Explore: Natural Selection and Speciation

INSTRUCTOR:
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Learning Goals:

- Understand the concept of natural selection and its role in evolution.
- Analyze the impact of environmental factors on species adaptation.
- **Collect and interpret data from simulations.**

Objectives:

- Use the online simulation to observe how different traits affect survival.
- Record data on population changes and make predictions based on findings.
- **Explain how natural selection can lead to evolutionary changes in species.**

Background Information:

Natural selection is a process where organisms with traits that better suit their environment tend to survive and reproduce more than those with less favorable traits. This leads to a change in the traits of populations over generations. Key terms include:

- **Natural Selection:** The process by which organisms better adapted to their environment tend to survive and produce more offspring.
- **Adaptation**: A trait that improves an organism's chances of survival and reproduction in a particular environment.
- **Population**: A group of individuals of the same species living in a particular area.

Part 1: Initial Simulation

Instructions:

1. **Access the Simulation:**
   - Visit the simulation at [Natural Selection Simulation](#).
2. **Simulation Setup:**
   - Choose the environment settings and select traits for your population.
   - Observe how different traits affect survival and reproduction over the years.
3. **Data Collection:**
   - Record the initial population traits and the changes in traits after each specified year.
   - Note the environmental factors that were present and how they may have influenced survival.
4. **Data Analysis:**

- - Create a data table to organize your observations, including:
    - Year
    - Traits for three birds
    - Plumage color
    - Bird size
    - Beak size and shape
    - Mutation shifts (in Year 0)
    - Description of each bird based on the traits

5. **Reflection Questions:**
   - **What traits provided a survival advantage in the simulation?**
   - **How did the environmental conditions affect the population?**
   - **Can you predict what might happen in future years if the environmental conditions changed again?**

- **Of those that you selected, how fit do you think each phenotype is in the current environment?**
  - Sentence Stem: *"I believe the phenotype _____ is _____ fit in the current environment because _____."*

Part 2: Post-Hurricane Simulation

Instructions:

1. Set Up the New Simulation:
   - After a major hurricane, the populations are spread out. Choose your food sources, predators, and foliage for the new environment.
   - Rerun the simulation for the next million years, stopping every 50,000 years to record data.
2. **Data Collection:**
   - Create a new data table to track the changes in the populations from Year 500,000 to Year 1,000,000, including:
     - Year (stopping every 50,000 years)
     - Traits for three birds (plumage color, bird size, beak size and shape)
     - Mutation changes for each 50,000-year interval
     - Final description of each bird based on these traits
3. **Data Analysis:**
   - Fill in the table with the final population sizes and characteristics from Part 1 as your starting point.
4. **Reflection Questions:**

- What adaptations did the populations develop in response to the new environmental conditions?
- How did the mutation changes influence the survival of different phenotypes?
- What do you think the long-term effects of the hurricane will be on the population?

Birds you began with: Draw Below

Data Table Template for Part 1

- **Data Table Template**:

Year	Bird 1 Traits	Bird 2 Traits	Bird 3 Traits	Mutation Shifts	Description of Birds
Year 0	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:		
Year 125,000	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:		
Year 250,000	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:		
Year 375,000	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:		
Year 500,000	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:	Plumage Color: Size: Beak Size & Shape:		

Data Table Template for Part 2:

Year	Bird 1 Traits	Bird 2 Traits	Bird 3 Traits	Mutation Changes	Description of Birds
Year 500,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**		
Year 550,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**		
Year 600,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**		
Year 650,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**		
Year 700,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**		

Year 750,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	
Year 800,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	
Year 850,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	
Year 900,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	
Year 950,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	
Year 1,000,000	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	**Plumage Color:** **Size:** **Beak Size & Shape:**	

Part 2 Reflection Questions:

1. **What adaptations did the populations develop in response to the new environmental conditions after the hurricane?**

