Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

2275 Speedway, Mail Code C9000
Austin, TX 78712
(512) 471-5847
www.esi.utexas.edu

Jollyville Plateau Salamander Ecology

Lesson Plan for Grades: 9-12
Length of Lesson: 1 hour 45 minutes

Authored by: Stavana Strutz, Nathan Bendik, & Hayley Gillespie for UT Environmental Science Institute
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Subject area/course:
- Biology, Aquatic Science

Materials:
- Computer & internet access.

TEKS/SEs:

§112.32. Aquatic Science

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:
- (F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;
- (H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;
- (I) perform calculations using dimensional analysis, significant digits, and scientific notation; and
- (J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(4) Science concepts. Students know that aquatic environments are the product of Earth systems interactions. The student is expected to:
- (C) collect and evaluate global environmental data using technology such as maps, visualizations, satellite data, Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, buoys, etc.

(7) Science concepts. The student knows the origin and use of water in a watershed. The student is expected to:
- (C) identify water quantity and quality in a local watershed.

(9) Science concepts. The student knows the types and components of aquatic ecosystems. The student is expected to:
- (C) identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it.

§112.34. Biology
(2) Scientific processes. The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:
- (G) analyze, evaluate, make inferences, and predict trends from data; and

(11) Science concepts. The student knows that biological systems work to achieve and maintain balance. The student is expected to:
- (B) investigate and analyze how organisms, populations, and communities respond to external factors;

(12) Science concepts. The student knows that interdependence and interactions occur within an environmental

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system. The student is expected to:

- (F) describe how environmental change can impact ecosystem stability.

Lesson objective(s):

- Students will learn that animal populations affected by environmental factors such as pollution.
- Students will utilize mathematical and graphing skills.

Differentiation strategies to meet diverse learner needs:

- The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills.
- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.

ENGAGEMENT (15 minutes)

- Teacher will project or posts a picture of salamanders to the board (see engagement activity).
- Teacher poses statements to the entire class. Students should raise their hands as to whether they agree or disagree with the teacher's assertions. Afterward, the teacher will go over the answers.

EXPLORATION (45 minutes)

- Students will be given latitude and longitude coordinates of locations of the Jollyville Plateau Salamander. They will use Google Earth or Google Maps to look at the sites and describe the habitat. Students then make predictions about the health of the different populations at the different sites
- After visually inspecting the habitat, students will be given data on conductivity and juvenile salamander counts at each site. They will average the data, graph the data, and decide whether or not their predictions about habitat type and salamander population health were supported by data.
- As students are working through the exploration activity (see attached worksheet), walk around the room and facilitate their learning.

EXPLANATION (30 minutes)

- Divide the class into several groups. Each group is responsible for answering one of the following questions related to the Exploration Activity.

ELABORATION (15 minutes)

- Class comes back together as a group to discuss the broader implications of the analysis. Ask the class questions listed in the elaboration activity.
- Additionally, students can use statistical software, such as that found in Microsoft Excel to run a regression analysis on the effect of conductivity on juvenile salamander population size

EVALUATION (throughout entire lesson)

- Students will complete the worksheet attached to this lesson and participate in the engagement and elaboration activities

SOURCES AND RESOURCES

- **Dr. David Hillis' *Hot Science – Cool Talks* #101 "How a Salamander Saved a City",** www.hotsciencecooltalks.org
- ***IUCN Redlist***, www.iucnredlist.org/details/59275/0
- ***City of Austin Raw Data***, data.austintexas.gov/Environmental/JPS-juvs-and-SPC/95us-p2ms
- ***Chinese Giant Salamander***, www.arkive.org/chinese-giant-salamander/andrias-davidianus/#text=All
- ***Texas Salamander***, www.arkive.org/texas-salamander/eurycea-neotenes/

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TEACHER HANDOUT: Engagement Activity (15 minutes)

Purpose: To gauge students' knowledge about salamander ecology and biology and stimulate interest in the lesson.

