

Salamander Monitoring & the Scientific Method

Big Idea

The scientific method is a tool that guides research.

Essential Questions

- How can the scientific method be used to find answers to questions about the natural environment?
- Why are salamanders so important to the Smokies?
- How do qualitative and quantitative data differ?
- Why is replication important?
- How can scientists present their results?

Vocabulary

- Amphibian—a vertebrate animal with two main life stages
- Coverboard—a piece of artificial shelter placed in an animal's habitat to make it easier for scientists to study that animal
- Data—information gathered through an experiment
- Hypothesis—a suggested explanation of an event involving a possible relationship between similar events
- Metric system—a system of measurement based on the number 10. Scientists use this system because it is common throughout the world and easier to convert from one unit to the next. (i.e. 100 centimeters per 1 meter instead of 12 inches per foot).
- Qualitative—data that cannot be measured objectively but uses descriptions of size, appearance, value, etc.
- Quantitative—specific data based on a measurement of the quantity. Temperature, volume, mass, etc. are all quantitative data.
- Replication—repeating an experiment to improve reliability
- Research—an active, diligent, and systematic process of inquiry aimed at discovering, interpreting, and revising facts
- Salamander—an amphibian that is common in streams and woodlands throughout the Smoky Mountains. It has a body shape similar to that of a lizard, but has slimy skin.
- Snout-vent length—the length between the tip of a salamander's nose and the base of its back legs. This is a good way to measure a salamander to show how big it is even if it has lost its tail.
- Variable—one aspect of an experiment that a scientist changes to see the effect on other aspects of the experiment. Only one variable should change at a time.

Salamander Monitoring & the Scientific Method

Lesson Outline

- Introduction to the Scientific Method
- Salamander Facts Game Show
- Practicing Field Techniques—Aquatic Salamanders
- Qualitative vs. Quantitative Data
- Terrestrial Salamander Project
- Conclusion: Sharing Results

Salamander Monitoring & the Scientific Method

THE TEACHER'S ROLE

Salamander Monitoring and the Scientific Method will always be taught by a Tremont teacher/naturalist. For groups participating in cooperative teaching, two lesson groups will usually be brought together for this program, resulting in a total class size of up to 30 students. The teacher's role is to support the Tremont teacher/naturalist by monitoring student behavior and participation. During the search for salamanders, teachers can influence their group's interest by getting their hands dirty and searching along with their students. Teachers familiar with the use of a dichotomous key can help their students identify salamanders they catch, and any teacher can help check the accuracy of their students' length and weight measurements of the salamanders.



INTRODUCTION TO THE SCIENTIFIC METHOD

15 Minutes

(Note: this should be the first activity; the other activities should be followed in the sequence presented here to mimic the steps of the scientific method.)

Lead In

Before starting the project as scientists, students must first understand the scientific method. Ask the students what they know about the scientific method. Why do they think the scientific method is important? Read *The Crow and the Pitcher*, by Stephanie Gwyn Brown. With younger students, have a teacher or chaperone read the story out loud. With middle or high school students you may want to ask for a student volunteer or pair of volunteers to read the story. After reading the story, review the steps in the scientific method as pictured on the last two pages of the book. To help the group remember, ask for volunteers to be in charge of remembering each step.

Procedures

After reading *The Crow and the Pitcher*, introduce the tree cookie study. Explain to the students that herpetologists (biologists who study reptiles and amphibians) use coverboards to attract salamanders so they can better inventory and monitor salamander populations. Show the students the coverboards. Explain that the scientific literature suggests that square 1 ft x 1 ft x 1 in. thick boards of lumber are best for attracting salamanders, but in 2006, Tremont set up an experiment to compare the square pieces of lumber to a 3-inch tree "cookie." That study was done until 2010 when a new study was set up comparing the cookies of two different tree species, pitch pine (*Pinus rigida*) and chestnut oak (*Quercus prinus*). Ask the students what the question is that is being asked. (Which type of tree cookie is best at attracting salamanders?) Next, ask the students to form a hypothesis. (Either they think the pitch pine or the chestnut oak tree cookie will perform better at attracting salaman-

Salamander Monitoring & the Scientific Method

ders.) Probe the students as to why they chose their hypothesis. What are the differences between the two types of tree cookies? (hardwood versus softwood, decomposition rates, chemical properties of different woods) What factors might influence why salamanders prefer one over another (temperature under the boards, moisture, food, etc.)?

