BIOLOGICAL SCIENCES INITIATIVE

470 UCB Boulder, CO 80309-0470
Phone: 303-492-8230, Fax: 303-492-4916,
www.colorado.edu/Outreach/BSI

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Pikas and their Environment: What best predicts where pikas live?

Lesson Learning Goals

- Understand how an animal's environment can limit where it lives
- Gain specific knowledge about the American pika (*Ochotona princeps*)
- Derive scientific hypotheses and predictions about what limits where pikas live
- Design a web-based experiment
- Be able to distinguish between continuous and discrete data
- Learn to graph data and draw scientific conclusions from graphs

Colorado State Standards achieved through use of this lesson

HIGH SCHOOL

2.2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem

EIGHTH GRADE

2.1. Human activities can deliberately or inadvertently alter ecosystems and their resiliency

3.2. Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location

SIXTH GRADE

2.1 Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species

1. MATERIALS
   - Students will need the worksheets at the end of this document and internet access to perform this exercise.

2. ACTIVITY

   STEP 1: Background research
   - Students should be split into research teams of 2 to 4 people.
   - Each group is assigned 1 of 4 background research tasks and is given the appropriate "What do we know about pikas?" worksheet for that task. Some groups will be doing the same worksheets.
     - Research tasks and corresponding worksheets are on the following topics:
       - Basic Life History
       - Behavior
       - Reproduction
       - Ecology
   - Each group must compile information about their topic on the worksheet and then present their findings to the class
     - If desired, students can make a brief power point presentation using the information on their worksheets.

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STEP 2: Scientific method

- If students are not familiar with the scientific method and the development of hypotheses, predictions, or study designs, we recommend the use of BSI's "Developing Hypotheses 101" lesson plan.
- Once students are familiar with the scientific method generally, they will apply it to the question, "What limits where pikas can live?" in this exercise.
- It may help to show the intro video at this point (the first video at http://science-live.org/pikas/questions.html). If you do so, ONLY show the first 3:20 at this point in the lesson!
- Students should brainstorm what data they will need and the nature of that data. Then they should select *one continuous* and *one discrete* variable to investigate in this exercise.
- Of the variables below, the video highlights climate, water, talus depth, and vegetation, but latitude, elevation, and aspect are all important contributors to climate. We would encourage you to discuss those variables as well, so some students pursue those hypotheses.
- To answer this question, students can choose from the following variables:

Continuous	**Discrete**
Latitude	Underground Water (Present/Absent)
Average Precipitation	Talus Depth (Shallow/Deep)
Average Summer High Temperature	Aspect (South/North)
Elevation	Vegetation (High/Low Nutrition)

- In their teams, students should fill out Worksheet 2.
- Students are most likely to see results if they select vegetation, temperature, and precipitation.
- Hypotheses and predictions are very difficult to master. We have provided basic wording for those classes for which the generation of a whole hypothesis or prediction on their own would be too advanced.
- Graphing:
    - Continuous independent variable = scatter plot
    - Discrete independent variable = bar plot (students should average the number of years occupied for each discrete category in order to make this plot)

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Pikas and their Environment

Worksheet 1: What do we know about pikas?
Topic 1a: Basic Life History

Research Team Name: _____

1. What kind of animals are pikas' closest relatives? _____
2. Are pikas rodents? _____
3. How many species of pikas are there in the world? _____ In N. America? _____
4. Name 2 countries where pikas live:
    a. _____
    b. _____
5. List 3 distinguishing features of pikas:
    a. _____
    b. _____
    c. _____
6. How big are adult pikas? _____
7. What do pikas eat? _____
8. Do pikas drink water? _____
9. Where do pikas live? _____
10. What is talus? _____

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Pikas and their Environment

Worksheet 1: What do we know about pikas?
Topic 1b: Behavior

Research Team Name: _____

1. How many times a day does a pika fully fill its stomach? _____
2. What does coprophagic mean?

3. Why are pikas coprophagic?

4. What is a haypile?

5. What kinds of plants go in a haypile?

6. Why do pikas make short calls?

7. Do both sexes make long calls?

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Worksheet 1: What do we know about pikas?
Topic 1c: Reproduction

Research Team Name: _____

1. How old are pikas when they can first reproduce? _____
2. How old was the oldest a pika ever recorded? _____
3. Do pikas mate for life? _____
4. How many litters do female pikas have each year? _____
5. Do all litters survive? Why/why not?

