

Extinction and What We Eat

Lesson Overview:

In this lesson, students investigate the relationship between extinctions and human activities, including food production. Students *Racing Extinction* video clips to understand the scale of global extinctions. Activities include analyzing their own diets, by keeping a log of food eaten and quantifying the footprint of dietary choices. Students also compare maps of modern agriculture with environmental impacts and investigate the correlation between the decline of wildlife and human population increase.

Racing Extinction Video Clips:

- **Video Clip 1: Destroying Our Oceans**

This clip reveals how human activities like habitat destruction, overfishing, and carbon dioxide emissions are destroying Earth's oceans.

- **Video Clip 2: Change Your Diet, Save the World**

This clip examines the environmental impact of humanity's dietary dependence on meat, milk, and eggs.

- **Video Clip 3: An Encounter with a Manta Ray**

In this clip, Marine conservationist Shawn Heinrichs describes a special encounter with a manta ray in distress.

Lesson Duration: Up to two 45-minute sessions

Essential Questions:

- What is the relationship between food production and extinction?
- What is the impact of food production on habitat loss, carbon dioxide emissions, pollution, the decline of crop diversity, and soil erosion?
- What is the correlation between human population increase and consumption and decline of fish stocks and increased meat production?
- How does increased human population impact consumption & agriculture?
- How do different types of food production differ in their impacts on extinction and climate?

Objectives:

Students will:

- Describe the relationship between food production and extinction
- Use data to show environmental impacts of modern agriculture including habitat loss, CO2 emissions, pollution, decline of crop diversity, and soil erosion
- Demonstrate the statistical correlation between human population increase and consumption with decline of fish stocks and increased meat production
- Illustrate how increased human population impacts consumption and modern agriculture
- Quantify the footprint of their dietary choices to show how different types of food production differ in their impacts on extinction and climate

Standards:

- *Next Generation Science Standards*
 - HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
 - HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- *Common Core State Standards*
 - 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.
 - RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
 - WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize

multiple sources on the subject, demonstrating understanding of the subject under investigation.

- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.
- HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Materials Needed:

- Computer or mobile device with Internet access
- Graphics software (optional)

Teacher Preparation:

- Watch *Racing Extinction* video clips, or the entire documentary if possible
- Review online resources provided in lesson
- Consider strategies for ELL, struggling and accelerated students
- A week before the lesson, guide students to keep a log of food eaten during one week. Consider keeping your own log as an example to guide students. There are numerous free resources for creating an online food log, such as the [USDA SuperTracker](#). Several smart phone apps are also available. Alternatively, students can make their food log in a spreadsheet or in their notebooks. For this activity, ensure that the log includes:
 - Date
 - Meal eaten, including breakfast, lunch, dinner, or snack.
 - Items eaten. Students need only to use general categories such as meat, fish, dairy, vegetable, and so on.

Background Information (for the Teacher):

In the *Racing Extinction* documentary, the producers closely examine the causes for the dramatically decreased populations of wildlife across the globe. In particular, they focus on human activities as the cause. (Geologists are now considering officially calling the current geological era The Anthropocene in recognition of the geological scale impacts of humans.) In this lesson, students explore these causes. Students evaluate the evidence for causal links between human activities and environmental change, focusing on the correlations between the increase in human population and declines of wildlife. In particular, students investigate the connections between their dietary choices and the impacts of modern agriculture and fisheries.

Key learning points for this lesson:

- Scientists consider agriculture and commercial fisheries to be among the primary drivers of wildlife population declines and potential extinctions. As food production increases, wildlife populations are expected to decline, leading to species extinctions.

- Food production negatively affects the environment in numerous ways, causing habitat loss, increased carbon dioxide emissions and pollution, declines in crop diversity, and rapid soil erosion.
- Human population negatively impacts many wildlife populations, including fish stocks (a negative correlation between human and wildlife populations). As the human population increases so does total food consumption (a positive correlation).
- The increase in food production results in declines of fish stocks. Increased meat production also results in habitat loss, increased carbon dioxide emissions and pollution, declines in crop diversity, and rapid soil erosion. Grain production also results in these impacts, and around 70 percent of grain production is dedicated to feeding farm animals.
- Different types of food production differ significantly in their impacts on extinction and climate. Such differences offer potential solutions to the impact of food production if people can be persuaded to shift dietary preferences. For example:
 - Production of chicken takes 4 parts of energy for each part of protein produced (a 4:1 ratio), while beef takes 54 parts of energy for each part of protein produced (54:1).
 - Producing a kilogram of beef requires 100,000 liters of water, compared with 3,500 liters for a kilogram of chicken and 500 liters for a kilogram of potatoes.
 - Aquaculture is a promising alternative to wild fisheries. By 2020, aquaculture is expected to overtake wild fisheries as the world's main source of seafood. However, aquaculture of some species is heavily dependent on wild-caught food fish.