Wrap Up

Discuss how scientific research is taking place in Great Smoky Mountains National Park. This would be a great time to bring up the All Taxa Biodiversity Inventory and Discover Life in America. Explain that today they will be participating in an actual study taking place here at Tremont and the data will eventually be shared with other herpetologists.



SALAMANDER FACTS GAME SHOW

20 Minutes

Lead In

After forming a question, the next step in the scientific method is research. Tell the students that most research is performed in libraries, but today they will learn about salamanders by playing a game show. Ask the students what they already know about salamanders. This is a good time to reinforce prior knowledge and help them let go of their misconceptions. Set up the five triangular salamander flip charts around the room or outside. Split the class into five groups or teams and give each team a sheet of paper, clipboard and pencil. These teams will stay the same throughout the day.

Procedures

ALTERNATIVE 1

To do this activity, each team will nominate a game keeper for each station. The game keeper should change each time the group goes to a new station. Each station has a flip chart with four or five questions about salamanders. The game keeper should read the questions to the rest of their group while the group works together to decide on an answer and write it down on their sheet of paper. After asking all the questions for a station, the game keeper should go back over the questions and give the participants the answers. Each team should keep track of how many questions they get correct. Have groups switch every few minutes to a new station.

ALTERNATIVE 2

Break the group into five groups. Each group will “adopt” one of the flip charts and will be responsible for reading the questions and learning the answers as a group. After reading and learning the answers, each group will take turns quizzing the other groups about the questions from their flip chart.

Salamander Monitoring & the Scientific Method

Wrap Up



When all groups are finished with all five stations, gather all of the students together and discuss some of the things that they learned about salamanders.

PRACTICING FIELD TECHNIQUES—AQUATIC SALAMANDERS

45 Minutes

Lead In

Tell the students that before they perform the actual study that they will need to hone their skills at capturing, identifying, and measuring salamanders. Hike students to a nearby creek to search for aquatic salamanders. Have the students sit in a circle and show them the tools they will be using. Model the use of each tool with the help of a plastic salamander.

- Their eyes, to help them find small camouflaged amphibians under rocks, wood, leaves, etc.
- Their hands, to help them turn over rocks and wood but not to pick up salamanders, because the natural oils on our skin can make it hard for salamanders to breathe through their skin. Also, a squirmy salamander can escape from hands and fall a long distance to the ground.
- A zip-lock bag, to catch and hold salamanders. If the salamander is a larva and has gills, what else needs to be in the bag? (Water) Adult salamanders don't need water in the bag, but they do need plenty of air. There should only be one salamander in a bag at a time.
- A dichotomous key, to identify the salamanders they catch. Explain briefly what a key is, but don't go into much detail before they have caught any salamanders.
- A ruler, to measure the salamanders' total length as well as their snout-vent length. Explain that the vent is like an all-purpose hole for going to the bathroom, laying eggs, etc., and is located at the base of the rear legs. A snout-vent length combined with a total length gives us a good idea of the salamander's size even if it has lost its tail. What unit of measurement should we use? (Millimeters, because the metric system is used in science and salamanders are too small to be measured accurately with centimeters.) To illustrate the importance of precision, ask a student how tall he or she is. Round off the student's height to the lower measurement—for example, if a student says 4'2" you would say, "So you are 4 feet tall, right?" Explain that the student worked hard, ate lots of food, exercised, etc. to grow those extra two inches. When

Salamander Monitoring & the Scientific Method

measuring the length of salamanders, be sure to get as precise a measurement in millimeters as you possibly can. Those salamanders worked hard for their two extra millimeters!

