



ENVIRONMENTAL ECONOMICS & VALUES

Valuing the environment depends on a various number of factors. Students will put a value to the environment and debate whether a new hydroelectric dam should be placed in a North Carolina county.

LESSON LENGTH:

- 1.5 hours

GOALS:

- The students will have the opportunity to place their own values on the environment and roleplay as residents of various North Carolina cities during a debate. They'll understand the push and pull and difficulty of deciding what aspects of the environment should be valued more or less than others.

OBJECTIVES:

Students will be able to:

- Recount various impacts of humans on the environment, in North Carolina, nationally, and globally
- Debate and converse on various issues and topics related to environmental values
- Generate and debate trade-offs on topics in environmentalism and environmental ethics
- Assess data and evidence to formulate opinions and discuss those opinions

Note: When printing, make sure pages 13-14, 15-16, and 17-18 are back-to-back. They will be hand-outs to the students. It should be organized so you can just print this whole document double-sided.

STUDENT TAKEAWAYS FROM LESSON:

- Essential question / theme
 - The value of nature and nature as a shared resource
- Key concepts and vocabulary
 - Fair use of shared resource
 - Trade-offs: Trade-offs arise when we cannot attain everything that is desirable. Two desirable things may be at odds with each other, such that if one increases, another must decrease. (An environmental example is air travel - It is desirable to travel by airplane due to the efficiency of this mode of transportation. On the other hand, air travel increases carbon emissions, polluting the air. Keeping the air free from pollution is also desirable. Flying by airplane only when necessary is a balance one could strike between the competing objectives.)
 - Costs and benefits: Costs can be pecuniary or non-pecuniary. A cost is anything that detracts from welfare. Benefits can be defined similarly in that they can be pecuniary or non-pecuniary, but benefits improve welfare.
 - Market value: the monetary value associated with things like supplying timber, fish, and agricultural land (I.e. how much money would you make if you were to sell them instead?)
 - Recreational value: The intrinsic benefit people derive from using the environment for recreational activities, such as camping, hiking, viewing wildlife.
 - Ecosystem services: The services necessary for the proper functioning of the ecosystem, including flood protection provided by wetlands, carbon storage in trees, and water purification.
 - Nonuse benefits: The value people get from knowing that ecosystems exist and are available for generations to come
 - Revealed preference: learning about how much people value things by observing their (purchasing, recreation) behavior

- Nonmarket valuation: We can think about the value of the environment as comprising two parts: the market value, and the non-market value. The market value is, as described above, the economic value of the environment based on how much revenue we can generate from it. The non-market value of the environment is anything not included in the economic value. So, it encompasses recreational value, value of ecosystem services, and so on. Nonmarket valuation refers to the methods used to try to quantify these non-market benefits. The idea is that the market value is relatively easy to calculate, because it's a dollar value. The non-market value is more difficult to quantify.
- Replacement cost method: quantifies the cost of actions that would be taken to substitute for lost ecosystem services

ASSESSMENTS:

- Debating on placement of the dam

DIVERSITY (REACHING STUDENTS OF ALL LEVELS/ABILITIES):

- All students have an opportunity to participate
- Individual activities and group-based activities
- Each of the environmental values can be read aloud to the students

MATERIALS & EQUIPMENT:

- Environmental Valuation Activity List (Pages 7-8)
- Fontana Dam Handout (Pages 9-15)
- Writing utensil

LOCATION:

- This activity can be done anywhere.

RISK MANAGEMENT & SAFETY CONCERNS:

- The role play activity could trigger a personal experience of a student.

BAD WEATHER ALTERNATIVE:

- If short on time, the extend/elaborate section can be shortened.
- There should still be a discussion after the debate either about the debate itself or about valuing the environment by referring back to the original choices made by each individual.