6. How long is a pika pregnancy? _____
7. What is a leveret?

8. When do leverets' eyes open? _____
9. At what age are leverets kicked out of the nest? _____
10. What do juvenile pikas look for when they're searching for a new territory?

11. Do pikas move territories every year?

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Worksheet 1: What do we know about pikas?
Topic 1d: Ecology

Research Team Name: _____

1. What temperature is too hot for pikas? _____
2. What temperature is too cold for pikas? _____
3. What can protect pikas from cold temperatures? How does it protect them?

4. In which Colorado *life zones* do pikas live?

5. What is the lowest elevation a pika can usually live in Colorado?

6. What is the lowest elevation a pika can usually live in Washington?

7. What are the predators of pikas?

8. What is the top predator of pikas, and why is it better than the others?

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Worksheet 2: Design Your Experiment

1. What is your research question today?

2. What is your hypothesis? Note: Select one continuous and one discrete variable to include in your hypothesis.

   Our hypothesis is that _____ and _____ affect where pikas can live.

3. What are your predictions? You should write two predictions, one for each variable you are investigating.

   Continuous variable prediction:

   We predict that as _____ increases/decreases (circle one), pikas will be less likely to survive.

   Discrete variable prediction:

   We predict that pikas will be more likely to live in places that are _____

   than places that are _____.

4. What is your research plan? How will you choose your sample sites?

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5. Collect your data in the following table.

Site Number	Site Name	Continuous Variable:	Discrete Variable:	Number of Years with Pikas

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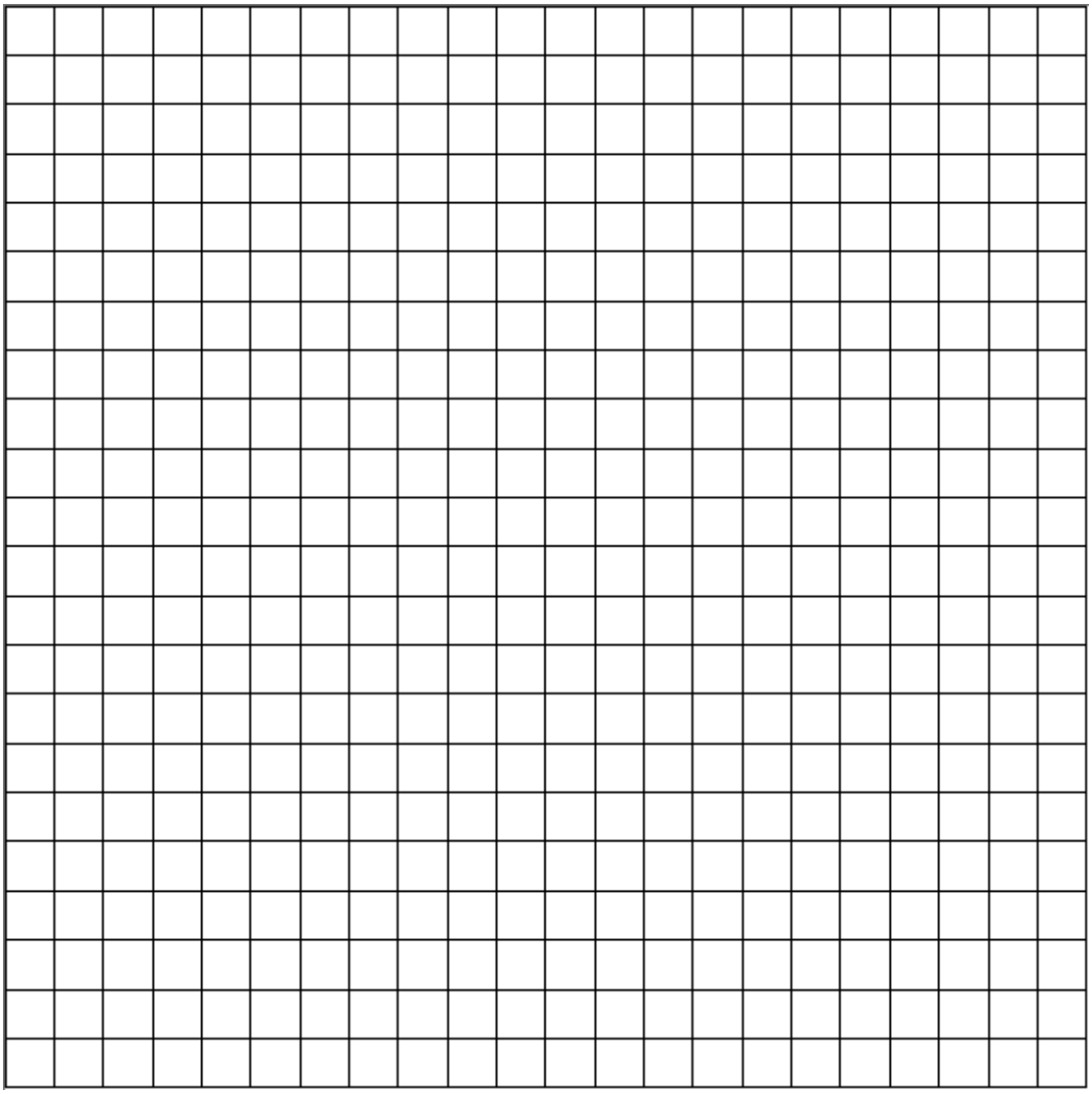
6. Graph your data. Include axis labels and be sure you make the right type of graphs for each variable



