they collect a lot of data and often use a table to keep track of the data. By keeping good records, ethologists can re-create what they have seen and use that information to determine why animals behave as they do.

Interpretation is different from observation. Interpretation includes the meaning or significance of an action. It is difficult, when making observations, to eliminate all interpretation. However, scientists try to separate their interpretations from their observations. Sharing ideas with others can also make separating observations and interpretations easier.

1.4 Explain

Support Your Interpretation

You have made accurate observations and learned how to separate observations from interpretations. When you were making observations of the animals in the pictures, you learned that it is difficult not to interpret behaviors as you are describing them. During your discussions with your team and the class, you were asked why you made your interpretations. They were asking you to support your interpretations with evidence.

explanation: a statement that connects a claim to evidence and science knowledge.

Now you will more formally connect your observations and interpretations to each other. You will write **explanations**. An explanation is a statement that connects a claim (a conclusion you have come to) with your evidence (the data you have collected) and science knowledge. The explanations you write will connect your observations and what you know about animals to your interpretations.

Be a Scientist

What Do Explanations Look Like?

Making claims and creating explanations are important parts of what scientists do. An explanation is made up of three parts:

Claim—a statement of what you understand or a conclusion that you reach from an investigation or set of investigations.

Evidence—data collected during investigations and observations.

Science knowledge—knowledge about how things work. You may have learned this through reading, talking to an expert, discussion, or other experiences.

An explanation is a statement that connects the claim to the evidence and science knowledge in a logical way. A good explanation can convince someone the claim is valid.

For example, suppose you have a pet hamster. You notice that when you remove the lid to the cage to feed the hamster, it runs toward the food cup. You learned in science class that some animals learn different behaviors. Dogs who are fed after a bell rings eventually respond to just

the bell. They begin to drool when they hear the bell, whether or not food is offered to them. You wonder if the hamster might have learned that the noise of the lid signals it is about to be fed. The next time you feed your hamster, you try to remove the lid very quietly and notice your hamster does not move toward the cup. You conclude that your hamster has learned that, when the lid makes noise, the food cup will be filled, and it is time to eat. You can now form an explanation.

Your **claim:** My hamster moves toward the food cup because of the noise of the lid.

Your **evidence:** I performed an experiment. My experiment showed that when there is no noise, the hamster does not move. The hamster moves toward the food cup when I lift the lid normally (with noise). When I lift the lid quietly, the hamster does not move toward the food cup.

Your **science knowledge:** Some animals, like dogs, can learn different behaviors.

Your **explanation:** My hamster moves toward the food cup because of the noise of the lid. When it hears the noise of the lid, my hamster moves toward the food cup. This is because my hamster has learned that when it hears me lifting the lid, I am going to feed it.

An explanation is what makes a claim different from an opinion. When you create an explanation, you use evidence and science knowledge to back up your claim. Then people know your claim is not simply something you think. It is something you have spent time investigating. You have found out things that show why your claim is likely to be correct.

Explain

Now that you know more about what an explanation is, you are going to write an explanation of the animal behavior you just observed. Use a *Create Your Explanation* page to help you make sure your explanation takes into account your claim, evidence, and science knowledge. Your interpretation of the animal's behavior is your claim. Your observations of behavior and what you recorded about your animal's structure and environment are your evidence. You may have some science knowledge from your own experiences or from readings. Record all of these in the appropriate boxes.

Create Your Explanation

Name:_____ **Date:**_____

Use this page to explain the lesson of your recent investigations.

Write a brief summary of the results from your investigation. You will use this summary to help you write your Explanation.

Claim—a statement of what you understand or a conclusion that you have reached from an investigation or a set of investigations.

Evidence—data collected during investigations and trends in that data.

Science knowledge—knowledge about how things work. You may have learned this through reading, talking to an expert, discussion, or other experiences.

Write your Explanation using the ***Claim***, ***Evidence*** and ***Science knowledge***.

Then write a statement using your evidence and science knowledge to support your claim. This is your explanation. A good explanation can convince someone else that your interpretation is good. If your statement doesn't seem convincing, revise your claim so your evidence and the science you know will support it. You can use the hamster example to know what to put in each part of your explanation.