LESSON:

ENGAGE

- Value of the Environment activity (see below):
 - Each of the students and instructors receive the Environmental Valuation Activity Handout.
 - The instructor should tell the students to place a monetary value based on how much they value that piece of the environment.
 - Lead a brief discussion as to who values what more or less and why do they value those more than others.
- The instructor asks open-ended discussion questions:
 - What do you enjoy about the environment?
 - What are different reasons why the environment may be considered valuable?
 - Introduce some definitions to help students talk about some of these concepts:
 - **Market value** of the environment- monetary value associated with things like supplying timber, fish and agricultural land
 - **Recreational value**- camping, hiking, viewing wildlife
 - **Ecosystem services**- flood protection by wetlands, carbon storage in trees, water purification... etc.
 - **Nonuse benefits**- the value people get from knowing that ecosystems exist and are available for generations to come
 - However, some of these are at odds. (Ex: market value of timber and the ecosystem services provided by forests) - trade-offs!

EXPLORE

- Describe the scenario using the scenario description in the handout (Page 9).
- Give each student (or pairs) a page (Pages 10-15) that has a map of the dam and an assigned role for the debate. The roles are six different residencies in various cities in North Carolina. These residents may or may not be located near the dam.
 - They are asked to discuss with their group the factors that are involved in making this decision. They are also asked to give weights (quantitative or qualitative based on their choice) to these factors.
 - With those weights in mind, they will choose a preferred option ([1] build the dam or [2] do not build the dam) from the perspective of the resident)
 - The instructor will tell students that they will be asked to debate in favor of their position among the larger group.
 - Establish rules about debates before beginning (be respectful, no interrupting, etc).
 - The instructor should act as the facilitator during this debate, allowing every group to speak once before anyone speaks twice.



- Instruct the whole group to come to a consensus as to which option will be chosen and if there are any other stipulations or compromises.

EXPLAIN

- Quantifying how much we value the environment is important for sustainability efforts.
- We have to know how much people are willing to pay and what the costs and benefits are. Costs and benefits can be human or environmental.

EXTEND/ELABORATE

- Instructor asks the students to review the number they wrote down at the beginning of the lesson when asked to quantify their valuation of the environment.
- Question: Now what if I told you that you'd be required to pay that amount to government, so the government can provide services toward conservation and pollution prevention - Would you change the number you wrote down? Why or why not?
- Discuss: Environmental conservation is not free, but how do we get people to pay for it? In an ideal world, individuals or corporations would pay for conservation up to the level at which they pollute (i.e. up to the monetary equivalent of the damages caused) and/or up to the amount they value the environment.
- But how do we quantify the value of the environment? (In terms of damages or in terms of benefits?) We just saw that when we ask people to pay for conservation services up to their valuation, they have an incentive to lie. They will state that they value the environment at a lower level than they actually value it.
 - This is known as the **problem of stated preferences**.
- Question: Can you think of other ways to quantify how much people value the environment? (Note that this may take some probing. Suggested probes are in parentheses)
 - (So if you can't ask people how much they value something, is there any way you can infer it?) We can look at people's behaviors to infer how much they value something. This is called "**revealed preference**"
 - As an example: How do we know how much people value national parks (in monetary terms)? We don't ask them how much they would want to pay for the entrance fee because they would lie to us since they know that's what we would charge them to get in.
 - Instead, we can look at whether they continue to visit national parks despite higher travel costs. If airfare increases \$100, but they still travel to the national park, we can infer that we are undercharging them for entrance. They value the park at a much higher level.
 - In other words, their *willingness to pay* is higher than the entrance fee.
 - (How can we put a price on the different things we value about the environment? Think about the various **ecosystem services** provided. How can you figure out how to quantify the value of those ecosystem services? Well, what if we had to replace those services? That would cost money...)
 - The "**replacement cost method**" quantifies the cost of actions that would be taken to substitute for lost ecosystem services



- Example: if the rivers/wetlands were providing clean water services before they were flooded by the hydroelectric dams, people will have to figure out other ways to clean the water. Those methods cost money. How much? That's the value of the replacement cost.
- (Ecosystem services have other human benefits. For example, human health. What happens to our health when we pollute the air, for example? Is there any way we can quantify the cost of polluting the air from that health perspective?)
 - This alludes to the “**cost of illness method**”, whereby we quantify the value of the environment in terms of damages to human health that result from degradation of the environment.
 - Example: some people develop asthma from polluted air. It costs money to treat asthma. Also, people with asthma are less productive from a labor market perspective. So, the cost of asthma treatment plus lost wages due to illness could be the monetary value of clean air.
 - This provides us with a lower bound on the value, of course.