Materials: none

Safety Information: N/A

Procedure:

- First, show students pictures of salamanders from to following websites:
  - Chinese Giant Salamander: http://www.arkive.org/chinese-giant-salamander/andrias-davidianus/#text=All
  - Texas Salamander: http://www.arkive.org/texas-salamander/eurycea-neotenes/
- Teacher will read the following statements to students and have them raise their hands if they agree/disagree or believe a statement to be true/false.
- Teacher goes over the responses at the end and assists students in determining the correct answers.
- Statements:
  - Salamanders are reptiles (false).
  - Salamanders are amphibians (true).
  - Salamanders are cold-blooded (true).
  - Salamanders live their entire lives in water (some do).
  - Salamanders live part of their lives in water and part on land (some do).
  - Salamanders breathe through their skin (the aquatic/neotenic species do).
    - Explain that neoteny is when adult animals retain characteristics of the juvenile state and that all amphibians begin their life cycle in water.
  - Salamanders have lungs (true).
    - Most terrestrial ones do while aquatic/neotenic ones have gills and sometimes lungs. Another group of salamanders lacks lungs and gills and breathes entirely through its skin and specialized mouth/throat tissue
  - Salamanders cannot regrow lost limbs (false).
  - Salamanders can grow up to 5 feet (true, the Chinese Giant Salamander can).
  - Salamanders are predators (true).

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STUDENT HANDOUT: Exploration Activity (45 minutes)

The Jollyville Plateau Salamander (*Eurycea tonkawae)* is an endangered salamander species found near the city of Austin, Texas. Like other amphibians, it has permeable skin that is used for oxygen exchange. This salamander and the group of salamanders it belongs to are neotenic meaning that they retain juvenile characteristics well into adulthood, such as entirely aquatic life cycle. This particular species is endangered.

Part 1

Map the populations of the Jollyville Plateau Salamander using Google Earth or Google Maps (turn on Earth mode). Use the following latitude and longitude coordinates and describe the habitat. Pay special attention to how much urbanization (roads, buildings, etc.) each site is surrounded by.

Site	**Latitude**	**Longitude**	**Habitat Description**
Franklin	30.4190	-97.8127	
Hill Marsh Spring	30.5076	-97.7551	
Spicewood	30.3622	-97.7470	
Tanglewood	30.4304	-97.7841	
Tributary 6	30.4254	-97.8146	
Ribelin	30.3992	-97.8326	

1) Do you expect the habitat to affect the salamanders?

2) In what ways might urban development affect salamanders?

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Part 2

The City of Austin monitors the status of the Jollyville Plateau Salamander by doing regular surveys of the populations. Below are data from the City of Austin. Conductivity measures ion concentrations in the water. For each of the sites listed, calculate the average conductivity and juveniles for 2008 – 2012.

3)

Year	Site	Development	Conductivity (us/cm)	Juveniles	Average Conductivity	Average Juveniles
2008	Tributary 6	Urban	902	1		
2009	Tributary 6	Urban	986	4		
2010	Tributary 6	Urban	1027	0		
2011	Tributary 6	Urban	1040	6		
2012	Tributary 6	Urban	1043	17		
2008	Tanglewood	Urban	732	0		
2009	Tanglewood	Urban	875	0		
2010	Tanglewood	Urban	933	1		
2011	Tanglewood	Urban	828	0		
2012	Tanglewood	Urban	912	0		
2008	Spicewood	Urban	700	0		
2009	Spicewood	Urban	697	0		
2010	Spicewood	Urban	860	0		
2011	Spicewood	Urban	853	0		
2012	Spicewood	Urban	773	0		
2008	Franklin	Rural	554	44		
2009	Franklin	Rural	571	2		
2010	Franklin	Rural	550	55		
2011	Franklin	Rural	565	14		
2012	Franklin	Rural	555	80		
2008	Ribelin	Rural	529	1		
2009	Ribelin	Rural	570	0		
2010	Ribelin	Rural	581	18		
2011	Ribelin	Rural	587	2		
2012	Ribelin	Rural	553	40		
2010	Hill Marsh	Transitional	916	25		
2011	Hill Marsh	Transitional	856	25		
2012	Hill Marsh	Transitional	895	33		

4) What do you think conductivity is an indicator of?

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5) Why is it important to count juvenile salamanders?

6) Create a bar graph of salamander counts by **development type**. Remember to include a title, axis labels and units.