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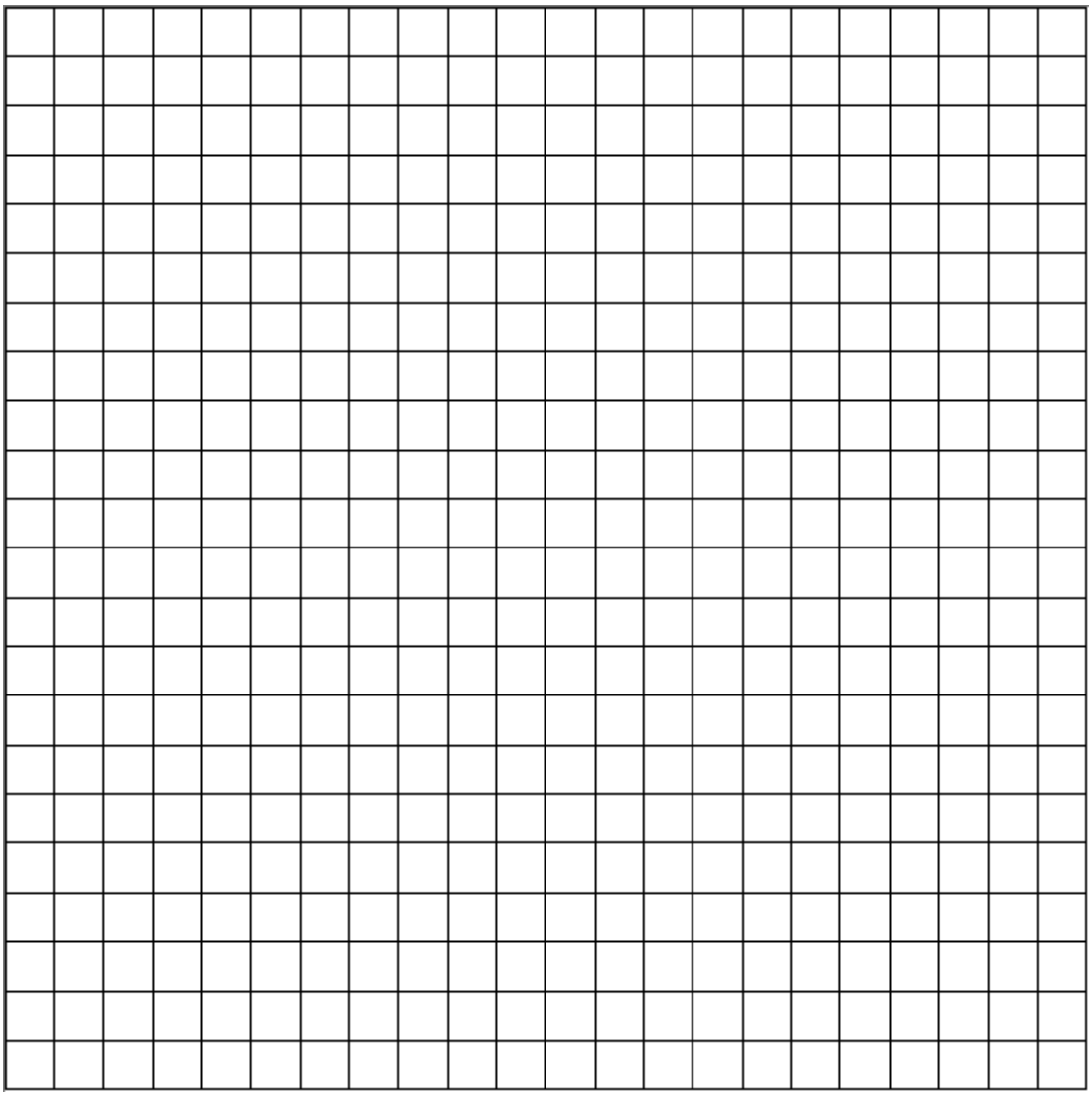