EVALUATE

- These points are overall discussion topics that can be used to start conversation if students are struggling with the discussion:
 - Local impact versus national impact
 - Perspectives and point of views are important
 - Short-term impacts versus long-term impacts
 - The difficulty in assigning weights to any one benefit/cost

REFERENCE MATERIALS/RESOURCES

- An article related to nonuse benefits: <https://theconversation.com/does-nature-have-value-beyond-what-it-provides-humans-47825>
- [Fontana dam is real! Though these roles are fabricated. The dam was built in 1944:](#)

This debate dates back to the building of the Fontana Dam by the Tennessee Valley Authority (TVA) as part of an overarching Tennessee Valley development project. In November of 1944, the gates of Fontana dam, the largest dam in the United States east of the Rocky Mountains, closed, marking one of the biggest successes of the TVA to date. The reservoir behind Fontana dam, Fontana Lake, flooded over 10,000 acres of land once part of the Little Tennessee River valley. Lands that that used to be communities, farms and cemeteries were lost. In addition, Highway 288, the only road providing access to many communities in this part of Swain County, was flooded. Once the TVA finished constructing Fontana Dam, the surrounding land became a part of the Great Smoky Mountains National Park. As a result of the reservoir and the inclusion of the remaining nearby land into the Great Smoky Mountains National Park, numerous families were displaced from their homes and relocated to surrounding counties. After resettlement became inevitable, an agreement now referred to as “The 1943 Agreement” was drafted to appease those being displaced by the Fontana Project. A complex agreement between Swain County, North Carolina, the Department of the Interior, and TVA was made, which promised the rebuilding of the North Shore Road so old homesteads could be accessed. Construction of the road began in



1948 and continued slowly until the 1970s. In 1973, road construction was halted due to environmental and engineering concerns. What resulted was a seven-mile stretch of road that abruptly comes to a dead end in the Great Smoky National Park and thus is referred to by many as the “Road to Nowhere.” (“A ‘Road to Nowhere’” Kerr, 2006)



ENVIRONMENTAL VALUATION ACTIVITY

Environmental Valuation Activity

1. _____ Clean Water
2. _____ Clean Air
3. _____ Old growth forest
4. _____ Zoos
5. _____ Aquariums
6. _____ Wood/lumber
7. _____ City parks
8. _____ Food Gardens
9. _____ Botanical Gardens
10. _____ Habitats for Endangered Species
11. _____ Land for Crop Production
12. _____ Pollinating Bees

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SCENARIO DESCRIPTION:

The Army Corps of Engineers is deciding if they should approve the creation of a new hydropower dam on the Little Tennessee River in Swain and Graham counties in North Carolina, United States. The proposed dam will accommodate recent increases in electricity demands in the western part of North Carolina and eastern part of Tennessee, called the Tennessee valley. Proponents of the dam say that the increased power from the dam would allow for more economic growth in the area.



Figure 1. A map showing the location of Swain county North Carolina.

The proposed dam would be the tallest dam east of the Mississippi at 480 feet tall and would generate 238.5 MW of power, which could power 854,000 people each year. The dam would create a lake (upstream of the dam) called Fontana Lake with 238 miles of shoreline and 10,230 acres of water. Over 40,000 acres along Fontana Lake's north shore would be transferred to the Great Smoky Mountains National Park, and several thousand acres along the south shore would be transferred to the U.S. Forest Service.

The building of Dam and its reservoir would require the purchase of 68,292 acres of land, 5,125 acres of which are forested and must be cleared. To build the dam, 1,311 families, 1,047 graves, and over 60 miles of roads must be relocated. The towns of Fontana, Bushnell, Forney, and Judson would be completely flooded. These towns are small towns whose families have lived in the area for generations. The communities rely on agriculture, raising livestock, hunting, and fishing for a living.

There is also the possibility that the dam flooding would completely cover the single highway to another town called Bryson, which would make it difficult for residents of this town to travel to and from their homes. The residents of Bryson are very concerned about this possibility.





Residents of Bryson, North Carolina:

You live in a mountain town along the Tennessee river upstream of the proposed dam location. Your town is an agricultural town with many small plots of corn and various other vegetables. You raise sheep for wool clothing and grow small orchards. People in your town take advantage of surrounding forests by hunting, gathering roots, fishing in creeks, and letting livestock graze in wooded areas. The people of your town also raise hogs.