Because your understanding of the picture you observed may not be complete, you may not be able to fully explain the animal's behavior. But use what you have read and what you know to develop your best explanation. Scientists finding out about new things do the same thing. When they only partly understand something, it is impossible for them to form a "perfect" explanation. They do the best they can based on what they understand. As they learn more, they make more accurate or clearer explanations.

This is what you will do now and what you will be doing throughout PBIS. You will explain your results the best you can based on what you know. Then, after you learn more, you will make your explanations more accurate.

Communicate

Share Your Explanation

Now you will share your observations, interpretations, and explanations with the class. Your classmates will listen carefully. They will want to know what your claim is. They will be checking to see if your claim is **valid**. You will have to make sure you support your claim with accurate and detailed observations and appropriate science knowledge. If you have done that, then your claim can be considered valid.

valid: well-grounded or justifiable.

Reflect

Explanations are critical for scientific understanding. Scientists in all science fields are trying to explain the way the world works. They develop explanations to help them inform other scientists of what they have learned from their observations.

1. After scientists make their observations and interpretations, they write explanations of what they have seen. Creating explanations can be difficult. What difficulties did you have developing an explanation of what you saw?
2. What questions do you still have about how explanations can be made?
3. One source of science knowledge might be your own experiments. List three more sources you might use for science knowledge.

What's the Point?

Science is about understanding the world around you. Scientists gain understanding by making observations and explaining what they see. Scientists make claims about what they observe. They support their claims with evidence they gather through their observations. They also look at the data, claims, and explanations others scientists have published. They combine all of that to create explanations. Other scientists carefully examine these explanations. They discuss them with each other and try to determine if the claim is valid. Valid claims require good observations and science knowledge as support.

Throughout PBIS, you will create explanations. Every explanation will include a claim, evidence, and science knowledge. Just like scientists, you will edit and improve your explanations.

To help others better understand what they learn, scientists must communicate their results effectively. When scientists share what they have learned, they allow others to question it and improve on the claims and explanations. By working together, scientists can develop a clearer understanding of the world.

1.5 Read

What Do Animals Need to Survive?

behavior: an animal's response to its environment.

adaptation: a special trait that allows an animal to survive in its environment.

species: a group of organisms that look alike and can breed with other members of the group and produce fertile offspring.

instinctive behavior: a behavior an animal is born with.

learned behavior: a behavior that comes from teaching or experience.

mammal: a warm-blooded animal with hair and in which the female has special glands to feed milk to its offspring

In this *Learning Set*, you have been exploring how scientists study animal behavior. One of the questions you are answering in this Unit is *Why do animals behave the way they do?* To answer that question, you need to understand what a **behavior** is from a scientific point of view. Scientists use the word behavior to describe an animal's response to its environment. One of the most important animal behaviors is survival.

Animals share certain needs for survival. These needs affect how they behave. They must obtain enough food for energy and to feed their young. They need protection from bad weather and enemies, and they need a safe place to raise a family. By using behaviors and other **adaptations**, or traits, to meet these basic needs, not only can an animal survive, but its family may survive, its group may survive, and its entire **species** may survive.

Lions live, travel, and hunt in groups called prides. This allows them to hunt cooperatively to catch bigger prey more often and protect each other.

Kinds of Behavior

A behavior can be **instinctive** or **learned**. Animals are born with instinctive behaviors. Learned behaviors come from teaching or experience. Most behaviors are a mixture of instinctive and learned. For example, **mammal** mothers have the instinct to care for their young, but some then learn from experience how to better care for their young. Whether a behavior is instinctive or learned, the most important thing an animal must do in its environment is survive.

Searching for Food

Animals need energy and materials to stay alive, grow, develop, and reproduce. They obtain the energy and the nutrients they need from the food they eat. The process by which animals break down their food to obtain energy and then use the energy is called **metabolism**. Finding enough of the right kind of food depends on many things: how and where animals live, how they find and gather or catch food, and how they digest that food.

An animal must live in a place that has the type of food it needs and it must have ways to gather or catch the amount of food it requires. Some animals have claws and big teeth; others are able to run fast. Animals might live in cooperative groups and help one another find food. Other animals live alone.

