Statistics in Biology

≈ 14 - 18 days

Authors

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SUBJECT/GRADE LEVEL

Life Science
Computer Science
9-12

Materials

- This lesson is ideal for districts or schools that are 1:1 but can be modified into all group work instead of a mix of individual and group.
- This lesson will also utilize the python coding and the jupyter notebook program which can be downloaded onto any computer from this site.

STANDARDS

Next Generation Science Standards

- HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Mathematics Standards | Common Core State Standards

- CCSS.MATH.CONTENT.HSS.MD.B.7- Analyze decisions and strategies using probability concepts (eg. product testing, medical testing, pulling a hockey goalie at the end of a game).

English Language Arts Standards | Common Core State

- CCSS.ELA-LITERACY.RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

LESSON OBJECTIVE(S)

Students will research possible solutions to protect threatened or endangered species and utilize Python programming to evaluate the effectiveness of their proposed solutions.

CAREER CONNECTION(S)

Mentor Background: Dr. Haley Dozier is a computer scientist in the Software Engineering and Evaluation Branch at the Information Technology Laboratory (ITL) which is a part of the U.S. Army Engineer Research and Development Center (ERDC). Dr. Dozier began her career at ITL as an intern in May of 2018 and

continued her employment full time in May of 2019 after her graduation from the University of Southern Mississippi where she earned her doctoral degree in Computational Science with an emphasis in Mathematics. Her doctoral dissertation was titled "Enhancement of Krylov Subspace Spectral Methods through the Use of the Residual". At ITL, Dr. Dozier has worked on a variety of research efforts focusing on the application of state-of-the-art machine learning techniques to both military and environmental issues. In February 2021, Dr. Dozier was honored by the Department of the Army with the Civilian Service Achievement Medal for her research contributions to ITL, and to ERDC.

STEM Careers: This lesson is applicable to many different careers including any career involving coding. This could be any field involving computer science, IT, or really any field of science that looks at comparing data.

ENGAGEMENT

Brief Description: Get students interested in many different possibilities of looking at endangered or threatened animals.

Procedures:
Show the following clips to your class to give them some examples of species that are endangered or threatened. I like to show the clip from the Lorax to give examples while not using a real species - this also puts a light hearted spin on a more serious topic in biology. Additionally, this clip will gain interest for students who are more visual and auditory learners and can help bridge the gap with the different levels of students in the class. Then have a class discussion and wait for some key species to come up and have backup clips for examples if students aren't sure or need additional clarification.

Lorax Clip (show first) - https://youtu.be/BXlYuaycRbU

Nat Geo Page - https://www.nationalgeographic.org/video/meet-some-worlds-most-endangered-animals/ The clip is embedded on this page. (Have this loaded prior to showing this to the class)

Assessment could be participation points for this segment of the class or an exit ticket at the end of class. (10 - 30 minutes depending on class discussion time)

EXPLORATION

Brief Description: Now the students will begin to investigate and research to find a species on the endangered or threatened list that interests them. (This should be done individually to get more examples and data for each class if the school is 1:1. If the school is not 1:1 and either has a lab, computer cart etc where some tech is available then this can be done in a group setting. If this is the case there should be a group grade as well as an individual grade to ensure equity and participation)

Procedures:
Have students visit this website: https://www.worldwildlife.org/species/directory

Have a class example that you will use that students CANNOT pick. This will allow you to make key connections throughout the discussions and assignments as well as have a go-to example to help scaffold your lesson and make connections for the students. Having a solid example that you utilize will allow students to parallel their species to your example.

I would show students this and have a sign up google sheet for individuals or groups so that the class has a variety of different animals. Another option is giving students this link but also having some required species. Either way would be fine; it just depends on how much scaffolding your class needs.

Students will not do too much in-depth research or evaluation here just enough to pick a species that they think will interest them. This should be a fairly shallow investigation but it does need to have some source provided by students so that they have not just blindly decided on a species. The species that they choose at this point should be locked into. This is to also help students be held accountable and responsible for meeting the requirements.

