CENTRAL QUESTION: WHO WINS AND WHO LOSES IN A RAPIDLY CHANGING FOREST?

TIME: 1.75-2 hours

OVERVIEW:

- **SECTION 1: GATHER** (30 minutes)
  How do museums gather their biological collections?
- **SECTION 2: ANALYZE** (20 minutes)
  What relationships do lodgepole pines have?
- **SECTION 3: INTERPRET** (25 minutes)
  How might decreasing lodgepole pine tree populations impact other organisms in the Uintas?
- **SECTION 4: COMMUNICATE** (40minutes)
  Who wins and who loses in a rapidly changing forest?

MATERIALS:

- One computer per two students
- One computer with the ability to broadcast material onto a screen visible by the entire class
- Printed or Digital ***Research Assistant Notebooks*** for students to record notes
- White board or other surface for teacher to use while facilitating class discussions
- Additional resources:
  - ***Student Learning Assessment Tool***
  - ***Student Rubric for Presenting Arguments***
  - ***Student Rubric for Assessing Learning Outcomes***

STANDARDS ALIGNMENT:

Utah SEEd Standard

- **6.4.2** - Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Emphasize consistent interactions in different environments, such as competition, predation, and mutualism.

NGSS Standard

- **LS2-2** - Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

ELA Standards

- **Speaking & Listening Standard 1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly..
- **Language Standard 6:** Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

GETTING STARTED

This investigation provides support for teaching the content standards, along with the nature of science/how science is done, developing claims, working with evidence, and using reasoning skills. (**Hint:** Review the documents entitled *Curriculum Alignment* and the *Student Learning Assessment Tool* for other alignments and to assess learning with your students.)

Before class...

- Review this instructional guide and determine your student learning goals, which sections you want students to work on during each class period of the investigation, and the steps which your students will need guided instruction.
- Review the following recommended strategies for optimizing student learning outcomes.
    - Working in pairs ensures that every student has the opportunity to share their ideas. As students progress though the investigation, you may want to combine pairs of students into small groups to provide more practice sharing and responding to the ideas of their peers.
    - Build a shared vocabulary for the learning tasks by identifying key vocabulary beforehand and encouraging students to use these words often. Model correct usage if needed.
        - **Key Vocabulary:** phenomenon, ecological relationships, Order, specimens, organism, predator, prey, symbiotic relationship, competitor, metadata, database query
    - Think about places you can activate prior knowledge by prompting students to relate new concepts to a familiar context.
    - Think about how to integrate the *Research Quest* investigations with other curriculum-aligned activities.
    - Create and engage student interest in the program by expressing your enthusiasm and/or describing your personal interest in this investigation. You may also want to emphasize that students will be working with authentic materials on research questions that scientists actually address in their work.
    - Introduce students to sentence stems that reinforce flexible thinking and help students verbalize their thought processes:
        - "I see..."
        - "I think..."
        - "I wonder..."

Set Up...

- Make copies of the Research Assistant Notebook (RAN) for each of your students, or use the PDF with your desired digital classroom system (ie. Google Classroom, Canvas, etc).
- Navigate to www.researchquest.org and login using the email address and password you used to create your *Research Quest* account. Then, navigate to the "My Account" tab at the far right of the navigation bar. You will find your **Student Access Code**.
- Have your unique Student Access Code and URL link [www.researchquest.org/student/] ready for students. **It is important you have students use this particular URL and access code to get into the investigations for FERPA.**

In class...

- Introduce the daily objectives and provide a brief overview of the investigation to the class.
- Provide each student with a copy of the *Research Assistant Notebook* (RAN).
- Arrange students into pairs, one pair per computer. Instruct them to navigate to the URL [www.researchquest.org/student/] and enter your unique Student Access Code.
- Students will find themselves on a landing page with the option to go into one of two investigation modules. They should choose, "Change in the Uinta Mountains: Normal or Not?" Then, they should click on investigation #2 "Who Wins and Who Loses in a Rapidly Changing Forest?"
- Once logged in, students will be on the introduction page for this investigation. They can read the overview and start at your direction.

SECTION 1: GATHER - HOW DO MUSEUMS GATHER THEIR BIOLOGICAL COLLECTIONS? *(30 minutes)*

OVERVIEW

Students will query collections for organisms from montane forests in the in the Uinta Mountains. They'll classify organisms (predator, competitor, mutualist) based on their relationship to the lodgepole pine using field notes and previous knowledge. Then, create a model to communicate and reason about these interactions.

ASSESSMENT

In this section, the instructor may find it useful to focus on the following critical thinking skills, defined in more detail in the *Student Learning Assessment Tool* which can be found through the "Teacher Support" tab and by clicking on the *Who wins and who loses in a rapidly changing forest*? link.