An animal must be able to digest the food it eats. Even if an animal finds a lot of food that has a lot of energy, it cannot use the energy if it cannot digest the food. Energy in food is measured in units called **calories**. A calorie is the amount of energy needed to raise the temperature of one gram of water by 1°C. Most foods contain thousands of calories of energy. For this reason, scientists use the **Calorie**, with a capital *C*, to measure the energy in foods. One Calorie is the same as 1 kilocalorie or 1000 calories.

Some animals eat only meat, and some eat only vegetable matter. Some eat both. All have different ways of getting their food and digesting it. You will learn more about feeding behaviors and adaptations in *Learning Set 2*.

metabolism: the combination of chemical reactions through which an organism builds up or breaks down materials converting energy to carry out its life processes.

calorie: the amount of energy needed to raise the temperature of one gram of water by 1°C.

Calorie: the amount of energy in foods. One Calorie is the same as 1 kilocalorie or 1000 calories.

roosts: communal resting places, mostly for a single species of birds.

Protection

In addition to finding food, animals must remain safe—from their enemies and from their external environment. Remaining safe from enemies is a primary concern for many animals. Organisms have developed different behaviors to keep them safe. Birds may form **roosts** that can number in the thousands. With many birds together in one place, many eyes are on the lookout, and each bird is safer than if it were sitting on a branch all alone. Some mammals that live in herds form a protective ring around their young if they are threatened by predators. Others like turtles retreat into their hard shells when they sense danger.

Some birds form roosts in trees at night for protection from enemies.

Many animals living in cold climates, such as these polar bears, have fur, fat, and short limbs to conserve body heat.

Some animals, such as this golden retriever, pant to cool off their bodies.

But even if they are safe from enemies, animals might not be safe from their environment. Animals need a way to keep their internal temperature and fluids fairly constant. This process is called **homeostasis**. Some animals that live in hot areas have a special circulatory system that moves cooler blood across the brain, so they will not die from heat stroke while running. Or they may sweat or pant to cool off their bodies. Animals may shiver if they get too cold. The muscle action used to shiver produces heat that warms their bodies.

Reproduction

If animals have enough food and are safe, they can use their energy for reproducing and raising their young. Animals raise offspring in one of two ways. Either they feed and protect the young until they are old enough to go out on their own, or the mother leaves the young to manage for themselves.

homeostasis: the maintenance of stable internal conditions in an organism.

mammary glands: milk-producing glands found in female mammals that are used to feed the young.

One characteristic of mammals is that the mother raises the young on mother's milk. She produces the milk in her **mammary glands** and continues to feed her young until they are old enough to eat on their own. A mother must obtain enough energy from her food to meet her own needs and to produce milk for her young.

In many birds, both the mother and the father help feed and protect the young, which are called **hatchlings**. In some birds, the parents gather food for the young, process it in their own stomachs with **enzymes**, and then **regurgitate** it to feed to the young. These parents continue to feed their offspring until the young birds can gather food on their own.

Other animals, like fish and turtles, lay many eggs in the water or on land, and then leave. When the eggs hatch, the young must take care of themselves.

Why do animals use different strategies for raising their young? In animals that rely on learned behaviors for survival, it may take a long time for the young to learn how to find food, how to find shelter, and how to protect themselves. In this case, the mother or both parents stay with and protect the young while they teach them what they need to know. In animals that rely mostly on instinctive behaviors, the young are born with the instincts they need to survive and do not need their parents.

hatchling: a very young baby bird.

enzymes: organic substances that cause chemical changes in other substances.

regurgitate: to bring partially digested food up from the stomach into the mouth.

A female turtle lays eggs, but she does not care for her eggs or the hatchlings. The hatchlings are born with the instintive behavior they need to survive. A female spider dies in the autumn, before the spiderlings (baby spiders) hatch the following spring. However, the spiderlings have the instinct to build a perfect web on their first attempt.

Many birds, such as these penguins, take care of their young and feed them regurgitated food.

Mammals produce milk in mammary glands to feed their young (left).

Some animals, such as this sea turtle, lay many eggs but leave the young to manage for themselves (right).

Stop and Think

1. Some large animals, such as lions, live and hunt in groups. What are some of the advantages of hunting with others?
2. Living in a group can help animals with protection. Describe two ways that living in a group can protect individuals.
3. Some animals have only a few young at a time. Others have many offspring, even thousands. How do the numbers of offspring connect with how the animals care for their young?

