# Shenandoah National Park

National Park Service
U.S. Department of the Interior

**Virtual Exploring Earth Science: Shenandoah Salamander and Climate Change Teacher Guide For Shenandoah National Park**

**Summary**

The following is a guide for teachers participating in the **Exploring Earth Science: The Shenandoah Salamander and Climate Change** program with Shenandoah National Park. This is a two-part program, each 1 hour in length. This guide provides activities, worksheets, and instructions for teacher and student use for the programs.

## *Before* the virtual program with a ranger, complete the following activities:

- Look on a map to find where Shenandoah National Park is located. Note how far it is from your school.
- In class, have your students watch the video "Climate Change in Shenandoah" (link to the video can be found in the References and Resources section) pausing throughout it to discuss the questions listed on the "Teacher Video Discussion" sheet found below.
- In class, have your students watch the "Shenandoah Salamander: Part 1" video on the Shenandoah Salamander page on the Shenandoah National Park website (link to the video can be found in the References and Resources section).
- After the video discussion, print and provide each student with a copy of the "Student Study Guide" found at the end of this document.
- Section 1 should be completed before the program using in-class discussion and independent research. Section 2 should be completed during the first virtual program with a ranger. Section 3 should be completed between the first and second virtual program with a ranger. Section 4 should be completed during the second virtual program with a ranger. Section 5 should be completed after the second virtual program with a ranger.
- Explain to the students that they will be using **primary source** resources to do their research on salamanders and climate change. Give a brief review of using only credible websites and avoiding plagiarism. A list of possible websites to use is available in this guide.

## *After* the first program with a ranger, explain the following project to your students

- Break your students into research teams of five or less.
- They are to use the study guide and independent research to complete a project. They will be expected to use posters, PowerPoint, or something creative to build a presentation which they will present during the second virtual program. This presentation should show a thorough response to the following question:
- How would you save the Shenandoah Salamander? Why should or shouldn't we save the Shenandoah Salamander?
- Consider this from the perspective of a park manager, scientist, lobbyist, or individual citizen.
- Research other endangered and recovered species for ideas and techniques.
- Consider the following:
    - Examples: Red Wolf, Whooping Crane, California Condor
    - Why do species become endangered?
    - What worked to recover the species? What didn't?
    - How is climate change impacting the salamander?
    - Apply it to Shenandoah. Consider the dueling ideas of the NPS.

- Compare the habitat of the Shenandoah Salamander and the Redbacked Salamander to habitats in the neighborhoods around your school. This will allow them to consider what factors impacted by climate change may impact the salamanders like rain, snowpack, wind, heat, etc.
- Encourage students to go out to explore areas that match the habitat of the Red-backed salamander and look for them, but remind them not to touch or move the salamanders.
- Encourage them to try at least one app to do citizen science like iNaturalist or Globe.

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***After* the first program with a ranger, explain the following project to your students:**

- Have students work in their research team to create a social media campaign (see a template in section 5 of the Student Study Guide).
- Have them determine what actions they could take to reduce their carbon footprints. Discuss why they could or could not make these changes in their lives. Discuss and compare. Have each student write and sign a pledge for how they will reduce their carbon footprints, hopefully in the area in which they release the most carbon dioxide.
- Optional: Do more with outreach and campaigning about climate change with an Extended Public Service Message.
    - In addition to creating a social media campaign, students could also work individually or in groups, to create a public service message or program to present to the school board, PTA, park managers, or local citizens' groups.
    - They could use multimedia programs or social media to create a podcast, movie, or publication.
    - These programs should demonstrate students' views on the importance of preserving high elevation habitats and the Shenandoah salamander and ways that individuals can reduce the use of fossil fuels to slow down climate change.

## References and Resources for Teachers

This compilation of links is for teacher reference to answer questions about Shenandoah National Park, salamander species, climate change and more. Teachers can provide this information to students for research purposes or use for their own class discussions.