   ○ *Sentence Stem: "The populations adapted by _____ because _____."*

2. **How did the mutation changes influence the survival of different phenotypes in the new environment?**

   ○ *Sentence Stem: "The mutation changes affected survival by _____ because _____."*

3. **What patterns did you observe in the population characteristics over time?**

   ○ *Sentence Stem: "I noticed that the population characteristics changed by _____ due to _____."*

4. **What long-term effects do you think the hurricane will have on the population, and why?**

   ○ *Sentence Stem: "I believe the long-term effects of the hurricane will be _____ because _____."*

Birds you Ended With

Teacher Instructions: Natural Selection Simulation

Overview:

This assignment explores the concept of natural selection through an interactive online simulation. Students will analyze how different traits affect survival and reproduction in varying environmental conditions.

Preparation:

1. **Materials Needed:**
   - Computers or tablets with internet access for each student or group.
   - Art supplies (pencils, colored pencils, paper) for drawing phenotypes.
   - Student assignment sheets for data collection and reflections.
   - Projector or smartboard for demonstration.
2. **Set Up the Simulation:**
   - Ensure that all students have access to the simulation at [Natural Selection Simulation](#).
   - Familiarize yourself with the simulation features so you can guide students effectively.

Instructions for the Students:

1. **Introduction to Natural Selection:**
   - Begin the class with a brief introduction to natural selection and its key concepts, including adaptation, mutation, and population dynamics.
2. **Drawing Bird Phenotypes:**
   - **Before the Simulation:**
     - Ask students to draw three different bird phenotypes on their assignment sheets based on traits they anticipate will affect survival (e.g., plumage color, size, beak shape). They should label each drawing with traits.
     - This activity helps students visualize their predictions and understand the importance of physical traits in natural selection.
3. **Running Part 1 of the Simulation:**
   - Guide students through setting up their initial simulations, encouraging them to experiment with different environmental settings and traits for their bird populations.
   - **Data Collection:**
     - Instruct students to fill out the data table as they progress through the simulation, noting any changes in traits and characteristics after each specified year.
4. **Reflection:**
   - After completing Part 1, have students answer the reflection questions using the provided sentence stems. Discuss their thoughts as a class to encourage deeper understanding.

Part 2 Instructions:

1. **Post-Hurricane Simulation:**

- Explain that after a simulated hurricane, they will rerun the simulation with new environmental factors.
- Have students select their food sources, predators, and foliage for this new environment.
2. **Data Collection for Part 2:**
- Remind students to fill out the new data table as they track changes over the next million years, stopping every 50,000 years to note mutation changes and phenotype alterations.
3. **Drawing Bird Phenotypes Again:**
- **After the Simulation:**
- Ask students to redraw their three bird phenotypes after the second simulation. They should illustrate any changes in traits and label them accordingly.
- This will help them visualize the impact of the environmental changes on the bird populations.
4. **Final Reflection:**
- Have students respond to the reflection questions from Part 2, encouraging them to think critically about the effects of the hurricane and the new environment on their bird populations.

Differentiation Strategies:

1. **For Advanced Students:**
- Encourage them to conduct further research on real-world examples of natural selection and how specific species have adapted to environmental changes.
- Have them create a presentation or infographic summarizing their findings.
2. **For Struggling Students:**
- Provide a guided template for drawing and data collection to help structure their observations.
- Pair them with a peer mentor during the simulation to facilitate discussion and understanding of key concepts.
3. **For ELL Students:**
- Use visual aids, such as images of birds with various traits, to support vocabulary development.
- Provide translated versions of key terms and concepts if necessary.
4. **For Students with Special Needs:**
- Allow additional time for the simulation and reflections.
- Provide assistive technology tools or alternative means of expression (e.g., oral presentations) to complete assignments.

Assessment:

Evaluate students based on their participation in the simulation, accuracy and completeness of their data tables, quality of their drawings, and depth of thought in their reflections. Use a rubric that considers both content understanding and effort.