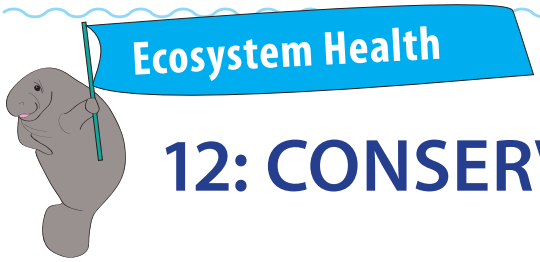


12: CONSERVE OR DEVELOP?

Grade Level: 9-12
Time: 1 hour

SUMMARY:

In this lesson, students are divided into groups and given a piece of property which they must decide whether to conserve or develop. Each property has a different set of characteristics that make it unique and important to the health of the ecosystem. All of the properties in this lesson are a part of the same watershed, as shown on the first map. Students need to determine what impacts their decision may have on the environment, the species in the surrounding area, and the local community. This lesson is a great introduction to ecology and land conservation and management, and illustrates how a decision to develop or conserve a piece of land can impact the local community and ecosystem.

OBJECTIVES:

Students will:

- Develop a general understanding of land conservation and ecology.
- Learn about ecosystems and how human actions affect ecosystems and their functions.
- Work together to decide what to do with their property, taking its characteristics into consideration.

STEM APPLICATIONS:

- **Science (ecology, land conservation)** – Students develop a general understanding of factors that go into land planning and how humans can impact ecosystems and landscapes.
- **Engineering** – Students must work together in groups to decide how best to utilize their parcel of land, which may include designing what their property would look like.

NGSS ALIGNMENT:

- **Practice 1.** Asking Questions and Defining Problems
  - **9-12** - Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables.
  - **9-12** - Ask questions to clarify and refine a model, an explanation, or an engineering problem.
  - **9-12** - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
- **Practice 3**. Planning and Carrying Out Investigations
  - **9-12** - Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
  - **9-12** - Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
- **Practice 6.** Constructing Explanations and Designing Solutions
  - **9-12** - Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.
  - **9-12** - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- **Practice 7**. Engaging in Argument from Evidence
  - **9-12** - Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., tradeoffs), constraints, and ethical issues.

VOCABULARY:

- **Ecology** – The study of the relationships of organisms between one another and their environment.
- **Ecosystem** – A community of living things, non-living elements, and their interrelationships.
- **Ecosystem Services** – The benefits humans obtain from ecosystems.
- **Conservation (of land)** – The environment, lands and their natural resources are used by humans and managed in a responsible manner.
- **Preservation** – The environment, lands and their natural resources are not consumed by humans, but instead maintained in their pristine form.
- **Sustainability** – Meeting the needs of the present without compromising the needs of future generations
- **Sedimentation** – The natural process in which material (such as stones and sand) is carried to the bottom of a body of water and forms a solid layer.
- **Groundwater** – Water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations.
- **Eutrophication** – A process where water bodies receive excess nutrients which stimulate excessive plant growth, which causes a lack of oxygen.
- **Biodiversity** – The variety of life in the world or in a particular habitat or ecosystem.

MATERIALS:

- Watershed Map containing all of the properties, see figure 1.
- Property characteristics of each of the properties
- White board
- Optional: PowerPoint slide showing the watershed map (available on NAMEPA website)

BACKGROUND:

As the human population continues to increase, the exploitation of natural resources increases as well. In order to continue to provide people with food, places to live, energy, water, etc., land that was once undeveloped is converted for human use. Land development can lead to habitat loss, sedimentation of rivers and streams, increased runoff, and water pollution, among other impacts, and in turn can negatively affect ecosystems and species populations. When deciding what to do with a piece of land, many factors must be taken into consideration, including ecosystem services and how local species and members of the community will be affected. There are methods used nowadays to determine what type of impact development could have, as well as how to minimize effects on the environment.

ACTIVITY:

1. Engage/Elicit

Start the lesson by asking the students what an ecosystem is. Refer to the vocabulary above for the definition. Ask the students how humans impact ecosystems.

Answers may include:

- Pollution (climate change/ fossil fuel emissions)
- Deforestation
- Overfishing
- Land development (be sure to mention if it is not said)

Ask the students if they know the difference between conservation and preservation. After taking answers, make sure the students know that preservation refers to leaving land untouched and in its natural state, whereas conservation refers to responsibly managing land for human use.

Explain that you are going to be talking about land development and how it impacts freshwater ecosystems. Before beginning the activity, ask the students if they can define "ecosystem services." After taking answers, explain that ecosystem services are the benefits humans obtain from ecosystems.

Examples of ecosystem services include:

- Climate regulation and carbon storage
- Erosion control
- Pollination

Continue with a discussion about a specific ecosystem, for an example, a wetland. Ask the students what sort of ecosystem services a wetland provides.