### Video Discussion Activity

**"Climate Change in Shenandoah" Video**
Video (U.S. National Park Service) (nps.gov)

**"Shenandoah Salamander: Part 1" Video**
Shenandoah Salamander - Shenandoah National Park (U.S. National Park Service) (nps.gov)

### Recommended Websites for Student Questions

**National Park Service (NPS)**
http://www.nps.gov/subjects/climatechange/index.htm

**Environmental Protection Agency (EPA)**
https://www.epa.gov/climate-indicators
https://archive.epa.gov/climatechange/kids/index.html
Greenhouse Gas (GHG) Emissions and Removals | US EPA

**National Oceanic and Atmospheric Administration (NOAA)**
http://www.climate.gov/
http://www.cpc.ncep.noaa.gov/

**National Aeronautics and Space Administration (NASA)**
http://climate.nasa.gov/
http://pmm.nasa.gov/science/climate-change
http://climatekids.nasa.gov/
What is the greenhouse effect? – Climate Change: Vital Signs of the Planet (nasa.gov)

### Resources for Teacher background information:

**Shenandoah Salamander Video**
https://www.nps.gov/shen/learn/nature/shenandoah-salamander-film.htm

### Red-backed salamander info:

**Shenandoah National Park Amphibians**
https://www.nps.gov/shen/learn/nature/amphibians.htm
**Virginia Fish and Wildlife**
https://vafwis.dgif.virginia.gov/fwis/booklet.html?Menu=_.Taxonomy&bova=020043&version=15684
**Virginia Department of Game & Inland Fisheries**
https://www.dgif.virginia.gov/wildlife/information/eastern-red-backed-salamander/
**Virginia Herpetological Society**
https://www.virginiaherpetologicalsociety.com/amphibians/salamanders/eastern-red-backed-salamander/red-backed_salamander.php
**University of Michigan Animal Diversity Web**
https://animaldiversity.org/site/accounts/information/Plethodon_cinereus.html

## Shenandoah salamander info:

**Shenandoah National Park**
http://www.nps.gov/shen/naturescience/shenandoah_salamander.htm
**Virginia Fish and Wildlife**
http://www.vafwis.org/fwis/booklet.html?Menu=_.Taxonomy&bova=020045_
**Virginia Department of Game & Inland Fisheries**
https://www.dgif.virginia.gov/wildlife/information/shenandoah-salamander/
**Virginia Herpetological Society**
https://www.virginiaherpetologicalsociety.com/amphibians/salamanders/shenandoah-salamander/shenandoah_salamander.php

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## General Salamander Information

David, Bishop, and Haas Carola. "Sustaining America's Aquatic Biodiversity - Salamander Biodiversity and Conservation." Virginia Cooperative Extension. Department of Fisheries and Wildlife Sciences, Virginia Tech, 2009. http://pubs.ext.vt.edu/420/420-528/420-528.html

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## Going Further

**Resource Issues**

**Park Air Profiles - Shenandoah National Park**
https://www.nps.gov/articles/airprofiles-shen.htm
**Non-native and Invasive Species**
Invasive Species - Shenandoah National Park (U.S. National Park Service) (nps.gov)
**Nonnative Species Management**
https://www.nps.gov/shen/learn/nature/nonnative-species-management.htm
**Hemlock Woolly Adelgid**
http://www.nps.gov/shen/naturescience/eastern_hemlock.htm
https://www.fs.fed.us/research/invasive-species/insects/hemlock-wooly-adelgid.php
**Emerald Ash Borer**
http://www.emeraldashborer.info/

**Success Stories of other imperiled species**

**Peregrine Falcons at Shenandoah National Park**
http://www.nps.gov/shen/naturescience/falcon.htm
**12 Conservation Success Stories**
https://www.endangered.org/12-conservation-success-stories-for-endangered-species-day/

**Instructions:** In class, have your students watch the "Climate Change in Shenandoah" video (In References and Resources section) pausing throughout it to discuss the following questions:

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***Segment 1, Time 0 – 1:03, Pause***

**Discussion Questions:**

- What is Climate Change? How is this different than weather?
- Why would the Industrial Revolution be a turning point in Climate Change?
- What are some events we see happening in the video that are happening due to Climate Change?
- Can you think of other changes that will come about due to Climate Change and warming temperatures?
- How does melting glaciers and sea level rise affect people?
- How might Climate Change affect the Appalachian Mountains if there are no glaciers here and the ocean is hours driving distance away?