Assessment for this would be the signup sheet with the following requirements:

Student name - Species - Species Status (Threatened, Endangered, etc) - Reason for choosing species - source from research

(30 mins - 1.5 hours : This will take longer if group work as there will be more discussion. This could also be given as homework for the night/ submitted via a bellringer for the next class depending on how much time you have in each class).

EXPLANATION

Brief Description:
During this section of the class you will elaborate on biodiversity and why having species that are threatened and endangered matters. Focusing on the cause of the species that the species has, how to mitigate and why mitigating is important.

Procedures:
This section can take as long as 5 days depending on which route you decide to take with your class.

Key Vocab and concepts: Biodiversity, interdependence of species, ripple effect, symbiotic relationships.

This can be explained by using the "Our Planet" documentary series on Netflix (also on Youtube as of when this lesson plan is written). For example this would be an ideal route if students are virtual or hybrid as it allows students to go more at their own pace. I would encourage you to utilize tools such as Edpuzzle to scaffold for students as well as track and gather data for student progress. I have included the link to the Frozen Worlds Episode on Netflix for your reference but you could utilize any or all of the Episodes that are available. If using this method I would include time for class discussion or discussion guides with time to go over in class to dig into the concepts that are in the video and relate them to the idea of threatened and endangered species.

You could use a lab at this time or do a mini unit on pollution or deforestation to help show the human element and impact on the biosphere in general.

ELABORATION

Brief Description: At this point students should hopefully be making connections between the content being explicitly taught and the species that they picked at the start of this unit. In order to make sure this is happening be sure to be making clear connections to an example of your choice and asking students to elaborate on how they think it connects. This could be done again in person via class discussion, assignments, bell ringers or exit tickets.

Procedures:
During this portion you will research the causes of status of your class example species. This is a great time to review/introduce key aspects of credible sources and research tips and tricks. This alone can take up to a class period. I would have a formative assessment of exit tickets looking at what key aspects are involved in a credible source. You could focus on one or many aspects.

Once you have given your students 2 class days to do research on their species and present their work to you in whatever format you choose (google form, mini-presentation, jigsaw with peer eval etc.) then you will introduce python and jupyter notebook.

This will take some time to get students used to - they will be using a math function within the notebook to help them evaluate their model that they have presented. This portion should be either an extension, class activity, or have substantial amounts of scaffolding available.

Use your class example species to show students how to utilize a jupyter notebook to begin just typing in information about the species and how to import important libraries. This will help students get familiar with the formatting and the ways that this tech works.

Use a google doc for students to be able to copy and paste the basics into their own notebook to minimize tech errors at this step of the process. Once you have introduced students to jupyter notebook - give them some small examples to follow along and complete to help them learn the software. This step alone will take 1.5 - 3 class periods. There will likely be many questions - urge students to ask questions and help each other when needed.

Once students have explored the program and typed up the basic findings about their species they will need to find data surrounding a cause of their species status as threatened, endangered or nearly extinct. They will then import their data and follow the steps to analyze the important variables. This should be done using python as well as analyzing literary texts. As prior noted - jupyter notebook and python coding are great tools but may need to be used as just an extension or not as heavily weighted on correctness but on completion or attempted completion.

EVALUATION

Brief Description: This is the culmination of the unit and can be presented to the class, submitted via a video or done via zoom.

Procedures:

Students will then make a presentation utilizing their jupyter notebook as well as the sources that they found regarding their species. This can be done using powerpoint, google sites, zoom and google docs, a poster - whatever is best for your situation - I would require a visual of some sort as well as a presentation piece. This will take approximately 3-5 days for students to present if done during class (advised and included in the time span).

Students should present the following information:

Species name - common and scientific

Species Status - threatened, endangered, nearly extinct, etc.

Causes of species status - both examples and sources

Ways to mitigate impact - data found and sources

Original idea/evaluation of previous ideas to mitigate impact - including data from python/jupyter notebook analysis and literary/source analysis.

Reflection on project and decision on how to make an impact.

REFERENCES

- The BSCS 5# Instruction model - creating teachable moments (link)