- A spring scale, to find the mass of the salamanders. What unit? (Grams) What might be the problem with weighing a salamander using this scale? (Attaching the scale to the salamander would hurt it.) Instead, we'll clip the scale to the bag, find the mass of the salamander and bag put together, let the salamander go, weigh the bag, and subtract to find the mass of the salamander.
- A thermometer, to find out if there is a difference in the temperature between the two types of cookies. We will be measuring the temperature in degrees Celcius. The thermometer should be held about 12 inches away from the surface of the soil. The temperature will appear on the digital readout.

Procedures

Establish boundaries for the stream search and give each student or pair of students a plastic bag. As they begin to find salamanders, work with the students to identify using the dichotomous key, accurately measure the total and snout-vent length, and use the spring scales to weigh the salamanders. To practice filling in a data sheet, they can record their findings on a sheet of paper. Remind students that salamanders are delicate vertebrates that need to be handled with care, and that each one needs to return to the area where it found when the group is done with it.

Wrap Up

Have the students return to the circle and give their zip-lock bags back. Ask them to report what kinds of salamanders they caught. Which species was the most common? Which salamander was the longest or heaviest? What did they learn about salamanders that they didn't know before?



QUALITATIVE VS. QUANTITATIVE DATA

10 Minutes

Lead In

What does quality mean? How about quantity? There are two types of data. Qualitative data uses descriptions of size, appearance, value, etc., but cannot be measured. It is usually a ranking system such as on a scale of 1 to 3, how would you rate the soil moisture? The number 1 would be dry, 2 moderately moist, and a 3 would be very wet. Quantitative data is specific data based on a measurement—the quantity. Temperatures, volume, mass, etc. are all quantitative data.

Salamander Monitoring & the Scientific Method

Procedures

Give each team a set of qualitative and quantitative matching cards and have them decide which cards belong in each category.

Wrap Up

Go over the cards with the whole group and make sure all the students understand the difference between qualitative and quantitative data.



TERRESTRIAL SALAMANDER PROJECT

50 Minutes

Lead In

Tell the students now that they know a little more about salamanders and how to catch and measure them, they are going to begin collecting real data associated with a research project at Tremont. Walk to the monitoring site and point out any poison ivy that might be growing. Explain to the students that scientists want to know more about salamanders and their needs. In their teams, have the students brainstorm additional questions scientists might have about salamanders and salamander populations.

Have each group present some of their questions. Try and find the closest student question to “What type of habitat would you find a higher salamander population?” Besides trying to figure out which coverboard is best at attracting salamanders, this is one of the other primary questions asked by this study. Tell the students that one big difference between habitats around Tremont is the presence or absence of hemlock trees. Discuss the issues surrounding the hemlock woolly adelgid, and have students brainstorm ways that the loss of the hemlock might change the forest floor habitat where salamanders live (light, temperature, soil moisture, food availability).

Next, review the other primary experiment—the tree cookies. Explain that scientists have different methods for sampling salamanders (time-constrained search in a grid; pitfall traps). A common way is using something called a coverboard, which is usually a piece of store-bought wood cut into short boards and placed in the study area. Why coverboards? Why might salamanders seek this type of cover? Review why salamanders might be found under coverboards (humidity, sturdy cover, dark, semi-natural). Tell the students that for this study we are comparing the effectiveness of two types of natural tree cookies (cut here on site from fallen trees) in attracting salamanders: pitch pine and chestnut oak. Review the differences that might exist between the cookies (temperature, moisture, texture, food items, rate of decomposition, hardwood versus softwood, chemical properties of each wood, etc.).