Revise Your Explanation

You have just read about how an animal's behavior and adaptations help it survive in its environment and carry out its basic needs. With your group, look at the explanation of animal behavior you created on your *Create Your Explanation* pages after interpreting the pictures of animals. Now that you know more about the science of animal behavior, you can probably revise your explanation based on some of this science knowledge.

Review and rewrite your explanation based on your new science knowledge. First, check to make sure your claim is accurate. You may have just read information that shows that your claim was inaccurate. If your claim does not match the science you have read, revise it. Next, support your claim with the science knowledge you just learned.

Then, rewrite your explanation to make it more complete. Remember that an explanation is a statement that connects a claim to evidence and science knowledge in a logical way. Try to write your explanation so that it tells why your claim is true. Be sure that your explanation matches the science you just read.

Communicate

Share Your Explanation

Share your new explanation with the class. When you share your explanation, tell the class what makes this revised explanation more accurate than your earlier one. As each group shares their explanation, pay special attention to how the other groups have supported their claim with science knowledge. Ask questions or make suggestions if you think a group's claim is not as accurate as it could be, or if the group has not supported their claim well enough with observations and science knowledge.

Reflect

Explanation is an important scientific practice. Scientists use what they already know along with new evidence collected from investigations to explain how the world works. You will be doing a lot of scientific explanation in PBIS. It will get easier as the year goes on. For now, think about the differences between the first animal behavior explanations your class wrote and the new explanations. Identifying what makes the earlier explanations different from the newer ones will help you get better at explaining. Answer the following questions and be prepared to discuss them in class.

1. What are you able to explain now about the animal behaviors in the pictures that you were not able to explain well earlier?
2. What makes your revised explanations better than the earlier explanations?
3. In order to make a complete explanation, science claims need to be supported by evidence. What are some sources of evidence you might use to support your claims?

Be a Scientist

Good Explanations Tell Us How and Why

A good explanation uses what scientists know about how things work. The best scientific explanations use agreed-upon science knowledge in a logical way to support a claim. These kinds of explanations can usually convince others that a claim is valid. And with more science knowledge, you can write better explanations.

What's the Point?

You have learned that animals have many different behaviors and adaptations to help them survive in their environments. These behaviors can be instinctive or learned. Animals gather or catch food to obtain energy. They use other behaviors and adaptations to remain safe from enemies and to protect themselves against extreme weather. When energy gathering is efficient and animals are safe, they can reproduce. Animals care for their young in many ways, from total care and protection to laying eggs in water or on the ground and leaving the young to manage for themselves. Survival and success in animals depends on a wide variety of behaviors and adaptations.

Learning Set 1

Back to the Big Question

How do scientists answer big questions and solve big problems?

The *Big Question* for this Unit is *How do scientists answer big questions and solve big problems?* You are answering the *Big Question* in the context of answering the science question: *Why do animals behave the way they do?* You will be applying your answers to those questions to a *Big Challenge*, creating an animal enclosure that allows an animal to behave as it would in its natural environment. To design an enclosure that meets all the criteria, it is important to know about how the animal behaves in the wild and what affects that behavior. You have learned that to better understand why animals behave as they do, scientists make observations. You have developed and used procedures for observing animal behavior. You will use those procedures as you learn more about animal behavior and address the *Big Challenge*.

iteration: a repetition that attempts to improve on a process or product.

Earlier in this *Learning Set*, you designed an observational plan to watch your classmates. Now that you've learned so much more about observing animal behavior, you will develop a new plan. It will probably make your observations a lot easier and allow you to collect more reliable data. Each time you develop a plan, you can use the successes and challenges from your previous experience to make a better plan. Scientists use their previous experiences to improve their procedures too. When they improve their procedures, the data they collect are usually more reliable. Scientists often perform almost the same investigation over and over again, each time using what they have learned earlier to make their next investigation and data more reliable. When someone redesigns a procedure or product based on what they have learned, it is called **iteration**. The word refers to the process of revising a plan or product. We also refer to each revision as an iteration.

You will now use all the things you have learned about how ethologists design their plans, make their observations and collect data, organize and analyze data, and describe their results, to develop a new observation plan. Then you will observe the students in your class one more time.