Where would your concerns lie as a resident of Bryson?

What positives would the dam bring?

What negatives would the dam bring?

Based on your positives and negatives, would you be in favor or not in favor of the proposed dam?

Options:

1. Build the dam as is described with the stipulation that if the highway to Bryson floods, then the Army Corps of Engineers will build a new highway.
2. Do not build the dam.

Residents of Fontana, North Carolina:

You live in a mountain town along the Tennessee river upstream of the proposed dam location. Your town is an agricultural town with many small plots of corn and various other vegetables. You raise sheep for wool clothing and grow small orchards. People in your town take advantage of surrounding forests by hunting, gathering roots, fishing in creeks, and letting livestock graze in wooded areas. The people of your town also raise hogs.

What positives would the dam bring?

What negatives would the dam bring?

Would anything change if the government offered to compensate you with money for your house and land?

Based on your positives and negatives and the compensation, would you be in favor or not in favor of the proposed dam?

Options:

1. Build the dam as is described with the stipulation that if the highway to Bryson floods, then the Army Corps of Engineers will build a new highway.
2. Do not build the dam.





Figure 1. A map of communities that would be displaced by the dam creation.

The proposed plan would create a new village for construction workers and families. The creation of the dam is estimated to give 5,000 jobs and the dam creation would last 3 years. The creation of 5,000 jobs would be much needed in a struggling economy. The total estimated cost of the dam is \$954,517,766.



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Residents of Weaverville, North Carolina

You live in a small town near Asheville, North Carolina, which is a 2-hour drive from the proposed dam location. Your town has faced recent economic hardship in recent years, and many people are without jobs due to economic downturn during the recent recession. You had previously worked in construction but are now without a job.

What positives would the dam bring to you or your town?

What negatives would the dam bring to you or your town?

What about the residents downstream? Would this influence your decision?

Based on your positives and negatives and the job opportunities, would you be in favor or not in favor of the proposed dam?

Options:

1. Build the dam as is described with the stipulation that if the highway to Bryson floods, then the Army Corps of Engineers will build a new highway.
2. Do not build the dam.

Residents of Raleigh, North Carolina

You live in Raleigh, North Carolina which is a 6-hour drive to the proposed dam location. You have a job working in downtown Raleigh. You are comfortable with your current job and lifestyle. During long weekends, you like to travel to the western part of the state to go on hikes and camping trips and enjoy the outdoors. You are also an environmental conscious resident

What positives would the dam bring to you or your town?

What negatives would the dam bring to you or your town?

Do the benefits of the dam outweigh the cost of the dam?

Based on your positives and negatives and the benefits/costs, would you be in favor or not in favor of the proposed dam?

Options:

1. Build the dam as is described with the stipulation that if the highway to Bryson floods, then the Army Corps of Engineers will build a new highway.
2. Do not build the dam.





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Residents of Durham, North Carolina

You are an environmentalist living in Durham, North Carolina, which is several hours from the proposed dam location. You have spent many years studying the effects of different types of energy sources on the local environments, people, and economics. You are a researcher at a university, and you spend time reading about renewable energy, fossil fuels, and social impacts.

What positives would the dam bring to you or your town?

What negatives would the dam bring to you or your town?

Do the benefits of the dam outweigh the cost of the dam? What other potential energy options could be used?

Based on your positives and negatives and the benefits/costs, would you be in favor or not in favor of the proposed dam?

Options:

1. Build the dam as is described with the stipulation that if the highway to Bryson floods, then the Army Corps of Engineers will build a new highway.
2. Do not build the dam.

Residents of Waynesville, NC

You are a local business owner in Waynesville, North Carolina, which is 1 hour and 15 minutes away from the proposed dam location. You own a small business in downtown Waynesville, which is nestled between nearby cafes, restaurants, and art galleries. Your business thrives on tourism from people traveling to see the Blue Ridge mountains and exploring western North Carolina. You are also thinking about energy costs for your small business.

What positives would the dam bring to you or your town?

What negatives would the dam bring to you or your town?