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***Segment 2, Time 1:04 – 1:56, Pause***

**Discussion Questions:**

- What is phenology?
- What does endemic mean? Why would this make the Shenandoah Salamander important?
- How do you think a salamander might breathe if it is lungless? (Answer: Through its skin)
- What does the Shenandoah Salamander need that makes Climate Change a concern for it? How might Climate Change affect the Shenandoah Salamander?

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***Segment 3, Time 1:57 – 2:29, Pause***

**Discussion Questions:**

- Why might people never see this animal?
- What might happen to the ecosystem if the Shenandoah Salamander disappears?
- What would happen to the populations of their prey (ie. insects/invertebrates) and predators (ie. snakes)?
- How might the salamander help the non-living parts of the ecosystem like soil?

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***Segment 4, Time 2:30 – End***

**Discussion Questions:**

- Why might we be studying moisture and temperature?
- Why might we be studying competition with another Salamander?
- Why would it matter to study the Shenandoah Salamander?
- Why would we want to ensure the survival of the Shenandoah Salamander?

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

**Instructions:** You will use this study guide throughout your program and to complete a research project with your research team to answer the following question:

How would you work to save the Shenandoah Salamander? Why should or shouldn't we save the Shenandoah Salamander?

**Student Study Guide Section 1:** Complete *BEFORE* the first program
Using in-class discussion and independent research, complete this section prior to the first virtual program with a ranger.

### Climate Change

What is "Climate Change?"

### Greenhouse Gases

Identify some natural or human processes that might *increase* the amount of greenhouse gases in the atmosphere.

| Human Causes | Natural Causes |
|---|---|
| 1. | 1. |
| 2. | 2. |
| 3. | 3. |

List three examples of greenhouse gases:

1.

2.

3.

What are some of the positive and negative implications of the greenhouse effect?

What has happened or might happen to the Earth due to Climate Change?

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

## Endangered Species

What is an Endangered Species? Define and list at least one example.

What can cause a species to become endangered? List three potential reasons.

1.

2.

3.

## Your impact/The Future

Identify some things you can do that might decrease the amount of greenhouse gases in the atmosphere.

## National Parks

How far is Shenandoah from your school? Miles: _____ Drive time? _____

What does a National Park do?

Use this space to write down questions or notes to help you with your upcoming project:

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

**Student Study Guide Section 2:** *Complete DURING the virtual program*

**National Parks**

What are the dueling mandates of the NPS?

_____ & _____ VS. _____ & _____

**Shenandoah Salamander**
**(Plethodon Shenandoah)**

What does endemic mean? Circle the correct answer:

A. Not very many

B. Widespread and common

C. Found only in one place

D. Migratory through seasons

E. Breathes through their skin

**Limited Habitat**

Use this space to draw where you think the Shenandoah Salamander would live. Be sure to include what you think it needs to survive:

Is there anything else it needs that is not included in your drawing? If so, what?

Which section of the mountain does the Shenandoah Salamander live on?

A. Bottom B. Middle C. Top

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

## Competition

Circle the species for which the following statements are true.

- I am endangered.

  Shenandoah Salamander and/or Red-backed Salamander

- I am carnivorous.

  Shenandoah Salamander and/or Red-backed Salamander

- I am endemic to Shenandoah National Park.

  Shenandoah Salamander and/or Red-backed Salamander

- I live at high and low elevation.

  Shenandoah Salamander and/or Red-backed Salamander

## Climate Change

How will the effects of climate change impact the Shenandoah Salamander?

A. Melting glaciers faster

B. Decreasing haze and air pollution

C. Lowering sea levels

D. Raising average temperatures

E. Impacting migration of animals

F. Causing larger, more frequent fires

G. All the above

How will the circled effects of climate change impact the Shenandoah Salamander?

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

**Student Study Guide Section 3:** Complete *BETWEEN* the first and second virtual programs

Using what you have learned in class, during your first program, and with additional research, you are now tasked to complete a research project with your assigned group.