Salamander Monitoring & the Scientific Method

Procedures

Ask the student who volunteered to remember the first step of the scientific method to share it with the group: “Ask a question.” What question might we ask about salamander habitat and tree cookies that we could answer today? Ask another student to share the second step: “Gather the facts.” Review facts about salamanders that the students already know that might help them answer the question. (They are cold-blooded, so more likely to be in a cool place in the summer and a warm place in the winter; they need moisture; they hide under many kinds of natural objects, etc.) What facts do we already know about the different species of trees used for the cookies that might help us answer the question? What data could we gather about the cookies that might help us answer our question? (The temperature and moisture level under each.)

Ask the next volunteer to share the third step: “Form a hypothesis.” Using their knowledge about salamanders and the tree species used for the cookies, have each team write down their own hypothesis for the tree cookie experiment.

Ask the fourth volunteer to reveal their step of the scientific method: “Tackle the experiment.” How might they experiment to find which type of tree cookie had more salamanders? (The best way would be to go look.) Hand a data sheet to each team and explain the procedure for checking the tree cookies, measuring any salamanders that are caught, and taking temperature (quantitative) and moisture (qualitative) measurements, and listing other invertebrates found under cookies. Use the original five teams from the Salamander Facts Game Show to work on a line in the grid of tree cookies (example Row 1 – boards 1-8).

To make the data-collection process run smoother, ask the group to choose someone who has good handwriting to write the data. Give the person the data sheet and clipboard and pronounce that this person now possesses the “Scepter of Power”—he or she is now the group leader and keeps everyone on task. Next assign one member of the group for each of the following tasks: to operate the thermometer; to catch the salamanders and look for bugs; to look at soil moisture; to lift up the cookie and put it back in its original position, making sure the cookie is flush with the ground.

Wrap Up

After all of the data has been collected, have the students return all of their equipment except the data sheet. Ask the fifth volunteer to share the fifth step of the scientific method: “Review the results.” Have students work with their teams to come up with some sort of conclusion. Make sure they understand that the experiment is continuing and that there is a lot more data that will be collected over several years before a real conclusion can be made, but that for today they will make a conclusion based on their findings. They also need to explain if their findings supported their hypothesis.

Salamander Monitoring & the Scientific Method



Lead In

CONCLUSION: SHARING RESULTS

30 Minutes

Hike back to the Tremont campus and go to the Cove Room, Science Room, or Pavilion. Ask the sixth volunteer to share the final step of the scientific method: "Share with the rest." Discuss how scientists report their findings to other people (journals, newspapers, conferences, posters, etc.).

Procedures

Hand each team a big piece of paper and some markers. Explain that they will be sharing their results with other scientists by making a poster. Ask what important things should probably be on the poster. (The question, their team's hypothesis, a description of the experiment and methods, and their conclusion.) Tell them that the purpose of a poster is for people who know nothing about the project to learn as much about it as possible, but that nobody wants to read a list of their data. Ask how they could put their data on a poster without just listing numbers. (They could make a graph.) The graphs do not only need to show the number of salamanders, but some groups could graph the temperature or soil moisture. For example, a team could make bar graphs comparing soil temperatures under the different species of tree cookies, or number of salamanders found under each species of cookies (if any were found). If the class didn't find any salamanders, hand out the data summary sheet of the project to date and have them add that data to their posters. Tell the students that it's OK for the poster to be creative, but that it must be clear and easily understood. Each team must work together and agree how the poster will look, because it represents everyone's work. Give the students about 10 or 15 minutes to make their posters.

Wrap Up

Have each team present their poster to the group and then hang it up to display for the rest of the school's time at Tremont. Ask if there were other questions they think could be asked with this experiment. Did their findings lead them to ask different questions? If they didn't catch any salamanders, does this tell scientists something? Thank the students for their hard work and contributions to science, and be sure to get their data sheets back.

