GREAT SMOKY MOUNTAINS INSTITUTE AT TREMONT

SALAMANDER INVESTIGATIONS

GRADE LEVEL
4th-8th

TIME FRAME
Half day (3 hours)

MATERIALS
- BEETLES Question Cards
- Salamander ID Keys
- Rulers
- Spring scale
- Zip top plastic bags (~1/student)
- Thermometers
- pH and DO Kit
- White plastic bin
- Field guide

LOCATIONS
- Loan Branch or Dorsey Stream
- Tiffani Island or Walker Springs as a backup in high water.

CROSS-CUTTING CONCEPTS
Systems and Systems Models

Students will explore a part of an ecosystem to understand the whole ecosystem better.

Cause and Effect

Students choose a subject to investigate and argue the implications of what they discover from evidence.

IDEAL SEASONS
Any season (salamanders are less common in the winter)

INVITE
EXPLORE
WONDER
CREATE
REFLECT
SHARE

LESSON SUMMARY
Students will do science by investigating the natural world and studying salamanders. They will use a variety of scientific practices such as making observations, developing questions, designing studies, and sharing findings.

Guiding questions: What do scientists do? How can we become scientists as we study a species unique to the Smoky Mountains?

KEY LESSON CHARACTERISTICS

WHAT LEARNERS DO	SKILLS & KNOWLEDGE	SOCIAL & EMOTIONAL ABILITIES
Explore the stream and catch salamanders	How scientists investigate nature	**Social Awareness** Show empathy and concern for salamanders' safety
Make observations	Nature sketching skills and techniques	**Relationship skills** Work with peers to develop a field investigation and share findings as a team
Ask questions	Finding and arguing from evidence	
Develop and test an experiment	Biodiversity in stream	
Share findings		

LESSON FLOW

- ALL THE SALAMANDERS
- SALAMANDER SEARCH
- SALAMANDER SKETCHING
- TESTABLE QUESTIONS
- INVESTIGATION
- SHARE FINDINGS
- WHAT DO SCIENTISTS DO?

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ALL THE SALAMANDERS

The "All the Salamanders" video is part of the #SmokiesCool Project and can be found by searching "#SmokiesCool" on YouTube or Vimeo.

TIME CONSTRAINTS

If you can't watch the music video, you can accomplish a similar goal by asking the students what they already know about salamanders. The rest of the information will come during the lesson.

WHY PLASTIC BAGS?

The barrier provided by the plastic bag can support salamander health because...

- ...they breathe through their skin. Their skin is incredibly sensitive to chemicals we might have on our skin.
- ...they are cold blooded. Their bodies are adapted to operate at cooler temperatures. Our hands are much warmer and can cause stress.

RANAVIRUS

Ranavirus is a virus that effects fish, reptiles and amphibians. It is not directly harmful to humans, but is commonly spread from human activity. To prevent the spread of ranavirus, have students spray water shoes with nolvasan if they were used in a different stream.

EXPLORATION TIPS

- Label bags with numbers so that students can remember which salamander was theirs.
- Use the community science maps to mark where each salamander was caught.
- Salamander daycare: Bring a bin and add water as a cool and safe place that students can drop off bagged salamanders while they continue to explore.

"ALL THE SALAMANDERS" *10 MIN*

1. Gather all the students in front of the projector. Ask what students already know about salamanders. Give some time to share.

Since we're going to be doing science today, we need to start off with some research to get some background knowledge. Listen closely; this music video has some important information about salamanders that could be helpful to us."

2. Play the "All the Salamanders" video.
3. After the video, ask students what information they learned from the video that might be important later.

"Let's use some of this new knowledge and go find some salamanders!"

SALAMANDER SEARCH *30 - 45 MIN*

1. Tell students they are going find and catch salamanders. Demonstrate how to catch a salamander using a plastic bag: Near the plastic demo salamander, press the bottom of the bag flush with the ground. Use a stick or a finger to nudge the salamander into the bag.
2. Make sure the students understand all the considerations and rules below.

- Salamanders can detach their tail if they feel threatened. After dropping a tail, salamanders are at a disadvantage due to the loss of an important defense mechanism and the energy stored in the tail.
- Rocks or logs need to be returned to same location, as they provide habitat to our forest friends.
- Place only one salamander in each bag and do not reuse bags. Some salamanders carry or are infected by the *ranavirus* and we don't want to spread it.
- Be mindful of the "salamander hotels" (mesh bags full of leaves). They are part of a community science study and should not be disturbed.
- Students must stay within the boundaries that you create (example, Upper or Lower Loan or within sight of an adult).

3. Find and catch salamanders.

SALAMANDER INVESTIGATIONS

CO-TEACH OPPORTUNITY
The "Basic Journal Entry/Sketch" activity is also found as a co-teaching quick card.

ALTERNATE ACTIVITY
"I notice, I wonder, it reminds me of" provides an opportunity to allow students to start asking questions and may be used instead. You can then introduce tools and ask more "I wonder" questions based on the tools before moving into an investigation.

