**It’s us or them! – Weighing species extinction against human health.**

**Description**

In this multi-day project, students will play different roles as part of a team of experts deciding if several different species of disease transmitting animals should be wiped out to stop people from getting sick.

**Introduction**

Millions of people get sick or die each year from illnesses that were transmitted to them from another animal species. In response, some will ask, “’Why don’t we kill all the animals making us sick?” The answer to this question requires the weighing of several factors: benefit to humans, cost of the loss of the species, and potential unintended consequences. During this process students will learn about the One Health initiative which attempts to understand the links between human health, the environment, and animal populations.

Diseases transmitted to humans from another species are known as zoonitic diseases. The particular species that carries the disease is known as a vector. These vector species themselves are not causing the illness, but rather they are passing some disease carrying agent to us.

While it may be possible to cure or treat the disease, many species carry multiple diseases that are difficult to find a definitive cure for. Example include the Zika virus and Ebola. Both are the subject of much research, but we are still not yet close to a cure.

This project has students role play a team of experts developing a plan to eliminate one of these vector species as a quick solution to one of these diseases. Each student will be responsible for researching part of the project, but will need to share and collaborate with their group to produce a meaningful final project. There are 4 roles for the students to fill and assigning a student to a particular role can allow a teacher to differentiate within this project. Below are a few notes to help guide you in the creation of student groups.

**Doctor** – This is the most straightforward role within the group and is recommended for students who struggle in the course. Students, especially higher level, seem to gravitate towards this role as it sounds prestigious. It is recommended that you do not put your highest level student in this role.

**Ecologist** – This role is also straight forward to complete. The most challenging aspect of this role tends to be predicting the future for the vector species and describing the ecological impact of the species elimination. I low level student will need some guidance in this role.

**Engineer** – This role is not recommended for struggling students. This role has the least guidance and requires the student to generate a plan for eliminating the species and speculate what could go wrong. This higher order thinking and loose structure may present a challenge for a student who is not accustom to open ended problem solving.

**Executive** – The role of this student is to ensure that work is being completed, holding other students accountable, and synthesizing other student’s work into a coherent project. This role is best suited to an organized student as it requires planning and coordination. A student who is struggling in the class can excel in this role with proper mentorship as this role leans heavily on an individual’s ability to work with others and summarize. This is arguably the most challenging role and requires strong social skills.

**Curriculum Alignment**

Bio 2.1.3 Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.

Bio.2.2.1 Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.

Bio.2.2.2 Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.

**Objectives**

Students will be able to describe how organisms in an environment can influence one another.

Students will be able to infer how human actions could impact the environment.

Students will be able to explain how human health is interconnected with animal populations and the environment.

**Time & Location**

300 - 360 minutes of class time, four 90 minute class periods.

Classroom with computer access

**Teacher Materials**

Teacher computer with internet access

Copy of Zoonotic Disease Intro Lecture PowerPoint

Digital Projector

Classroom sound system/ speakers

Dry erase board w/ markers

Print outs:

Student Project Handout – One per student

Doctor Data Sheet – One per group of 4 students

Ecologist Data Sheet – One per group of 4 students

Engineer Data Sheet – One per group of 4 students

Executive Data Sheet – One per group of 4 students

**Student Materials**

Computers/Laptops with internet access (recommend 1 computer per 2 students)

One copy of student project hand out

One copy of the role appropriate data sheet (Doctor, Ecologist, Engineer, or Executive)

**Safety**

No issues anticipated.

**Student Prior Knowledge**

Students should understand that diseases can be carried by an organism and transmitted to another.

Students should have a basic understanding of ecology and food webs.

Students should be able to predict changes in food web populations in response to changes and disruption.

**Teacher Preparations**

Teacher will need to ensure that all students will be able to access a computer with an internet connection.

Prepare copies listed in teacher materials

Ensure PowerPoint mentioned in teacher materials can be displayed to class.

On the first day of the lesson plan Que up YouTube video to ensure a swift transition.

Check that the audio of the video can be heard throughout the classroom.

**Activities**

Teacher will open the class with the Zoonotic disease Intro PowerPoint

On the first slide the teacher will ask students “What the most dangerous animal you can think of?”

Teacher will record all student responses on the board while prompting students to explain why they suggested that particular animal and how many people they think that animal kills in a year.

After students have provided several suggestions, reveal that mosquitoes cause the most human deaths each year, but this is not due to the animal directly killing the human, but rather a disease they carry causes the death.

Teacher will progress through the PowerPoint explaining the concepts of one health, and zoonotic disease transmission.

At the end of the presentation, the teacher will ask students if they think mosquitoes should be killed.