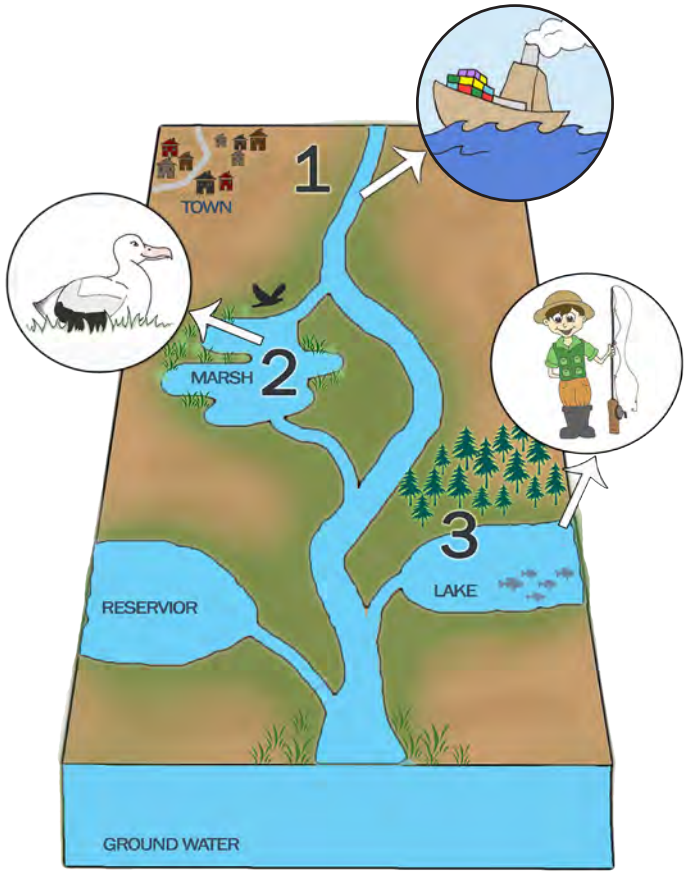


Figure 1. Watershed map sowing 3 properties

Answers may include:

- Flood control
- Water purification
- Shoreline protection

Shift the discussion towards freshwater ecosystems in general. What value do they provide?

Answers may include:

- Dams provide electricity
- Provide water for irrigation, industry and drinking water
- Provide us with food
- Aesthetic and recreational value

Mention that freshwater ecosystems are connected to marine ecosystems; rivers that do not flow into other rivers or lakes usually flow into the ocean. Explain that ecosystem services are extremely valuable to humans, yet they are often not taken into consideration when developing a piece of land. A primary reason for this is because it's very difficult to put a monetary value on these things.

To take the discussion further, you can talk about why it's important to protect ecosystems and biodiversity in general. Some reasons you can mention are for economic reasons, recreation, aesthetic value, for future generations, etc. The idea is to get students thinking about all of the ways that we as humans benefit from ecosystems and biodiversity.

2. Explore

Divide the students into three groups. Explain that each group will receive a different property, all of which are situated on the same watershed. Each property has a different project that is being proposed. As a group, the students must decide what to do with their property – will they develop it or conserve it? Students should make a list of pros and cons of each, and any potential impacts their decision may have. Each group should receive a copy of the watershed map showing where their property is in relation to other properties, as well as the list of property characteristics for their specific property. You could also use the PowerPoint slide available on the NAMEPA website (www.namepa.net/education./education) to project the watershed map so that all students can see it.

Points to consider during the group decision-making process:

- Future use of the property
- Will the value of the property increase or decrease with your decision?
- Will you make money from your decision?
- How could this decision potentially impact local wildlife?
- How could this decision impact the other students' properties and the local community?
- What do you think the value is of the property when it's undeveloped vs. developed?

3. Explain

Allow 20 minutes for groups to arrive at a decision and make a list of the potential effects their decision may have.

Potential impacts of development may include the following:

- Increased runoff (i.e. from removal of trees)
- Sedimentation
- Decreased habitat for local wildlife
- Aesthetic impacts
- May affect drinking water supply
- Development could help local economy

Points to consider for each property:

Property #1:

- Development could positively impact local economy
- Building the port could cause sedimentation in the river
- Other properties are downstream, so any pollution from the construction or running of port could impact those properties and the reservoir
- Because it's a partly forested property, it could help with groundwater recharge
- Forested properties also help prevent flooding
- Port could negatively impact river otter populations, affecting the local ecosystem

Property #2:

- Construction and running of dam could lead to some habitat loss for birds
- If dam was constructed, there would most likely not be a recreational fishing area
- Dam would provide renewable energy to community
- Could impact property #3 and reservoir downstream
- Dam could negatively impact other organisms living in the marsh

Property #3:

- Housing development would create new homes, in turn stimulating the local economy
- Housing development would require cutting down forest, an important habitat for birds and other organisms
- Forested habitat helps with groundwater recharge
- Development may negatively impact fishing area and reduce beaver habitat
- Construction of homes could lead to pollution in river/lake

Afterwards, each group should elect a member to present their decision, list of potential impacts, and brief explanation of their reasoning.