SALAMANDER DETAILS
Encourage students to focus on the details of their salamanders. If they need inspiration, have them consider...
- number of toes
- shape of tail
- coloration
- relative size of legs

NOTES ON TIMING
Plan to spend at least 1.5 hours for the development of questions, investigation, and sharing.

GOOGLE-ABLE QUESTIONS
A third category might be Google-able questions: questions that can't be explored today, but we could research them in a guidebook or on the internet.

GROUPING
Students may be grouped...
- at random
- with friends
- based on questions they want to investigate

CO-TEACH OPPORTUNITY
Coming up with a thoughtful, testable question can be hard. If you have enough adults, assign one adult per research group to help develop and test a question and keep students on task.

INVESTIGATION TIP
Designate one area as a home base where students can find all the tools.

SALAMANDER SKETCHING — *15 - 20 MIN*

1. After collecting salamanders, have students sketch them.

   "Take some time to sketch the things you notice about your salamander in your journal. Remember, this is not about making the most beautiful picture; rather, it's about making good observations about the specific salamander you are looking at. A great way to include all your observations is by adding labels and notes around your sketch. Also include a few questions that you have about your salamander."

2. Give students a chance to share their journal entry with the person next to them. Reflect in pairs or a large group.

   - *What did you notice as you were sketching?*
   - *Where did you find salamanders?*
   - *Did you notice any colors or patterns on your salamanders?*
   - *Did your salamander look like anyone else's salamander?*

TESTABLE QUESTIONS — *10 MIN*

1. Ask students what questions they recorded in their journal entries. Compile these questions on a whiteboard and keep them visible.
2. Show students the tools available to them and demonstrate how to use them.
3. Divide students into groups and give each group a set of question cards. Instruct the to divide the questions into two piles:
   - Testable questions: Questions we could investigate today using the tools that we have
   - Non-testable questions: Questions we could not investigate today or at all
4. Students share their thoughts. Allow room for discussion of whether questions are testable or not.
5. Look at the list of student questions and determine which are testable.

   - *Which of these questions are testable?*
   - *Could we change any questions to make them testable?*

INVESTIGATION — *30 - 45 MIN*

1. Have each group come up with several questions they could investigate. Encourage them to try to come up with questions that are deeper than "what species is my salamander?" Encourage them to think of questions that include multiple variables, then choose one that they like.
2. Check in with groups before they start investigation to make sure they have a good testable question and a plan for investigating and recording information.
3. Let students investigate. Circulate among groups to make sure everyone is on task. When groups are finished they should head back to the "home base."

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USE INSPIRATION

The Smokies Science Investigations (SSI) posters on the Cove Room walls often help inspire students to create visual displays about their investigation.

"DISCOVERY SWAP" STYLE

This style encourages peer to peer discussion as students to take ownership over their investigation. A short write up can be found in the additional activities section and a full write-up can be found on the BEETLES Project website.

FLIP THE SCRIPT

Start by asking, "What did we do today?" and recording students' thoughts. Finish by writing the word "science" at the top. Ask students if the list of things they did can be considered science.

LET'S DO SCIENCE

New research suggests girls are more likely to be persistent in science activities with the phrase "let's do science" instead of "be a scientist."

SHARE RESULTS *10 - 15 MIN*

1. As students finish up their investigations, encourage them make sure that their data are organized and consider what they've discovered.

?
- *Did you notice any patterns? What evidence do you have?*
- *What made you curious about your question in the first place?*
- *What questions do you still have about the organism you studied?*
- *How could you find more information about these organisms?*
- *What helped you to learn today?*

2. Instruct students to create a display on a whiteboard to show what they learned from their investigation. Each group's display should include:
   - Original question
   - Methods
   - Findings and evidence
   - Additional information they'd like to share
   - Acknowledgments
3. Students share investigations "Discovery Swap" style. Groups decide on half its members to be "As" and half its members to be "Bs." All the "As" circulate while the "Bs" stay with the display to answer questions. After a few minutes, "As" and "Bs" switch places.

?
- *How did it feel to teach and talk with classmates about your investigations?*
- *How did it feel to learn from classmates?*
- *What helped you learn?*

WHAT DO SCIENTISTS DO? *5 - 10 MIN*

1. Write "**scientist**" on your write board and ask the students to turn and talk to a neighbor about what a scientist does.

?
- *What do scientists do?*

2. Share as a large group things that scientists do and write students' thoughts on a the whiteboard below the word "scientist."
3. Erase the word "scientist" from the white board and replace it with the group's name. Ask if the list still holds true based on what the group did today.

BRING IT HOME

- Teachers can lead an exploratory investigation with organisms in their schoolyard.
- Students can find animal homes in their neighborhoods. What characteristics do these places have that make them good homes for animals?
- What is unique to each schoolyard that students may be excited about investigating (ex. spiders, millipedes, squirrels, etc.)?

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ALTERNATE ACTIVITIES

SALAMANDER TAILS

Students imagine they are salamanders and explore some of the environmental challenges salamanders face.

Required materials: *2 bandanas or flag football belts*

1. Explain that there are lots of factors that challenge a salamander, including competition and predation from other salamanders as well as environmental factors.
2. Have students sit in a large circle. Select two volunteers and have each tuck a bandana into back of their pants, allowing it to hang down like a tail.