- Use primary source resources to do additional research on salamanders and climate change. Use only credible websites and avoid plagiarism.
    - Suggested websites to look into are for the following organizations: NPS, Shenandoah National Park, EPA, NOAA, NASA, Fish and Wildlife Service, Virginia Herpetological Society, and Virginia Department of Game & Inland Fisheries.
- You will use posters, PowerPoint, or something creative to build a presentation which you will present during the second virtual program. This presentation should show a thorough response to the following question.

How would you save the Shenandoah Salamander? Why should or shouldn't we save the Shenandoah Salamander?

- Consider this from the perspective of a park manager, scientist, lobbyist, or individual citizen.
- Research other endangered and recovered species for ideas and techniques. Consider the following:
    - Examples: Red Wolf, Whooping Crane, California Condor
    - Why do species become endangered?
    - What worked to recover the species? What didn't?
    - How is climate change impacting the salamander?
    - Apply it to Shenandoah. Consider the dueling ideas of the NPS.
- Compare the habitat of the Shenandoah Salamander and the Redbacked Salamander to habitats in the neighborhoods around your school or in Shenandoah National Park. Consider what factors impacted by climate change may impact the salamanders like rain, snowpack, wind, heat, etc.
    - Go out to explore areas that match the habitat of the Red-backed salamander or other native salamanders to your area and look for them. Remember: do not to touch or move the salamanders.
    - Try at least one app like iNaturalist or Globe to try out citizen science.

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

**Student Study Guide Section 4: Complete DURING your second virtual program**

Use this space to take notes about the projects of your classmates. What are their suggestions? What do you like? Circle the ones you like. What questions do you have? Put R, A, or D next to them once we assign the RAD framework to them.

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

## RAD Framework

RAD stands for resist, accept and direct. The RAD Climate Change framework is used by the National Park Service in efforts towards climate change affecting ecosystems' processes, function, structure or composition.

1. Resist the trajectory of change, by working to maintain or restore ecosystem processes, function, structure, or composition based upon historical or acceptable current conditions.
2. Accept the trajectory of change, by allowing ecosystem processes, function, structure, or composition to change, without intervening to alter their trajectory.
3. Direct the trajectory of change, by actively shaping ecosystem processes, function, structure, or composition towards desired new conditions.

Circle the category or categories of the RAD framework that your ideas fall into?

Resist Accept Direct

Circle the category or categories of the RAD framework that our current work regarding climate change in Shenandoah National Park falls into?

Resist Accept Direct

Which of the actions taken by Shenandoah National Park do you find most affective?

What are some ideas of what you specifically can do in your school to help the park save the Shenandoah salamander and combat the effects of climate change in your community?

What was the most interesting thing you learned during your program with Shenandoah National Park?