After having a brief discussion about potential impacts, ask the students whether or not they believe ecosystem services should be taken into consideration in the decision making process. If so, how? Engage students in a discussion about ways to determine the value of different ecosystem services.

5. Extend:

Optional: After arriving at their decisions, have the groups of students create a drawing of what could be their property if they chose to develop it. What are some things they can do to reduce the impact the development would have on the environment? Encourage them to be creative!

5. Evaluate/Wrap-up:

End the lesson by reiterating how important healthy ecosystems are to us as human beings. Tell the students that these types of decisions are made all of the time, and it is often very difficult to estimate what types of impacts land development or modification may have on ecosystems and on people. Do they think a monetary value should be placed on ecosystem services? A great way to Wrap-up this lesson is by having a discussion about ways in which a developer or homeowner can lessen their impact on the environment. Some answers may include:

- Reusing materials or using materials taken from on the site
- Using rainwater to water plants
- Recycling materials
- Planting trees to provide shade in summer and heat in winter
- Using renewable energy sources

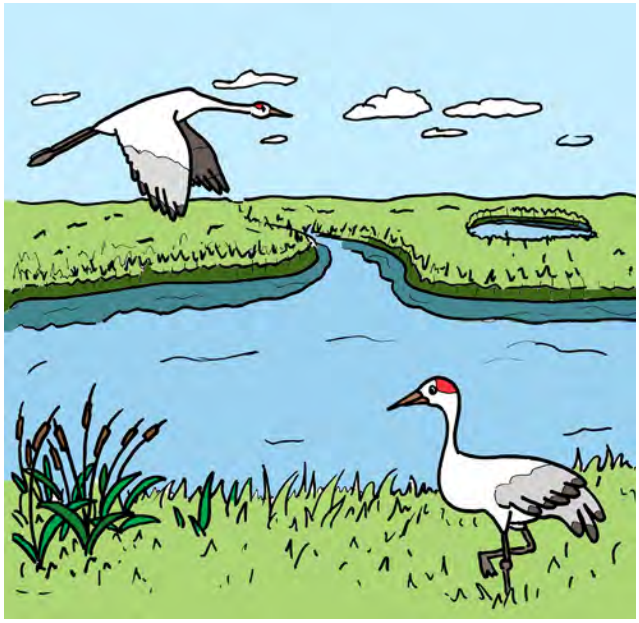
6. Dive Deeper

To learn more about land conservation, visit the Nature Conservancy's website: www.nature.org. To learn more about ecosystems and how to lessen your impact, visit www.namepa.net/education.

PROPERTY #1

Proposed Project: Port

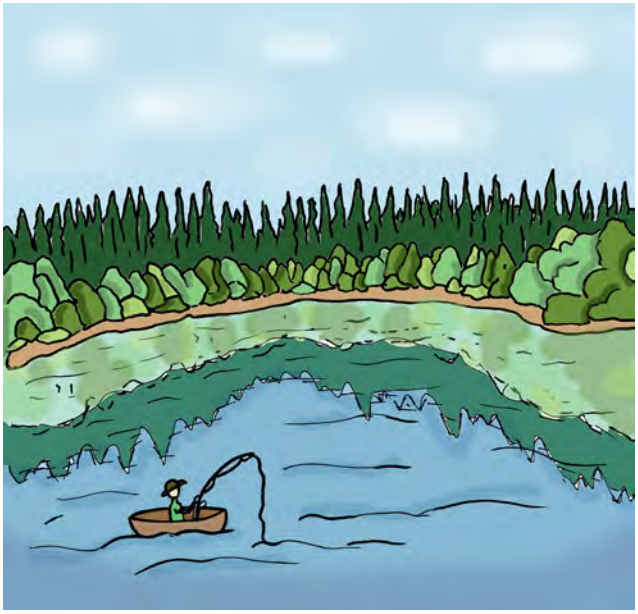
- Farthest upstream on river
- Close to local community
- Partly forested
- Important habitat for river otters



PROPERTY #2

Proposed Project: Dam

- Marsh
- Seasonal Flooding
- Important habitat for migratory birds
- Helps with groundwater recharge for reservoir
- Recreational fishing area



PROPERTY #3

Proposed Project: Housing Development

- Downstream on river
- Mostly forested
- Adjacent to lake
- Recreational fishing area
- Beaver Habitiat