7) Graph the juvenile salamander population as it relates to conductivity. Remember to include a title, axis labels, and axis units.

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8) Which development type has the lowest number of salamanders?

9) Which development type has the highest conductivity?

10) What happens to salamander counts as conductivity increases? Why do you think that is?

11) What do you expect to happen to salamanders as suburban sprawl/urbanization increases?

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TEACHER HANDOUT: Exploration Activity (45 minutes)

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Site	Latitude	Longitude	Habitat Description
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Hill Marsh Spring	30.5076	-97.7551	Transitional
Spicewood	30.3622	-97.7470	Urban
Tanglewood	30.4304	-97.7841	Urban
Tributary 6	30.4254	-97.8146	Urban
Ribelin	30.3992	-97.8326	Rural

1) Do you expect the habitat to affect the salamanders? Why?

   Yes but any answer acceptable with justification.

2) In what ways might development affect salamanders?

   Development might hurt salamanders via increased pollution and habitat loss. There are other potential correct answers.

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2009	Spicewood	Urban	697	0		
2010	Spicewood	Urban	860	0		
2011	Spicewood	Urban	853	0		
2012	Spicewood	Urban	773	0		
2008	Franklin	Rural	554	44	559	39
2009	Franklin	Rural	571	2		
2010	Franklin	Rural	550	55		
2011	Franklin	Rural	565	14		
2012	Franklin	Rural	555	80		
2008	Ribelin	Rural	529	1	564	12
2009	Ribelin	Rural	570	0		
2010	Ribelin	Rural	581	18		
2011	Ribelin	Rural	587	2		
2012	Ribelin	Rural	553	40		
2010	Hill Marsh	Transitional	916	25	889	28
2011	Hill Marsh	Transitional	856	25		
2012	Hill Marsh	Transitional	895	33		

4) What do you think conductivity is an indicator of?

Conductivity is an indicator of water quality. Higher conductivity means more ions in the world and more pollution.

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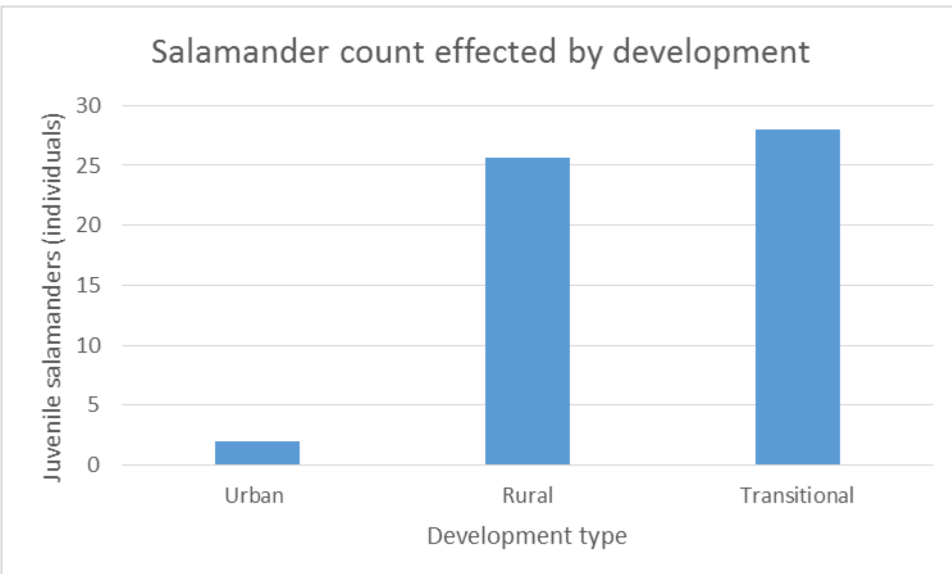
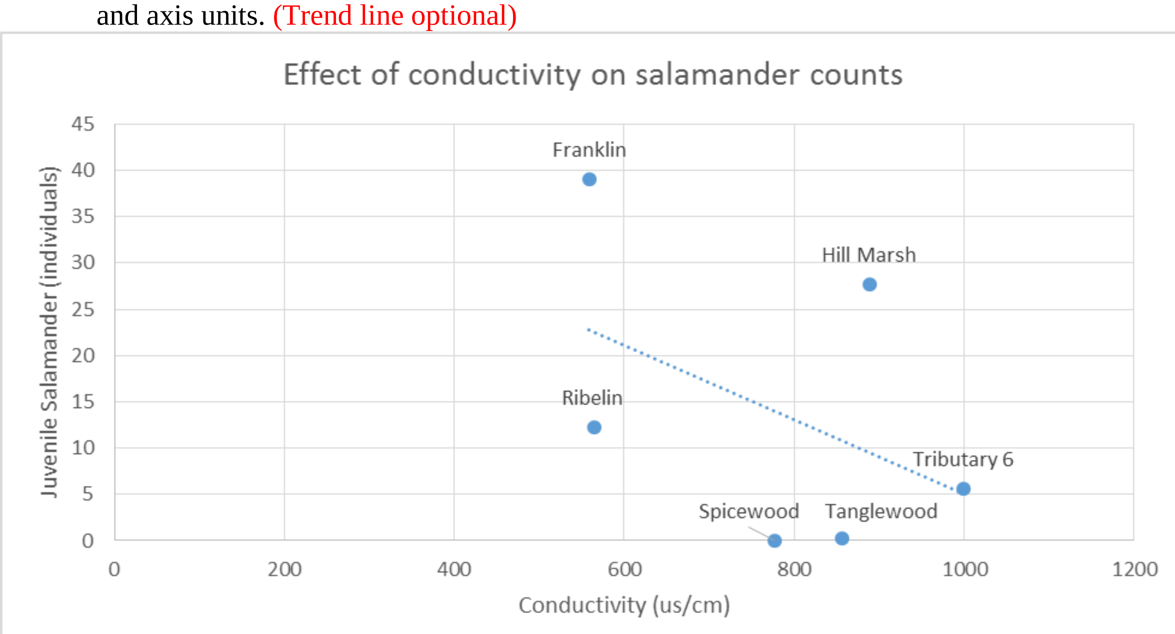
5) Why is it important to count juvenile salamanders?