***** ALL DATA SHEETS NEED TO BE RETURNED TO TREMONT'S CITIZEN SCIENCE COORDINATOR!**

Salamander Monitoring & the Scientific Method

Salamander Facts Game Show

BIODIVERSITY

- There are 31 species of these in Great Smoky Mountains National Park.
(Salamanders)
- This place has been named the salamander capital of the world!
(Great Smoky Mountains National Park)
- If you added up all the vertebrates in the GSMNP, including humans, it would be A. more than B. the same as C. less than the number of salamanders in the park.
(C. Less than)
- What is special about Jordan's Red-cheeked salamander?
(It is endemic to the park {only found here and no where else in the world}).

LIFE CYCLE

- The aquatic, gilled stage of the life cycle of an amphibian is called ____?
(Larva)
- When salamanders lose their gills, develop thicker skin, develop eyelids, and look like an adult, they are transforming into ____?
(Juveniles)
- When salamanders can reproduce they are call ____?
(Adults)
- All Amphibians must go to water to breed and lay eggs. True or False
(False. They need to be in moist environments.)
- Name 3 things that make salamanders different from reptiles.
(They do not have scaly skin, they do not have nails, they lay jelly-like eggs instead of leathery eggs.)

SALAMANDER ANATOMY

- A salamanders skin is A. scaly B. moist and slimy to the touch?
(B. moist and slimy)
- How do Lungless or Plethodontidae salamanders breath?
(Through their skin)
- A keeled tail has what shape and where would you find these salamanders?
(Shape of a cat's eye or diamond, aquatic environments)
- To measure salamanders you measure from the tip of nose to the vent. Why?
(Because salamander tails can break off and be in various stages of re-growth.)

SALAMANDER DEFENSE

- The red color on the red salamander, red eft and red-cheeked salamander means what in nature?
(Dangerous or harmful if swallowed)
- Why do salamanders have tails that can detach?
(So they can get away from predators.)

Salamander Monitoring & the Scientific Method

- Salamander tails will re-grow if they detach. True or False
(True)
- A slimy salamander can secrete a thick slime that ____?
(Reduces water loss, makes them distasteful to predators, causes hands of humans or mouths of animals to become sticky.)

SCIENTIFIC NAMES

- Salamanders are in what kingdom?
(Animalia or animals)
- Salamanders are in what phylum?
(Vertebrates or Chordate)
- Salamanders are in what class?
(Amphibians)
- The largest salamander in North America is called ____?
(Hellbender)

Salamander Monitoring & the Scientific Method

Dichotomous Key for Terrestrial Salamanders Found at Tremont

- 1A Rear legs larger and longer than front legs; light line from eye back to corner of mouth; often dark brownish overall.....**Dusky Salamanders** (*Desmognathus* spp.), **go to 2.**
- 1B Legs all about the same size; line from eye to mouth absent; can be reddish, yellow, golden, gray, black, or a variety of other colors.....**go to 3.**
- 2A Tail rounded in cross-section; back usually with reddish and yellowish stripe, edges either straight or wavy; belly usually gray speckled with white; may have orange or yellow cheek patches (make note if you find one with orange cheeks).....**Imitator Salamander** (*Desmognathus imitator*)
- 2B Tail keeled in cross-section; back is mottled olive, sometimes with some chestnut; belly is light colored, usually with **YELLOW UNDER THE TAIL**; small white spots along side of body and usually along sides of head.....**Santeetlah Salamander** (*Desmognathus santeetlah*)
- 3A Slender and short-legged; yellow, orange, or golden.....**Brook Salamanders** (*Eurycea* spp.) **go to 4.**
- 3B Not especially slender and/or not yellow, orange, or golden.....**go to 5.**
- 4A Two dark stripes down the side of back; bellies unpigmented and are whitish, yellow, or reddish; tails long and thin; look and often move like tiny yellow snakes.....**Blue Ridge Two-lined Salamander** (*Eurycea wilderae*)
- 4B Black spots on back, spots becoming bars on the sides of the tail; belly yellowish to cream color; tail very long, usually comprising over 60% of the total body length.....**Long-tailed Salamander** (*Eurycea longicauda*)
- 5A Stout-bodied; red, orange, or pink with speckles.....**go to 6.**
- 5B Slender-bodied; gray, black, or red only on back.....**go to 7.**
- 6A Reddish with black speckles all over body, including belly; black chin; eye yellow or golden, NOT brown.....**Black-chinned Red Salamander** (*Pseudotriton ruber schenki*)
- 6B Reddish, purple, or salmon color; black speckles over back, but not on belly; tailed keeled; dark lines from eye forward to nose.....**Spring Salamander** (*Gyrinophilus poryphyriticus*)
- 7A Black on back and belly with white speckles all over, especially on back and sides.....**Northern Slimy Salamander** (*Plethodon glutinosus*)
- 7B Salamander not black with white speckles.....**go to 8.**
- 8A Salt and pepper belly; back is either with a red or grayish straight-edged stripe; sometimes with a reddish tip at the nose; never has stripe on side of head like a dusky (avoid confusing this species with Imitator Salamander).....**Southern Redback Salamander** (*Plethodon serratus*)
- 8B Belly is gray to black with no little to no speckles; back with reddish zig-zag stripe,