- **Observation:** Make detailed, sense-based observations to categorize organisms.
- **Connections:** Relate methods used to gather collections with the data that is collected for each organism.

	STUDENT ACTION	TIPS FOR SUPPORTING CRITICAL THINKING
STEP 1 *(4 minutes)*	• Watch the video on Step 1 of the investigation. (4:00 min.) • Use your *Research Assistant Notebook* Step 1 to make note of the three main types of ecological relationships. *Research Assistant Notebook (RAN): page 1*	• Direct students' attention to the following before beginning the video: *In this video, you'll be introduced to concept of ecological relationships and how scientists gather data to understand what relationships exist within an ecosystem. Listen for the three main types of ecological relationships Dr. Mitch references and instructions for your first task.* • **Key Vocabulary:** phenomenon, ecological relationships
STEP 2 *(20 minutes)*	• Explore three of the many ways that scientists gather specimens and data from the field: pitfall traps, mist nets, and camera traps.	• *Note:* These simulated experiences of collecting specimens is intended to help students understand where data comes from before they actually use that data to develop models and reason with those models to answer the central question in this investigation. • **Key Vocabulary:** specimens, Order
STEP 3 *(5 minutes)*	**REFLECT** • Once you've downloaded and sent your collected results to the museum, review your findings. • With your partner reflect on the practice of collecting specimens. ***a.*** What are three common collecting methods scientists use? ***b.*** What types of information do scientists record for the specimens they collect? ***c.*** Why do you think they record this information? What is the benefit? *Research Assistant Notebook (RAN): page 1*	• You may choose to answer these questions via a group discussion. This may provide additional opportunities to check for understanding with students on where data comes from and how it is gathered (nature of science). • Example of types of information scientists record for the specimens they collect: Date, Time, Location, Species, Family, etc. • *Suggested extension: Students can develop their own questions about their community or local ecosystem then collect data to learn about the world around them. Use iNaturalist or Survey123 to help guide students through their own fieldwork as they gather data from their community.*

SECTION 2: ANALYZE - WHAT RELATIONSHIPS DO LODGEPOLE PINES HAVE? *(18 minutes)*

OVERVIEW

Students will look for evidence of known tree killers (drought, pathogens, predators, and wildfire) in museum specimens and images of trees from Uinta Mountains. Then, analyze water and temperature data, looking for cause and effect relationships that could explain this phenomena.

ASSESSMENT

- **Comparisons:** Note similarities and differences among organism relationships.
- **Observation:** Make detailed, sense-based observations to classify the relationship between organisms.
- **Flexible Thinking**: Keep mind open to multiple ideas until all data is evaluated.

	STUDENT ACTION	TIPS FOR SUPPORTING CRITICAL THINKING
STEP 4 *(5 minutes)*	• Watch the video on Step 4 of the investigation. (2:01 min.) • Use your *Research Assistant Notebook* Step 4 to discuss the questions about metadata and record your responses. *Research Assistant Notebook (RAN): page 1*	• Students will learn what metadata is and how it can help scientists develop a broader understanding of the interactions organisms within an ecosystem have with one another. They should listen for what metadata is, why it is important, and how it will help them with the next part of their research. • **Key Vocabulary:** metadata
STEP 5 *(1 minute)*	• Assess the query Isabel has set up to find organisms in the museum's collections that have a relationship with the lodgepole pine trees and then click "Submit" to view results on the next page.	• Students just need to review the query form then click "submit." • **Key Vocabulary:** organism, database query
STEP 6 *(1 minute)*	• Review the database results then click "Next" to transfer the database results into an interactive where you can build a model to visualize the relationships between organisms that have a relationship with the lodgepole pine trees.	• Students will import the database results into an interactive that will allow them to build model to visualize the interactions between organisms that have a relationship to the lodgepole pine trees. • *Note:* The point to Steps 5 and 6 are to help understand how the data that is collected in the field is used for research back at the museum. You can also help students understand the value of making models by asking if they would like to work with hundreds of text heavy records like this or if visualizing it through a model would be helpful.
STEP 7 & STEP 8 *(20 minutes)*	• Classify the relationship between lodgepole pine trees and other organisms. **a.** Click on an organism. **b.** Use the information about the lodgepole pine and the organism you selected to identify the relationship between these two organisms. Repeat the process until all relationships have been defined. *Research Assistant Notebook (RAN): page 2*	• If needed model with the whole class, otherwise students can start building their model. Students will record their observations in their RAN so they can process what they observed in their model. • If modeling is needed for recording observations you can use these: *Examples*: I observed there are more predator-prey relationships than competitor or mutualist relationships. Or, I noticed the least chipmunk depends on the lodgepole pine for food. If the lodgepole pines die off that will mean the chipmunk will have less food to choose from. This could cause their population to decrease which could impact the coyote who eats chipmunks.

