

Keystone Species: What the Tree Doin'?

Unit: ECOLOGY	Utah SEEd Standard / NGSS Performance Expectation: BIO 1.1: Plan and carry out an investigation to analyze and interpret data to determine how biotic and abiotic factors can affect the stability and change of a population. Emphasize stability and change in populations' carrying capacities and an ecosystem's biodiversity. (LS2.A, LS2.C)	Time: 90 Minutes
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Access to all material for this lesson: [Lesson Folder](#)

Anchor Phenomenon	Tree population over time on the Serengeti
Driving Question(s)	What is a keystone species, and how do they impact an ecosystem's biotic and abiotic components? How do changes in biotic and abiotic factors impact the stability of an ecosystem?
Performance Task	Students will be able to model how a keystone species impacts biotic and abiotic factors within an ecosystem and determine how a change to any of those factors affects the stability of the ecosystem.

Lesson Summary: Students will use keystone species models to evaluate the stability and change of the Serengeti. and other ecosystems

	Time	Guiding Question / Learning Objective	How are students answering the guiding question or meeting the learning objective? (Highlight the SEPs , DCIs , and CCCs in the corresponding color.)
 Engage	5-10 minutes	Succession pictures of Serengeti National Park	- Show students the succession pictures of the Serengeti - Define Biotic and Abiotic Factors
 Explore	15-20 minutes	Examples of keystone species	- Group Work- Keystone Species Cards: Wolf First, then discuss; give 2 other ecosystem cards and discuss.
 Explain	10-15 minutes	Group and class discussion about keystone species	- Build Homeostasis Keystone Models, discuss - Define keystone and keystone species
 Elaborate	15-20 minutes	What caused the trees to come back?	- Introduce Rinderpest (BIOTIC) - Introduce Wildfires (ABIOTIC) - Discuss wildfires and fire triangle
 Evaluate	20 minutes	ID Serengeti keystone species	- Ask the question "Identify keystone species of Serengeti"= wildebeest - Show graph for proof - What part of the fire triangle does the wildebeest help to control - Think pair share- How does wildebeest=keystone species

Three Dimensions Focused on in This Lesson		
Disciplinary Core Idea: NGSS Appendix E If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.	Science and Engineering Practices: NGSS Appendix F Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.	Crosscutting Concept: NGSS Appendix G In grades 9-12, students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They recognize systems can be designed for greater or lesser stability.
Learning Objectives 1. Students will use and develop models to analyze the impact a keystone species on the stability of an ecosystem.		
Related Knowledge and Skills from Prior Grades		
Disciplinary Core Idea: NGSS Appendix E Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	Science and Engineering Practices: NGSS Appendix F Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	Crosscutting Concept: NGSS Appendix G In grades 6-8, students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.
Connections to Mathematics and ELA/Literacy Standards		
ELA/Literacy Standards: RST.11-12.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	Mathematics Standards: MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	

- **WHAT.9-12:** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- **HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling.
- **HSN.Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Materials

Handouts	Lab Supplies	Other Resources
What the Tree Doing? Student Worksheet Keystone Species Cards Gray Wolf Keystone Species Card	Homeostasis Keystone Model	Teacher slides Rinderpest information sheet Student rubric Serengeti Video Full Saguaro Cactus Video

ENGAGE

1. Succession photos from the Serengeti.
 - **Slides 2-5:** Show the students the four pictures of the Serengeti (Be sure to mention that these pictures were all shot from the same spot over the years.)
 - Allow students about 10 seconds to look at each slide; review the slides as needed.
 - While showing pictures, students will answer questions 1 and 2 on the worksheet.
2. After the final Serengeti slide (**slide 5**), ask for observations on what changed in the picture.
 - THINK PAIR SHARE- Questions 1 and 2 from worksheet (**slide 6**).
3. Go over **slide 7** and discuss the differences between Biotic and Abiotic factors.

Teacher Tips

- Go back over succession slides as needed.
- During the biotic/abiotic slide, you can have students identify the factors from the picture or, for a higher-level class, identify biotic/abiotic factors and where you would find them.
- I kept clicking between the 4 photos for about 45 seconds and asked the students to make observations, then discuss the observation.
- Make predictions about the causes of the changes.



EXPLORE

Keystone Species Examples

- **Slide 8:** Divide students into groups however best fits your classroom
- Pass out the Gray Wolf Keystone Species Card to the students
- Each group will be examining the “gray wolf.” (Slide 8)
 - o Students will answer questions 3-6 on the worksheet under Ecosystem Model 1. (5 mins)
- TELL STUDENTS TO BE PREPARED TO SHARE
 - o Have a few students share their description/diagram from question 5 to help them think about how organisms interact.
- After reviewing the wolf as a class, hand out keystone blocks.
 - o Students will create a keystone model following the guidelines (**slide 9**):
 - Each block must touch one other block
 - The structure must be free-standing
 - You can tape 2 blocks to the table to provide support
 - If you remove any block, the entire structure will fall.
 - o An arch is the correct structure (otter is the keystone, sea urchin eats kelp, clam eats phytoplankton), but it is not the only thing they can build that will work if they explain how they used the organisms to make it.
 - Ask students to consider the organisms on the blocks and how they will help them build their structure.
 - o Students will answer questions 7 and 8 on the worksheet once the model is complete.