Salamander Monitoring & the Scientific Method

which is often dark and hard to distinguish; may be reddish coloration where the limbs join the body; sides are dark with tiny white spots; tail may have pattern of medium-sized spots; (this species is easily confused with Southern Redback Salamander).....**Southern Zigzag Salamander** (*Plethodon ventralis*)

Salamander Monitoring & the Scientific Method

Tremont Salamander Key for Salamanders Found in Streams

- 1A Gills absent.....adult, **go to 2.**
1B Gills present.....larva, go to 13.

ADULTS

- 2A Rear legs larger and longer than front legs; light line from eye back to corner of mouth; often dark brownish over all**Dusky salamanders** (*Desmognathus*), **go to 3.**
2B Legs all about same size; line from eye to mouth absent; can be reddish, yellow, golden, gray, black, or variety of colors.....**go to 8.**
- 3A Undersides blackish; back mottled chestnut and green, not in defined spots; tail keeled; sides sometimes with white spots; head big and fat-looking.....
Black-bellied Salamander (*D. quadramaculatus*)
3B Undersides not blackish.....**go to 4.**
- 4A Tips of toes have black friction pads, especially when seen from below; tail keeled.....
black-bellied or seal salamander, **go to 5.**
4B Tips of toes same color as rest of toe.....**go to 6.**
- 5A Undersides very light, even transparent; mottled back often grading into reddish spots at the tail; often especially bug-eyed and long-snouted; tail keeled.....
Seal Salamander (*D. monticola*)
5B Undersides light colored, but otherwise better fitting description for black-bellied salamander in (3).....**Black-bellied Salamander**
- 6A Tail keeled, triangular in cross-section.....**go to 7.**
6B Tail rounded in cross-section; back usually with reddish and or yellowish stripe, edges either straight or wavy; belly usually gray speckled with white; may have orange or yellow cheek patches (make note if you find one with orange cheeks)
Imitator Salamander (*D. imitator*)
- 7A Back decorated with reddish spots, often ringed with faint white, and sometimes merging together into wavy red stripe on back; belly is light colored; tail keeled.....
Spotted Dusky Salamander (*D. conanti*)
7B Back is mottled olive, sometimes with some chestnut; belly is light colored, usually with YELLOW UNDER THE TAIL; small white spots along sides of body and usually along sides of head.....**Santeetlah-type Salamander** (*D. santeetlah*)
- 8A Slender and short-legged; yellow, orange, or golden.....genus *Eurycea*, **go to 9.**
8B Not especially slender and/or not yellow, orange or golden.....**go to 10.**
- 9A Two dark stripes down the sides of its back; look and often move like tiny yellow snakes
Blue Ridge Two-lined Salamander (*E. wilderae*)

