Lesson Information

Course: Biology
Topic: Human Impact on the Environment and Biodiversity
Grade Level: 9th
Class Periods: Six 90-minute block periods

Standards

- Science: Next Generation Science Standards
  - DCI LS2.C: Ecosystem Dynamics, Functioning, and Resilience
  - DCI LS4.D: Biodiversity and Humans (*Secondary*)
  - DCI ETS1.B: Developing Possible Solutions (*Secondary*)
- Mathematics: Common Core State Standards
  - High School: Modeling
  - HSN.Q.A.1
  - HSN.Q.A.2
  - HSN.Q.A.3
- Technology: International Standards for Technology Education
  - Innovative Designer (4a)

Objectives

1) Students will conduct online research from reliable sources to summarize and organize relevant information about their chosen ecosystem and the major negative human impact affecting it.
2) Students will apply the engineering design process to design, evaluate, and refine a solution for reducing the impacts of their chosen negative human activities.
3) Students will create an emotional yet informational appeal (PSA) using video editing software to clearly communicate their proposed solution with others.

Materials and Equipment

- ❑ Class discussion notes
- ❑ Student project outline
- ❑ Student rubric
- ❑ Laptops and laptop chargers
- ❑ Internet access for online research
- ❑ Basic modeling supplies (e.g. cardboard, poster board, glue, markers, scissors)
- ❑ Graphic design software (e.g. Canva, Publisher, Photoshop)
- ❑ Video editing software (e.g. iMovie, Adobe Spark, Movie Maker)

Introduction/Rationale

The goal of this lesson is to engage students in discussions about how humans are negatively impacting our world. Humans in certain parts of the world are working to conserve or even rejuvenate ecosystems, while in other areas many human activities are detrimental to the environment. As the world's population grows and we are continually forced to consider how we are treating the Earth, the students will collect real-world information about these problems and propose possible solutions to mitigate negative consequences of human activities.

The idea is that student groups will become experts for their chosen ecosystems, human impacts, and proposed solutions. Through the engineering design process, they will brainstorm multiple ideas and decide which solution would benefit their issue most effectively and efficiently. Some groups may be able to physically model their solutions while others may remain more hypothetical as they imagine how their solutions would be implemented. In the end, students will create an emotional appeal in the form of a video public service announcement to inform the audience of the negative human impact and promote their proposed solution.

Content/Context

The major focus of this lesson is for students to determine how changes in the environment that are caused by humans can disrupt the ecosystem and even threaten the survival of plants or animals that make up the ecosystem. The NGSS emphasize human impacts such as habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change (NGSS Lead States, 2013). This is the Ecosystem Dynamics, Functioning, and Resilience disciplinary core idea.

The students must also consider the overall effects on the ecosystem's level of biodiversity. The human impacts discussed are all negative; they cause the ecosystem's biodiversity to decrease through lowering populations to the point of extinction. The topic of biodiversity is introduced in this lesson and will be revisited later during the school year with evolution. Students will acknowledge humankind's needs for the resources our Earth provides, specifically how biodiversity is something we all depend upon. There must be a balance between human needs and the biodiversity of an ecosystem so it can still function and be productive for the plants and animals living in it. It is therefore our task to sustain biodiversity by preserving aspects of the Earth, another topic which will be discussed again with evolution. These additional ideas are secondary to the primary disciplinary core idea and are included in the Biodiversity and Humans disciplinary core idea.

This particular performance expectation also involves an Engineering, Technology, and Applications of Science disciplinary core idea: Developing Possible Solutions. Students will be asked to apply the NASA Engineering Design Process (ask, imagine, plan, create, experiment, improve) as they determine and evaluate a potential solution for their negative human impact of focus (May, 2017). They must consider constraints such as cost, safety, reliability, and aesthetics. Students must also consider social, cultural, and environmental impacts of their proposed solutions. The technology standard involved closely aligns with the engineering design process principles (ISTE, 2018). Defining appropriate quantities for modeling and keeping in mind accuracy and limitations are key for incorporating aspects of the mathematics standards involved (CCSS, 2018).

Student Instructions

Student instructions are primarily outlined in the project overview document. Below is the teacher instructional outline for this project as well as an indication of student instructions.