Teacher Tips

- Students will look at 3 ecosystems. Pass out Gray Wolf first and hold onto the other materials until later in class.
- The Keystone model template is provided, but you could have a woodshop teacher create these blocks out of wood to be reused and be more stable.
- During the keystone building activity, don't tell students what structure they are creating; let them figure it out as they go, but guide them by using the organisms on the blocks.

Group Creation Ideas

- Count off
- Birthdays
- Student choice
- **Jigsaw (works well with larger class)**

EXPLAIN

Keystone species discussion

- In **slide 10**, introduce what a keystone is in relation to the structure they just built.
- Go to **slide 11** and introduce the term “KEYSTONE” species.
- Students answer question 9 on the worksheet.

Yellowstone/Gray Wolf tie-in

- Relate the keystone arch that they built back to the gray wolf card they read and have students create a keystone model using the organisms from Yellowstone. (Question 10 on the worksheet)
- Have students share what their model looks like and what organism (gray wolf) is the keystone in Yellowstone and explain why.
- Show **slide 12** and ask students if they can use a food web to represent keystone species as well as an arch and explain why.

More keystone species examples (**slide 13**)

- Pass out the other Keystone Species Cards, ensuring each group has a different keystone.
- Give students time to read and discuss the animal cards as a group (7-10 minutes)
- Students will answer questions 11-15 under Ecosystems 2 & 3 on the worksheet.

Teacher Tips

- Jigsaw
- Round robin
- Speed share
- Calling out specific kids, etc.

If you are using wooden blocks for the keystone model activity, you can add Velcro pieces to the back of the blocks and have laminated cards with the organisms from Yellowstone for students to attach to the blocks.

- Let students “play” with the blocks for a couple of minutes. This helped the blocks being distractions during discussion time.

While the discussion of keystone species is going on, listen for kids who may think Keystone species are only APEX Predators or other fallacies. Be sure to give those groups an example opposite of what



- Students will share their findings about the gray wolf and the other animals they investigated with the class.
- After students have learned about other keystone species, they can answer question 19 and draw another keystone model using a new keystone species.

they believe a keystone species is.

ELABORATE

Rinderpest (BIOTIC) (slide 16)

- Students will pull out a device to take a picture of the QR code and read about rinderpest (a Biotic factor). Students will need to share as a group.
- Students will answer questions 16-18 on the rinderpest section of the worksheet.

Wildfire (ABIOTIC)

- Ask students, "What causes a wildfire?" (an ABIOTIC factor) (**Slide 17-18**)
- Introduce the fire triangle, drive home the fact that no fire can occur without these three parts
- What part of the fire triangle is the problem with the fire triangle Serengeti?
- What is the keystone species of the Serengeti = WILDEBEEST
- Students will answer question 19 on the wildfires section of the worksheet

Teacher Tips

- Make sure QR code still works for rinderpest
- Make copies of the QR code to have in class if needed.
- Make sure students understand how biotic and abiotic factors can both affect stability in an ecosystem.
- The students needed guidance to get them to this idea
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EVALUATE

Think-Pair- Share- How do wildebeest = keystone species

Follow-up questions from student worksheet (20-22)

1. Based on all the information you have learned, what animal is the keystone species in the Serengeti? (**Slide 19-21**)
 - a. Explain why it is the keystone species. How does it determine the stability of the Serengeti?
2. You saw what the Serengeti ecosystem looks like now. How might this ecosystem be affected if the rinderpest virus were to hit it again?
3. What abiotic factors in an ecosystem could cause a keystone species to shift or change? What biotic factors could cause a keystone species to shift or change?

Teacher Tips

- It helps to watch the section in the HHMI video that talks about this phenomenon to solidify the concept



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POSSIBLE EXTENSION / ALTERNATIVE ADAPTATIONS

[Serengeti Video](#) - Watch the video as an extension or part of a sub-plan (**Slide 22**)

[Saguaro Cactus Video](#)

- Possible video to show that Producers can also be Keystone Species

Have students create a keystone model using their local ecosystems.

Key terms to know for lesson:

Rinderpest, Biotic, Abiotic, Keystone Species, Serengeti, Herbivore, Carnivore, Omnivore, Apex, Carrying Capacities

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