



Youth Exploring Science (YES! to Science) High School Citizen Science Program in Glacier National Park

Overview

Grade Level: 9-12

Subjects: Science, Math, Technology

Location: Glacier National Park mountain goat and pika survey sites

Skills: Observe, Categorize and Classify, Identify Relationships and Patterns, Communicate, Problem Solving, Use of Scientific Field Equipment

Concepts/Topics: Ecosystem diversity and health, interaction of living organisms with each other and their environment, environmental problems and people.

Vocabulary: Control, Data, Dependent Variable, Ecosystem, Error Analysis, Hypothesis, Independent Variable, Inquiry, Investigate, Natural Phenomenon, Observation, Prediction, Statistical Tests, Testable, Variable

Summary: Students will learn how to collect wildlife data, develop research questions and testable hypotheses, and calculate statistics using real collected data from Glacier's High Country Citizen Science Program.

Goal: Give students a hands-on approach to conducting the scientific method and understanding how conducting research can help answer pertinent questions for resource managers and wildlife conservation.

Objectives:

- 1) Tell what national parks protect and one reason why Glacier National Park was established.
- 2) Identify mountain goat and pika species in the field.
- 3) Provide two reasons that both mountain goats and pikas are studied due to concerns about effects of climate change in western Montana.
- 4) Collect data and analyze existing data to generate appropriate research questions to further the understanding of mountain goat/pika populations and resource needs.
- 5) Investigate climate change effects in Glacier National Park and understand the management issues this change may create for park managers.
- 6) Understand the scientific method and how to develop testable hypotheses.

Montana Curriculum Science, Math and Technology Standards addressed:

Science Content Standard 1- Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate the results and form reasonable conclusions of scientific investigations.

Science Content Standard 2- Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Science Content Standard 3- Students, through the inquiry process, demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Science Content Standard 5- Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures and societies.

Technology Content Standard 1- A student must use digital tools and resources for problem solving and decision making.

Technology Content Standard 3- A student must apply digital tools and skills with creativity and innovation to express his/herself, construct knowledge and develop products and processes.

Technology Content Standard 4- A student must possess a functional understanding of technology concepts and operations.

Math Content Standard 1- Make sense of problems and persevere in solving them.

Math Content Standard 2- Reason abstractly and quantitatively.

Math Content Standard 4- Model with mathematics.

Math Content Standard 6- Attend to precision.

First Year Program

First Lesson:

- 1) Present “Introduction to the Citizen Science Program and Climate Change” PowerPoint presentation.
- 2) Within the presentation, make students aware of some climate change effects happening in Glacier National Park and why these changes caused concern for several “vulnerable” species, including mountain goats and pikas.
- 3) Allow time for questions.

Second Lesson:

- 1) Deliver presentation on mountain goat biology, identification, and reasons for studying them.
- 2) Explain mountain goat survey methods.

Third Lesson:

- 1) Deliver presentation on pika biology, identification, and reasons for studying them.
- 2) Explain pika survey methods.
- 3) Review survey sheets and identify variables currently collected. Define dependent vs. independent variables.
- 4) Assign students to develop three research questions for each species, using only the variables currently collected on the survey sheets, to be used during the last in-class lesson.

Fourth Lesson:

- 1) Ask the class to volunteer 3 or 4 examples of possible research questions they generated for both mountain goats and pikas. Use these examples to explain whether the question used the available research data and could be used to generate a testable hypothesis.
- 2) Break into groups of three and formulate a research question for each species. Develop a

corresponding hypothesis that is testable for each research question.

- 3) Gather students back together and ask students to share their research questions and hypotheses.
- 4) Ask students why scientists care about collecting data, asking questions, and developing hypotheses. What might their findings provide to resource managers?
- 5) Review upcoming field trip and necessary items to take.

Field Trip:

- 1) Teach students how to use GPS units and maps to navigate to mountain goat and/or pika survey sites.
- 2) Hike into field site(s).
- 3) Show students how to conduct surveys and record data, and how to use compasses, spotting scopes, binoculars.
- 4) Work with students on the use of digital cameras to take verification photos using digiscoping, taking digital photos through a spotting scope.
- 5) Ask students to follow survey protocols to conduct surveys to document mountain goat and pika populations.
- 6) Gather students back together to find out what they observed and discovered, what they would do differently in future surveys and solicit any questions or feedback.

Follow-up Classroom Lessons (1- 4 lessons depending on class needs)

- 1) Work with students to refine and finalize their research questions and corresponding hypotheses.
- 2) Explain how statistical tests are used to support or not support a hypothesis.
- 3) Work with students to isolate the variables needed for their hypothesis test, and to group and sort the data using Excel.
- 4) Conduct statistical tests using Excel software to determine significance values (P-values).
- 5) Help students understand their results.

Second Year Program

First Lesson:

- 1) Using the “Introduction to the Citizen Science and Climate Change Program” PowerPoint presentation, review climate change effects happening in Glacier National Park. Explain how those changes may affect wildlife species, notably more vulnerable species with specific habitat requirements such as mountain goats and pikas.
- 2) Allow time for questions.

Second Lesson:

- 1) Present presentation on mountain goat biology, identification, and reasons for studying them.
- 2) Explain mountain goat survey methods.

Third Lesson:

- 1) Present presentation on pika biology, identification, and reasons for studying them.
- 2) Explain pika survey methods.
- 3) Review survey sheets and identify variables currently collected. Define dependent vs. independent variables.
- 4) Have students identify research questions they would like to ask focusing on current predictions

of how climate change might affect each of these species. What data could we use from the current collect data or what data could we get that would answer those questions.

Fourth Lesson:

- 1) Ask the class to volunteer 3 or 4 examples of possible research questions and predictions they generated for both mountain goats and pikas.
- 2) Break into groups of three and formulate a research question for each species. Develop a hypothesis focused on prediction of climate change impacts on mountain goats and pikas.
- 3) Gather students back together and ask students to share their research questions and hypotheses.
- 4) Ask students why scientists care about collecting data, asking questions, and developing hypotheses. What might their findings provide to resource managers?
- 5) Review upcoming field trip and necessary items to take.

Field Trip:

- 1) Teach students how to use GPS units and maps to navigate to mountain goat and/or pika survey sites.
- 2) Hike into field site(s).
- 3) Show students how to conduct surveys and record data, and how to use compasses, spotting scopes, binoculars.
- 4) Work with students on the use of digital cameras to take verification photos using digiscoping, taking digital photos through a spotting scope.
- 5) Ask students to follow survey protocols to conduct surveys to document mountain goat and pika populations.
- 6) Gather students back together to find out what they observed and discovered, what they would do differently in future surveys and solicit any questions or feedback.

Follow-up Classroom Lessons (1- 4 lessons depending on class needs)

- 1) Show examples using graphs and/or charts of relationships between some of the variables we are collecting data on (e.g. time of day and number of mountain goats seen, or elevation and number of pika haypiles detected).
- 2) Show examples of relationships between other wildlife and climate in the forms of graphs or charts.
- 3) Ask students to form groups and develop hypotheses related to how climate change might affect these relationships, building from the research questions developed in Lesson 4.
- 4) Work with students to refine and finalize their research questions and corresponding predictions/hypotheses.
- 5) Work with students to draw graphs of their predictions as a way to understand how to design research that can address these types of questions.

For more information about the YES! to Science program contact Jami Belt at 406-888-7986 or jami_belt@nps.gov. You can also find out more about the Citizen Science Program by visiting our website at <http://www.nps.gov/glac/naturescience/ccrlc-citizen-science.htm>.