Juvenile salamanders are an important life stage because they indicate whether adult salamanders are reproducing. They are the next generation.

6) Create a bar chart of salamander counts by **development type**. Remember to include a title, axis labels and units.



7) Graph the juvenile salamander population as it relates to conductivity. Remember to include a title, axis labels, and axis units. (Trend line optional)



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8) Which development type has the lowest number of salamanders?

Urban

9) Which development type has the highest conductivity?

Urban

10) What happens to salamander counts as conductivity increases? Why do you think that is?

Salamander counts decrease as conductivity increases. Salamanders might be responding poorly to pollution in the water that is either killing them or decreasing their reproduction. There are other acceptable answers.

11) What do you expect to happen to salamanders as suburban sprawl/urbanization increases?

Salamander populations will likely decline and potentially go extinct in certain areas.

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<u>TEACHER HANDOUT:</u> Explanation Activity (30 minutes)

Purpose: To broaden students understanding of species interaction with their environment and with each other.

Materials: N/A

Safety Information: N/A

Procedure:

- Divide the class into small teams, each team has 3-4 minutes to share their answer one of the following questions from the elaboration activity:
    - What does conductivity measure? What do you think conductivity is an indicator of?
    - What are the three types of urban development in the data provided? In what ways does development affect salamanders?
    - What happens to salamander counts as conductivity increases? Why do you think that is?
    - Why is it important to count juvenile salamanders?
    - Do you expect the habitat to affect the salamanders? Why?

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<u>TEACHER HANDOUT:</u> Elaboration Activity (15 minutes)

Purpose: To broaden students understanding of species interaction with their environment and with each other.

Materials: N/A

Safety Information: N/A

Procedure:

- Class comes together as a group to discuss the broader implications of the analysis. Ask the class the following questions:
    - Are salamanders special in their ability to tell us information about pollution in the environment?
    - What would happen to the salamander populations if they were no longer listed as an endangered species?
    - What are some of the positive benefits of having salamanders listed as endangered?
    - How would the ecosystem change if salamanders were no longer a part of it?
    - What other species would be affected by salamander disappearance?
    - How could this analysis be made more effective? What mathematical component is missing from the lesson?