"In this game, there will be two salamanders in the middle. They are competing and each trying to steal the tail of the other. Everyone sitting in the circle represents another environmental factor that affects a salamander. They can also try to steal the salamanders' tails, but they must stay seated while doing so. The last salamander with a tail wins!"

- *What about this game might reflect real life? What doesn't?*
- *What different challenges might the people sitting in the circle represent?*

DISCOVERY SWAP

Students pay close attention, ask and answer questions about a salamander

1. With a partner, students spend ~10 minutes sketching and observing one salamander together. Emphasize asking questions about the salamander. Encourage the students to use "I notice, I wonder, and it reminds me of" in their journal entry.
2. After ~10 minutes but before students become restless, introduce field guides and other resources for students to add supplementary information about their salamanders. Students should record their source as they add information and answer their questions.
3. Each pair chooses one partner to be an "A" and the other to be the "B." All of the As circulate and visit the Bs. As should ask Bs questions and observe their salamander. After a few minutes of sharing As and Bs switch places.

- *What did it feel like to have scientific conversations with your peers?*
- *What questions do you still have about your salamander?*
- *What new questions arose during your conversations?*

DISCOVERY SWAP

Full "Discovery Swap" write up can be found on the BEETLES Project website.

PEER CONVERSATIONS

Remind students that as they circulate they should be asking questions and engaging in conversations with their peers.

- Presenters can ask things like "What do you notice?" or "Does this relate to your investigation?"
- Observers can ask things like, "What do you mean by that?" and, "What did you notice about...?"

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Salamander Investigations Field Card

All the Salamanders

"Listen closely; this music video has some important information about salamanders that could be helpful to us as we start our investigations."

- *What have you learned that may be useful later?*
- *What is the coolest thing you learned about salamanders?*

Salamander Search

1. With a partner, find a salamander so we can study it more closely.

SALAMANDER SEARCH RULES

- Handle salamanders gently so they don't lose their tails.
- Return rocks and logs whence they came.
- One salamander per bag.
- Leave salamander hotels alone.
- Stay in boundaries.

Salamander Sketching

1. Have students sketch their salamanders and include observations and questions.

- *Where did you find the salamanders?*
- *What did you notice as you were sketching?*
- *Did you notice any colors or patterns on your salamanders?*
- *Did your salamander look like anyone else's salamander?*

Salamander Investigations Field Card

Testable Questions

1. Ask students to share their questions in the journal and write them down on your whiteboard.
2. Divide students into groups. Give each group a set of question cards. Instruct the to divide the questions into two piles:
   - Testable questions
   - Non-testable questions
3. Students share their thoughts and supporting evidence.
4. Introduce tools. Determine which of the students' questions about salamanders are testable.

- *Which of these questions are testable?*
- *Could we change anything to make the others testable?*

Investigation

1. Have each group select one testable question to investigate. Check in with groups before they start to approve their question. Make sure they have a plan.
2. Circulate and help facilitate data collection.

Share findings

1. Have students present their investigation including...

- Original question
- Methods
- Findings and evidence
- Additional information they'd like to share
- Acknowledgements

2. Groups split in half to share their results. Group "A" circulates and group "B" stays with displays. Switch positions.

- *What did it feel like to discuss with peers?*
- *What helped you learn?*

What do scientists do?

1. Write "scientist" on your write board. Ask the students to turn and talk to a neighbor about what a scientist does.
2. Share as a group things that scientists do. Write students' thoughts on a the whiteboard below the word "scientist."
3. Erase the word "scientist" from the white board and replace it with the group's name. Ask if the list still holds true.

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AGE CONSIDERATIONS AND STANDARDS

4th - 5th	6th - 8th	9th - 12th
AGE RELATED TEACHING TIPS • Allow more time to explore and understand that students may not focus entirely on salamanders while exploring. • Offer more guidance when developing questions. • Students may benefit from more visuals.	AGE RELATED TEACHING TIPS • Allow more time to explore. • Students can use logic to build on previous information and use that to argue from evidence. RELATED STANDARDS MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	AGE RELATED TEACHING TIPS • Encourage students to challenge themselves when developing investigations. • Students can isolate variables and use them to determine if they may have an impact on their subject.

ADDITIONAL INFORMATION

- Salamanders are amphibians. Most hatch from eggs in the water as aquatic larva, with feather-like gills on their neck, but generally resembling an adult salamander. As they become adults, most of them go through an incomplete metamorphosis, losing their gills and transitioning to breathing through lungs or skin.
- Frogs go through a complete metamorphosis as they lose their tail and do not look like their juvenile self.
- Some adults continue to live in streams, while others move onto land. Most salamanders in the park (24 out of 30 species) breathe air directly through their skin, without using lungs. To facilitate this, they must keep their skin moist.
- As amphibians, salamanders are "cold-blooded," meaning their internal body temperature is derived mostly from that of the environment. The scientific term for this is ectothermic.
- Salamanders can be used to indicate the pollution levels of an ecosystem due to their sensitive skin.