What about the residents being directly affected? Would this influence your decision?

Based on your positives and negatives and the benefits/costs, would you be in favor or not in favor of the proposed dam?

Options:

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2. Do not build the dam.





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INSTRUCTOR VERSION:

Participants:

1. Residents of Bryson, North Carolina (2 people):

You live in a mountain town along the Tennessee river upstream of the proposed dam location. Your town is an agricultural town with many small plots of corn and various other vegetables. You raise sheep for wool clothing and grow small orchards. People in your town take advantage of surrounding forests by hunting, gathering roots, fishing in creeks, and letting livestock graze in wooded areas. The people of your town also raise hogs.

You are concerned that the cutting down of many trees will change your lifestyle and will leave you without economic resources. You are cautiously optimistic that the dam will bring more economic growth to the region and will lead to greater access to jobs and economic resources. However, you are also worried that if the highway to your town floods, it might take many years to build a new road leaving you without convenient access to other nearby towns. As a result, you are not in favor of the dam creation at the proposed location.

2. Residents of Fontana, North Carolina (2 people):

You live in a mountain town along the Tennessee river upstream of the proposed dam location. Your town is an agricultural town with many small plots of corn and various other vegetables. You raise sheep for wool clothing and grow small orchards. People in your town take advantage of surrounding forests by hunting, gathering roots, fishing in creeks, and letting livestock graze in wooded areas. The people of your town also raise hogs.

You are against the dam because it will force you to relocate and your home will be completely flooded. Your family has lived in the area for several generations, and you are sad and angered by the possibility of losing your home. The government has offered to compensate you with some money for your house and land, but you do not feel that the money matches the worth of the house and the land. You plan to file a lawsuit against the government for taking your land if they decide to go through with this plan.

3. Residents of Weaverville, North Carolina (2 people)

You live in a small town near Asheville, North Carolina, which is a 2-hour drive from the proposed dam location. Your town has faced recent economic hardship in recent years, and many people are without jobs due to economic downturn during the recent recession. You had previously worked in construction but are now without a job.

You are in favor of the dam creation because you believe that the increased power output from the dam will lead to economic growth in the area. You are also hoping to get one of the construction jobs creating



the dam. You regret that a few people will have to relocate their homes, but you believe that the economic benefit to the region of western North Carolina is worth this cost.

4. Residents of Raleigh, North Carolina (2 people)

You live in Raleigh, North Carolina, which is a 6-hour drive to the proposed dam location. You have a job working in downtown Raleigh. You are comfortable with your current job and lifestyle. During long weekends, you like to travel to the western part of the state to go on hikes and camping trips and enjoy the outdoors.

You are in favor of the dam because you are impressed by the government's desire to use natural renewable resources while, at the same time, protecting natural landscapes for the enjoyment of future generations. You are impressed that the plan includes increased protected National Park lands. You are unhappy that trees need to be cut down for the creation of the dam, but you believe that the protection of the larger forested land will be better overall for the natural landscape in the long run. As a result, you are in favor of the creation of the dam.

5. Residents of Waynesville, NC (2 people)

You are a local business owner in Waynesville, North Carolina, which is 1 hour and 15 minutes away from the proposed dam location. You own a small business in downtown Waynesville, which is nestled between nearby cafes, restaurants, and art galleries. Your business thrives on tourism from people traveling to see the Blue Ridge mountains and explore western North Carolina.

You are in favor of the dam because you believe that the local dam will reduce energy costs because there will be a decreased need to import fossil fuels to the area. You also are in favor of the dam because the increased national park will bring a greater number of tourists to the area who will also stop at your business and stay in your town when they travel to visit the mountains.

6. Residents of Durham, North Carolina (2 people)

You are an environmentalist living in Durham, North Carolina. You have spent many years studying the effects of different types of energy sources on the local environments, people, and economics. You are a researcher at a university, and you spend time reading about renewable energy, fossil fuels, and social impacts.

You are against this creation of a dam in Fontana. While in general you are in favor of renewable resources, you believe that, in this case, the costs to the local population would not justify the benefits of hydropower given that there are other avenues for renewable energy including solar and wind sources. You are also concerned about the downstream effects of the dam and the possibility that it could negatively impact plants and animals that live downstream.