Salamander Monitoring & the Scientific Method

9B Black spots on back, spots becoming bars on the sides of the tail; usually found away from streams under rocks or logs**Long-tailed Salamander** (*E. longicauda*)

10A Stout-bodied; red, orange, or pink with speckles.....**go to 11.**

10B Slender-bodied; gray, black, or red only on back.....**go to 12.**

11A Reddish with black speckles all over body; black chin; eye yellow or golden, NOT brown.....**Red Salamander** (*Pseudotriton ruber*)

11B Reddish or purple; with black speckles over back; keeled tail; dark lines from eye forward to nose.....**Spring Salamander** (*Gyrinophilus porphyriticus*)

12A Black on top and bottom with white speckles all over, especially on back and sides.....**Slimy Salamander** (*Plethodon glutinosus*)

12B Salt and pepper belly, back is either with a red stripe or grayish (“leadback”), sometimes with a reddish tip of nose; never has stripe on side of head like a dusky (avoid confusing this with Ocoee/Imitator).....**Red-backed Salamander** (*Plethodon serratus*)

LARVAE

13A Gills are white or VERY pale and appearing especially limp; total length usually > 40mm**Dusky Salamanders, go to 15.**

13B Gills various, but not white.....**go to 14.**

14A Gills like fingers (most obvious part is the central support of the gills), not like plumes, gills usually NOT reddish**Dusky Salamanders, go to 15.**

14B Gills like feathery plumes, often bright red; tail is especially keeled, but often hard to use this to separate species.....**go to 17.**

15A Black tips to toes, especially if seen from below.....**seal or black-bellied salamander, go to 16.**

15B Toe tips are the same color as rest of toe and foot.....**Unidentified Dusky Salamander.**

16A Head as wide as the thickest part of body.....**Black-bellied Salamander.**

Head more narrow and streamlined.....**Seal Salamander.**

Often cannot tell black-bellied salamander from seal salamander

17A Narrow, without costal grooves (ribbed creases in the sides between legs).....**go to 18.**

17B Stout-bodied, elongate, 16-19 costal grooves (“ribbed” creases on side of body).....**go to 19.**

18A Six to nine pairs of white spots down the back.....**Blue-ridge Two-lined Salamander.**

18B No spots on back (yet to be found in Walker Valley streams).....**Long-tailed Salamander.**

19A Back mottled or streaked with dark; 16-17 costal grooves.....**Red Salamander.**

19B Red gills; 17-19 costal grooves; faint oval outline on sides of head.....**Spring Salamander.**

Salamander Monitoring & the Scientific Method

Quantitative Qualitative Game Cards

Make a set for each team (usually five teams).

QUANTITATIVE

The temperature is 75 degrees Fahrenheit.

The sky is partly cloudy.

The time is 6:05 p.m.

The average temperature for this date is 25 degrees Celsius.

QUALITATIVE

The runner's speed was 6 km/hour.

75% of the earth is covered with water.

The Coke had 12 ounces of the 16 ounces left.

The soil moisture is rated as dry.

Salamander Monitoring & the Scientific Method

The meat was cooked medium-rare.

The white-tailed deer's condition was rated as poor because of the lack of food.

The index for ozone was a 5 on a 10 scale.

The salamander was thin.

The students learned a lot about nature.

We caught eight seal salamanders.

The water is cold today.

That is a beautiful drawing.

ANSWERS:

Quantitative: The temperature is 75 degrees Fahrenheit; The runner's speed was 6 km/hour; 75% of the earth is covered with water; The time is 6:05 p.m.; The Coke had 12 ounces of the 16 ounces left; The average temperature for this date is 25 degrees Celsius; The index for ozone was a 5 on a 10 scale; We caught eight seal salamanders.

Qualitative: The sky is partly cloudy; The soil moisture is rated as dry; The meat was cooked medium-rare; The white-tailed deer's condition was rated as poor because of the lack of food; The salamander was thin; The students learned a lot about nature; The water is cold today; That is a beautiful drawing.