1) Day 1:
    a) Begin by using the class notes to introduce the topic and provide additional context.
    b) Thoroughly review the project outline and provide the rubric to students (for thorough review on day two).

c) Assign student groups and allow students to choose their ecosystems of focus and avoid repeats within a single class.
d) Ask that students begin to conduct research about their ecosystem in regard to negative human impacts taking place. Promote the use of reliable resources and a shared note-taking document for the groups to use when finding data, tables, graphs, charts, and other scientific or academic information. The "ask" and "imagine" design phases should be emphasized.
e) Students should gather information in their notebooks and collect evidence that may be used in the PSA video.
f) Provide detailed, constructive feedback about each groups' topic/progress as they work.

2) Day 2:
   a) Briefly review the objectives of the project and emphasize how the engineering design process should be applied.
   b) Thoroughly review the rubric, which was provided on day one.
   c) Ask students to continue background research as needed.
   d) Be sure to provide feedback about students' current research and notes to hint at additional subtopics which may be beneficial to explore.
   e) Students should spend most of this class period in the "plan" phase of the design process. Some groups may reach the "create" phase.
   f) Students should gather information in their notebooks and collect evidence that may be used in the PSA video.
   g) Provide detailed, constructive feedback about each groups' topic/progress as they work.
3) Day 3:
   a) All students should be working through the "create" phase during this class period. Some may even begin the "test" phase.
   b) Students should gather information in their notebooks and collect evidence that may be used in the PSA video.
   c) Ask students to continue reviewing the project outline and rubric.
   d) Provide detailed, constructive feedback about each groups' topic/progress as they work.
4) Day 4:
   a) All students should be working on the "test" phase during this class period as well as moving on to the "improve" phase.
   b) Students should gather information in their notebooks and collect evidence that may be used in the PSA video.
   c) Ask students to continue reviewing the project outline and rubric.
   d) Provide detailed, constructive feedback about each groups' topic/progress as they work.
5) Day 5:
   a) All students should spend this day primarily on the PSA video, since they will have collected evidence to use. Groups should also be filming necessary speaking sessions.
   b) Ask students to continue reviewing the project outline and rubric.

   c) Provide detailed, constructive feedback about each groups' topic/progress as they work.
6) Day 6:
   a) This day is to be used to show all groups' PSA videos for discussion and peer evaluation.

Assessments

A student rubric was created to formally evaluate this design project.

The first two rubric categories address objective one; students are evaluated on how thoroughly students conducted necessary background research from reliable sources to organize relevant information to support their human impact and proposed solution. The teacher should provide regular feedback during the research process to promote further searching into key subtopics each group may encounter for their chosen ecosystems. Students should be promoted to find data, charts, tables, graphs, and other scientific and academic information in support of the human impact.

The second objective is somewhat assessed within the PSA video content for the final product, though it should also be informally assessed as students are working. Students should track their engineering design process in their notebooks, which can be collected periodically to check for content and quality. The teacher should provide regular feedback to promote high quality solutions as well as push students to think further outside the box as needed. Successful achievement and progress throughout the engineering design process may indeed be evident in the final video as well. Use the student project outline and rubric to help students recognize strengths and weaknesses.

The final objective is formally assessed with the student rubric. All of the four major project components from the project outline should be evident, along with indicators that students utilized the engineering design process. Students should also complete a self- and peer-evaluation to provide feedback to one another regarding the PSA video and the proposed solution. Sample peer evaluation questions are provided in the project outline.

References

Common Core State Standards Initiative. Standards for Mathematical Practice. High School: Number and Quantities » Quantity. (2018). Retrieved June 26, 2018, from http://www.corestandards.org/Math/Content/HSN/Q/

International Society for Technology in Education. (2018). ISTE Standards for STUDENTS. Retrieved June 26, 2018, from https://www.iste.org/standards/for-students

May, S. (2017, July 17). Engineering Design Process. Retrieved June 26, 2018, from https://www.nasa.gov/audience/foreducators/best/edp.html

NGSS Lead States. (2013). Next Generation Science Standards: For States, By States (Chapter 10: Dimension 3: Disciplinary Core Ideas - Life Sciences). Retrieved June 26, 2018, from https://www.nap.edu/read/13165/chapter/10#154

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