Be a Scientist

Iteration

Scientists develop procedures for their investigations. They try to make sure procedures have the right steps that are followed in the right order. But sometimes procedures do not work out as they had planned. When that happens, scientists change their procedures based on where they might have had difficulty and run the investigation again to collect better data. They are continually learning from their investigations.

In your group, you wrote a procedure the first time you observed your classmates. There were things that worked well with your procedure and things that needed improvement. Iteration gives you a chance to revise the procedure and not make the same mistakes again.

Later you will use the skills and processes you are learning to study animal behavior. You will use the observations you make of different animals to understand why animals behave the way they do. Once you understand that, you will be able to apply your understanding to designing an animal enclosure.

Plan

You will continue your investigations of animal behavior by observing your classmates again as they are engaged in an activity. Your goal is to accurately observe and record the details of the students' behavior and to interpret their behavior, explaining why they are doing what they are doing.

With your group, revise your plan to make more accurate observations. Make sure all members of your group agree on the plan and know how to follow through on it.

- **Will you watch an individual or all the students in the small group?**
- **How will you make sure you have observed all the members of the group?**
- **How will you make sure you have observed all the different behaviors?**
- **Will you each watch the whole scene or will it help to divide the observation task among all the members of your group?**

- How will you record what you see?
- Will you take notes on everything you see?
- How can you record quickly enough so you don't miss anything? Can you write key terms and not full sentences?
- Will you draw a picture?
- Will you keep track of the amount of time each behavior lasts? If so, how will you do this?

Observe

As you watch your classmates, pay careful attention to the details of the situation. Follow the plan you made in your group as closely as possible. Record your observations as accurately as possible. Try to observe everything about the scene, your classmates, and the people around them. Watch what they are saying and what they are doing.

Analyze Your Data

After the observation time is over, discuss your observations with your group. Allow each group member time to describe the behaviors they saw. Decide if all of you saw the same things or if some of the observations were different. Use the same procedure you used before to analyze your group's data.

The first step is to copy each observation on to a separate sticky note. Put only one observation on each note. Your entire group will also copy their observations. If some are repeated, you can make just one sticky note for that observation.

Once each observation is on a separate sticky note, read through them and discuss how they might be grouped into categories by behavior. Combine observations of similar behaviors. If you disagree with the categories, ask others to be clear about why they think a behavior fits into that category. Sometimes it is necessary to reorganize categories as more observations are examined. Once you have each observation in a pile, use index cards to label the categories.

As a group, prepare a description of the behaviors in each category. The description needs to be specific enough so that other students in your class can recognize it. This will help you describe your groupings to the rest of your class.

Then, using an *Observing and Interpreting Animal Behavior* page, record your observations of the students' behavior, your interpretations of their behavior, and anything important about the environment and the students that helped you make each interpretation.

Communicate

Each group will now share the categories they created, the reasoning behind their categories, and the behaviors and interpretations they recorded. Listen carefully to see if others made the same observations you made. Also, listen as each group describes their category labels. Think about whether they used the same labels as your group. Consider whether their labels would be understandable by other biologists.

Think about how the categories are the same as or different from the categories you created earlier in the unit. The students you observed were behaving differently, so the categories may be very different. It is interesting that some of the categories might also be the same, even though the overall behavior was very different.

Reflect

Iteration is an important part of scientific work. Repeating the same procedures again helps to check the validity of observations. Iteration also gives you a chance to revise your procedure when you learn it is difficult to do or when parts are missing.

1. What did you learn from revising and retrying your procedure?
2. In what ways were the observations and interpretations easier now than they were at the beginning of this *Learning Set?*
3. In what ways are your observations and interpretations more reliable? What did you do differently that made them more reliable?
4. What do you think you might do to make the observations and interpretations easier and more reliable next time?
5. How do you think iteration will help you when you design your animal enclosure?

What's the Point?

When ethologists study animal behavior, they have ideas about what they should do and how they should do it. They work hard to gather reliable data. One way to gather reliable data is to have a procedure to follow. One way to improve the validity of data is to revise a procedure when it does not work well and then collect new data. In the first section, you used a procedure, and in this section, you were able to update it. This revision probably helped you gather more reliable observations.