**Student Study Guide**
**Virtual Exploring Earth Science:**
**Shenandoah Salamander and Climate Change**

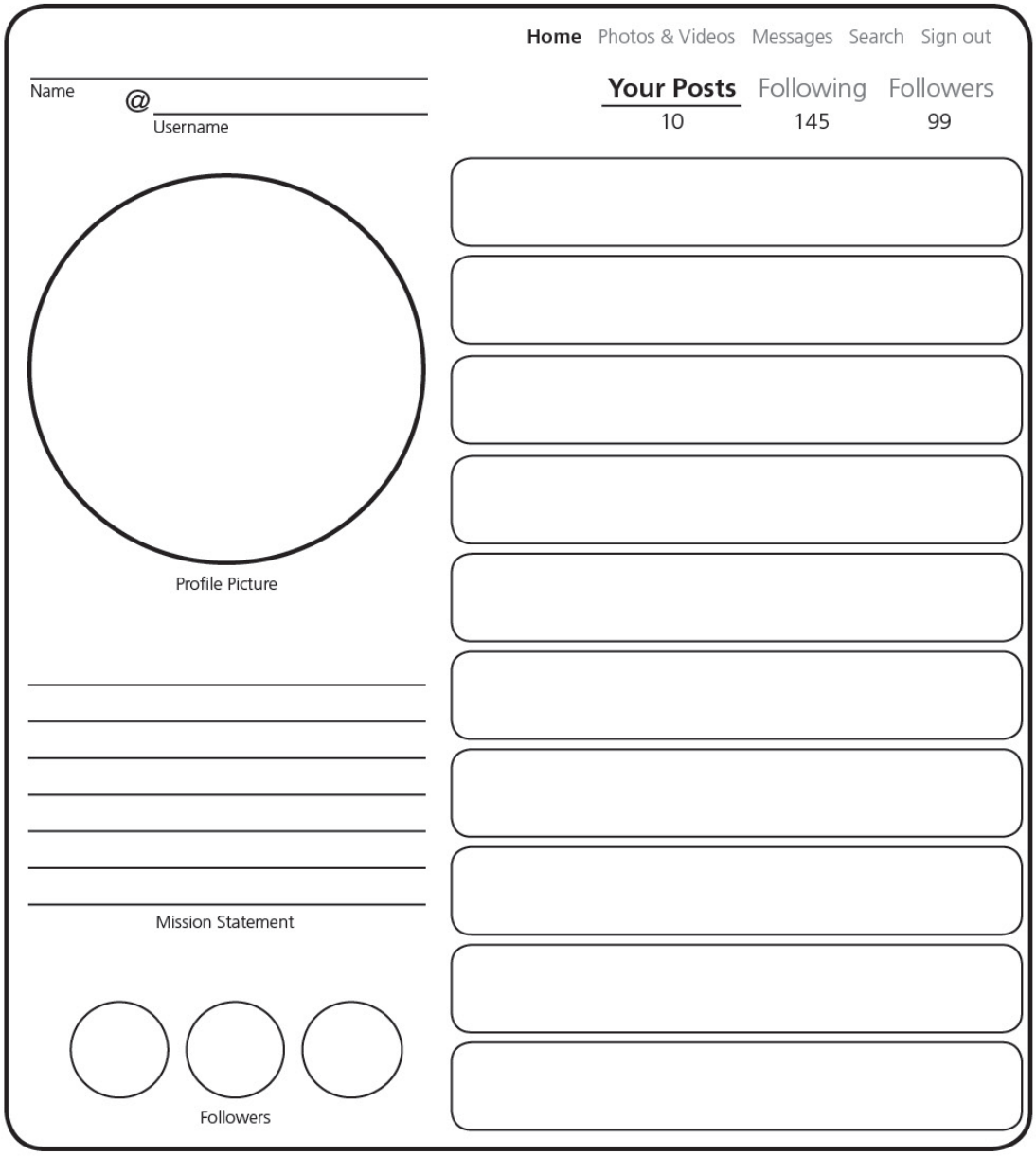
**Student Study Guide Section 5:** Complete *AFTER* your virtual program
Create a Social Media Campaign

1. Give your campaign a name and a username (a shortened version of your name).

2. Draw a logo that will be your campaign's profile picture.

3. Write a mission statement that explains what your campaign will accomplish.

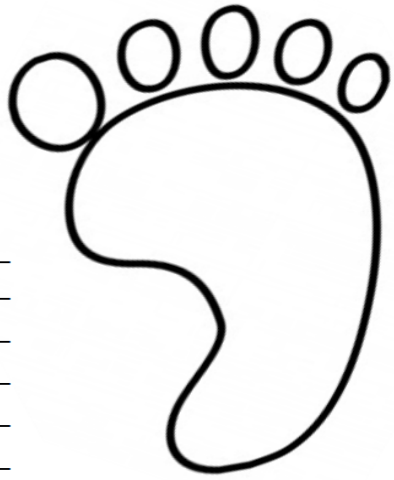
4. Post 10 campaign messages. Messages must be no longer than 140 characters - including hashtags! Your followers are more likely to see and repost shorter messages.



### Carbon Footprint and Pledge

Come up with activities you can do to reduce your carbon footprint at school or at home. Write them down below and take the pledge to reduce your personal impact!

## Carbon Footprint Pledge



I, _____
(write your name here)

Hereby pledge that I will...

_____
_____
_____
_____
_____
_____
(write your activity here)