SECTION 3: INTERPRET - HOW MIGHT DECREASING LODGEPOLE PINE POPULATIONS IMPACT OTHER ORGANISMS IN THE UINTAS? *(23 minutes)*

OVERVIEW

Students will use their interaction models to develop prediction cards for who wins and who loses as lodgepole pines die off in the Uinta Mountains.

ASSESSMENT

- **Interpretations:** Use their interaction models and organism information to construct an evidenced-based explanation.
- **Observation:** Make detailed, sense-based observations that discriminate between organisms.
- **Flexible Thinking**: Keep mind open to multiple ideas until all data is evaluated.

	STUDENT ACTION	TIPS FOR SUPPORTING CRITICAL THINKING
STEP 9 *(5 minutes)*	• Watch the video on Step 1 of the investigation. (2:55 min.)	• Direct students' attention to the following before beginning the video: *In this video, you'll hear about the benefits of using a model to show relationships between organisms. Listen for how the model you created can help you make an informed prediction about an organism's future.*
STEP 10 *(5 minutes)*	• Use your knowledge of relationships between organisms in the lodgepole pine community to make predictions about what may happen to those in predatory, mutualistic, and competitive relationships with the lodgepole pine.	• Remind students about the models they created in the Analyze Section, if needed refer them back to their *Research Assistant Notebook* Steps 7-8. • Use these questions on Step 10 to check for understanding and model predicting and reasoning, a warm up for Step 11.
STEP 11 *(20 minutes, Varies)*	• Choose at least three organisms that have a relationship with the lodgepole pine and fill out the cards to describe what you predict will happen to each of those organisms if the Lodgepole pine continues to die off in the Uinta Mountains. • What evidence led you to make the predication you made? Include that in the "Explain your thinking" box. *Research Assistant Notebook (RAN): page 3-4*	• Check for understanding on making predictions. Create one card as a class, discussing and modeling thinking as they go. Then, student pairs could work on their own to create the rest of their cards, at least 3. • Direct students though a Think-Pair-Share of their prediction cards. Have students share what they think might happen (their predictions). Then, as a class, choose an answer where there was the least consensus. This can drive lots of good conversation and is where rich critical thinking can be observed. Use the observation tool to assess student learning. You can also have students use the argumentation rubric to provide useful feedback/questions as they listen to other pairs share their predictions. • *Note:* Students can download their data summaries to use in a final presentation of their findings (during the "Communicate" section) or to add to a science journal to document their path through the investigation.

SECTION 4: COMMUNICATE - SHARE YOUR PREDICTION. *(40 minutes)*

OVERVIEW

Students will discuss predictions about who wins and who loses as lodgepole pines disappear from the Uinta Mountains.

ASSESSMENT

- **Interpretations:** Predicts patterns of interactions among organisms across multiple ecosystems
- **Evaluation:** Consider the strength of each piece of evidence.
- **Flexible Thinking**: Keep mind open to multiple ideas until all data is evaluated.

	STUDENT ACTION	TIPS FOR SUPPORTING CRITICAL THINKING
STEP 12 *(30 minutes, Varies)*	• Use the model from Step 11 to complete the graphic organizer on Step 12 of your *Research Assistant Notebook* to help you answer: *Who wins and who loses as lodgepole pines disappear from the Uinta Mountains?* *Research Assistant Notebook (RAN): page 5*	• Use this step to evaluate if students can easily transfer their knowledge to other ecosystems. • This step can be used for small group or large group discussion. • Have students support their answers with reasoning.
STEP 13 *(5 minutes)*	**REFLECT** • Reflect on the information you've gathered throughout this investigation and answer the following questions: **1.** What types of interactions can be found in desert ecosystems? **2.** What types of interactions can be found in aquatic ecosystems? **3.** Interactions between organisms are _____. **4.** If organism A is a predator that eats organisms B, C, and D, what do you predict would happen to organism A if organism B disappeared?	• This is an opportunity for reflective learning. Students can review what they learned and compare their thinking to Dr. Mitch's in preparation for the sharing their prediction comparisons in the next step.
STEP 14 *(5 minutes)*	• Watch the video on Step 4 of the investigation. (3:15 min.) • Discuss with your partner how your prediction compares to Mitch's. *Research Assistant Notebook (RAN): page 5*	• Direct students' attention to the following before beginning the video: *In this video you'll hear some predictions about how competitors, predators, and mutualists of the lodgepole pine may fare if the lodgepole pine population continues to decline in this ecosystem. Listen for what types of organisms will likely struggle and what types may be less affected as this Mountain Pine beetle infestation moves through the Uinta mountains.*