Teacher will lead the students in a discussion of the pros and cons of killing all mosquitoes, being sure to discuss the gains in human health, and the harm done to the environment. Discuss how unintended consequences might arise from any strategy or attempt to kill all of the mosquitoes.

After this class discussion inform students that they will be working as a group to research and decide if all of a particular species should be eliminated.

Students will be divided into groups of 4, whether these are assigned or students are allowed free choice depends upon the ability of the students and the teacher’s discretion.

Within each group the students will be fulfilling 1 of 4 roles:

* Doctor – Researches the disease
* Ecologist – Researches the ecological role of the vector organism
* Engineer – Develops a methodology for eliminating the organism
* Executive – Manages group and writes up final proposal detailing whether the organism should be eliminated or not.

It would be advisable for the teacher to help each group decide on what role they will play as each role requires a slightly different skill set. The engineer role is often the most challenging as it requires a good deal of creativity and provides the least amount of structure. The executive should also be a motivated student as due to the nature of this assignment they may be tempted to think that they do not have any work to complete until the end of the project.

Once the groups have been formed, have the students pick one of the four zoonotic diseases from the list.

It is recommended that the number of students completing each disease is equally spread, For a 8 groups there should be two groups researching each disease.

There is nothing prohibiting students from finding another zoonotic disease that is not currently on the list if the students are highly motivated.

While the students begin to work, have a meeting with the executives about developing a work plan for their group.

Describe to them that their role is to keep their team on task and to record what the group is doing each day. Additionally before anything gets really started they need to form a plan with their group.

Refer them to the data sheet they were given. Call the student’s attention to the planning section of the data sheet. The students should write out the tasks to be performed and who will perform them along with a timeline for the completion of the project.

Allow the executives to return to their group and discuss the plan for future work.

After the groups have had a few moments to start their plans, the teacher should circulate to check in with the executives to ensure that they have a clear plan and that the group agrees with this plan. Remind the executives that as the individual who will be writing up the final decision, they need to be involved with the research of all group members.

Depending on the level of students and available time, 1 to 2 days should be allowed for the students to perform research and develop their proposal.

After 1-2 days of time to work on their projects, each group will present their proposal.

The teacher will need to time each presentation and utilize the rubric on the student project handout sheet to evaluate the presentation.

**Assessment**

Students will be evaluated on their presentation based on the provided rubric. The teacher should ask probing questions if they are uncertain about a student’s grasp of the material.

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| **Topic** | **0** | **1** | **2** | **3** |
| **Description of the disease** | Not Included | 3 or fewer items from doctor data sheet included. | 1 or 2 items from doctor data sheet missing. | All data from doctor sheet clearly presented |
| **Ecological role of vector species** | Not Included. | 3 or fewer items from ecologist data sheet included. | 1 or 2 items from ecologist data sheet missing. | All information from ecologist data sheet included. |
| **Proposal for elimination of the species** | Not included | 3 or fewer items from engineer data sheet included. | 1 or 2 items from engineer data sheet missing. | All information from engineer sheet included. |
| **Executive summary and decision.** | Not included | Executive summary confusing or decision unclear. | Executive summary did not add to presentation and simply restated presentation. | Executive summary included and decision was well explained. |
| **Visuals** | Presentation lacked any visuals or structure. | Few pictures of poor quality.  Text sloppy or hard to read. | Several relevant pictures.  Text heavy. | More than 5 high quality relevant images.  Good balance between text and images. |
| **Time** | Less than 1 min  More than 7 min | Less than 2 min  More than 6 min | Less than 3 min  More than 5min | Presentation 3-5 minutes |

**Critical Vocabulary**

* **Zoonoses** - a disease that can be transmitted to humans from animals.
* **Incidence** - Incidence is the rate of new (or newly diagnosed) cases of the disease. It is generally reported as the number of new cases occurring within a period of time (e.g., per month, per year). It is more meaningful when the incidence rate is reported as a fraction of the population at risk of developing the disease (e.g., per 100,000 or per million population).
* **Prevalence** - Prevalence is the actual number of cases alive, with the disease either during a period of time (period prevalence) or at a particular date in time (point prevalence). Period prevalence provides the better measure of the disease load since it includes all new cases and all deaths between two dates, whereas point prevalence only counts those alive on a particular date.
* **Prognosis** - a doctor's opinion about how someone will recover from an illness or injury
* **Epidemiology** - the branch of medicine that deals with the incidence, distribution, and possible control of diseases and other factors relating to health.
* **Vector**: any living creature that transmits an infectious agent to humans.

**Author Information**

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This lesson plan was developed in collaboration with Dr. Elena N. Veety at the ASSIST center on the campus of NC State University.

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