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7. What can you conclude from your graphs? Do you reject or support your hypothesis?

8. Why do you think you found the results you did? Include some basic pika information that you learned in Part 1 of this activity.

9. What if one of your variables changed (for example, what if precipitation decreased?)? Would pika populations increase or decrease?

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Pikas and their Environment

Worksheet 1: What do we know about pikas?
Topic 1a: Basic Life History

Research Team Name: _____

1. What kind of animals are pikas' closest relatives? _____*rabbits*_____
2. Are pikas rodents? _____*no*_____
3. How many species of pikas are there in the world? ___*25*____ In N. America? __*2*____
4. Name 2 countries where pikas live:

   Possible answers: Afghanistan, Japan, Canada, US, China, Nepal, India, Mongolia

5. List 3 distinguishing features of pikas:

   Possible answers: Mickey mouse-like ears, NO tail, fur on the bottom of their feet and between their toes, long whiskers, gray-brown fur

6. How big are adult pikas? ___*the size of a potato, 6 ½ - 8 ½ inches, 0.25 - 0.4 lb* _____
7. What do pikas eat? _____*all types of plants*_____
8. Do pikas drink water? ____*yes, sometimes*_____
9. Where do pikas live? _____*in broken rock* _____
10. What is talus? ____*broken rock bigger than 4-5 inches*_____

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Worksheet 1: What do we know about pikas?
Topic 1b: Behavior

Research Team Name: _____

1. How many times a day does a pika fully fill its stomach? _____*9 times*_____

2. What does coprophagic mean?

   Animals that eat poop.

3. Why are pikas coprophagic?

   To get more nutrition from the food they eat

4. What is a haypile?

   A collection of plants that pikas store in the talus to feed off all winter long.

5. What kinds of plants go in a haypile?

   Any kind of plants, but sometimes they pick plants that have preservatives in them.

6. Why do pikas make short calls?

   To defend their haypiles/territories and alert the talus slope about predators.

7. Do both sexes make long calls?

   No, just males.

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Worksheet 1: What do we know about pikas?
Topic 1c: Reproduction

Research Team Name: _____

1. How old are pikas when they can first reproduce? _____*1 yr old*_____
2. How old was the oldest a pika ever recorded? _____*7 yrs old*_____
3. Do pikas mate for life? _____*no*_____
4. How many litters do female pikas have each year? _____*2*_____
5. Do all litters survive? Why/why not?

   Only one litter survives every year. It depends on the previous winter's snowpack.

6. How long is a pika pregnancy? ____*~1 month*_____
7. What is a leveret?

   a baby pika

8. When do leverets' eyes open? _____*at 9 days old*_____
9. At what age are leverets kicked out of the nest? _____*at 1 month old*_____
10. What do juvenile pikas look for when they're searching for a new territory?

    Good food, good shelter, and a good view.

11. Do pikas move territories every year?

    No.

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Worksheet 1: What do we know about pikas?
Topic 1d: Ecology

Research Team Name: _____

1. What temperature is too hot for pikas? _____*78 degrees F*_____
2. What temperature is too cold for pikas? _____*14 degrees F*_____
3. What can protect pikas from cold temperatures? How does it protect them?

   Snowpack. It insulates them.

4. In which Colorado *life zones* do pikas live?

   Alpine, subalpine, and montane.

5. What is the lowest elevation a pika can usually live in Colorado?

   9,000 feet

6. What is the lowest elevation a pika can usually live in Washington?

   Near sea level.

7. What are the predators of pikas?

   Weasels, coyotes, birds of prey.

8. What is the top predator of pikas, and why is it better than the others?

   Weasels, they are small and fast enough to catch them