ENGAGE

1. To engage students initially, show them a photo or pack of your favorite food.
2. Ask students to write a list of their favorite foods.
3. Show the class the *Racing Extinction* video clip: *Destroying Our Oceans*.
4. Students write in their notebooks three things that they could do personally to prevent further destruction of our oceans.
5. By a show of hands, tally how many students in the class suggest changing or modifying their diets to prevent further destruction of our oceans.
6. Working individually, students create a menu of their typical daily food consumption.
7. Present the class with a guiding question such as, "In what ways does food production contribute to the destruction of the environment and species extinctions?"

EXPLORE

1. Working in groups, students watch the *Racing Extinction* video clip: *Change Your Diet, Save the World*.
2. Working in small groups, students role play a team of advisors to a chef at a top restaurant. The job of the team is to create a dream meal that has a minimal environmental impact. As the team adds meal items to their plate (i.e., a hamburger), they track the resources that go into that item (i.e., grain to feed livestock, water, forest to clear the land, etc).
3. Each group then presents its dream meal to the class, which votes on the best meal for a combination of appeal and low environmental impact.
4. Students work in groups to estimate their total annual animal protein (meat and fish) consumption. Encourage students to consider various units to quantify their impact including biomass, calories or resources such as soil and water.
5. The group researches online to gather data on environmental impacts of modern agriculture, based on maps of modern agriculture and other resources. Ensure that each group's table of environmental impacts includes habitat loss, carbon

- dioxide emissions, pollution, the decline of crop diversity, and soil erosion. For summary information:
- a. [ScienceDaily](#): Agriculture, food production among worst environmental offenders, report finds
 - b. [Cornell University](#): U.S. could feed 800 million people with grain that livestock eat, Cornell ecologist advises animal scientists
 - c. [BBC](#): Agricultural Revolution in England 1500 - 1850
6. Each group develops a concept map, data table, or graphic organizer to categorize effects of agriculture and pollution on habitat loss. Ensure that each group's graphics include their answer to the guiding question, as well as supporting evidence and explanation of why the evidence supports the answer. Encourage groups to quantify their findings, using graphs and other graphical representations of data.
 7. Allow groups to interact and discuss each other's graphics, sharing findings and critiquing answers to the guiding question as well as their evidence.

EXPLAIN

1. Each group presents its graphic organizer to the class, stating how their evidence supports the reasoning behind their conclusions. Encourage groups to explain how they changed or modified their initial conclusions based on their discussions with other groups.
2. Return to the core idea presented with the guiding question and lead a discussion about various answers to the guiding question. Motivate students to discuss other ways they would collect evidence to support their answers. Encourage students to discuss the role of the scientific method in approaching complex questions about the environment, conservation and societal and human needs.

ELABORATE

1. Students watch the *Racing Extinction* video clip: *An Encounter with a Manta Ray*.
2. Students write a short passage on the connection between human activities and resource depletion. The passage should focus on how local communities sometimes have little choice but to exploit the most readily available resources.
3. Working in groups, students explore online resources to describe the statistical correlation of decline of fish stocks and increased meat production with human population increase. Groups should obtain data to calculate a correlation coefficient for the relationship between human population, decline of fish stocks, and meat production. Websites with information on the relationship between population and extinctions:
 - a. Center for Biological Diversity: [Human Population Growth and Extinction](#)
 - b. *Proceedings of the National Academy of Sciences*: [Unexpected patterns of fisheries collapse in the world's oceans](#)
 - c. GRID-Arendal/UNEP: [Impacts On Biodiversity And Ecosystems From Conventional Expansion Of Food Production](#)
 - d. *Scientific American*: [Aquaculture May Replace Wild Fish Stocks](#)
4. Each group chooses a case study of a particular decline in food-related resources and the consequent impacts on local communities. Possible examples include the collapse of the North Atlantic cod fishery, destruction of tropical rainforests, and the link between overgrazing and famine in the Sahel region of North Africa. Example articles:
 - a. *Nature*: Fisheries: [What's the catch?](#)
 - b. Mongabay: [Impact Of Deforestation: Local And National Consequences](#)
 - c. Texas A&M University, Department of Geosciences: [Desertification In The Sahel](#)
5. Working individually or in small groups, students brainstorm specific activities that publicize and educate about dietary choices. Students create a list of possible activities and discuss which are feasible to implement in a class setting. (They can later use this list as possible projects for Lesson 4.)

6. If time allows, students can also investigate the concept of the “tragedy of the commons,” an economic theory in which depletion of a shared resource results from the self-interested behavior of small groups of people. Articles referring to the Tragedy of the Commons:
- BBC: [How the world’s oceans could be running out of fish](#)
 - New Scientist*: [‘Shares’ in fish stocks halt commercial free-for-all](#)
 - University of Vermont: [Tragedies of the Commons in Modern Agriculture](#)

EVALUATE

Working individually students complete the following constructed responses.

- Write a short passage describing the relationship between food production and extinction.
- Which of the following has the greatest impact on food production: habitat loss, carbon dioxide emissions, pollution, the decline of crop diversity, or soil erosion? Justify your answer.
- Explain how human population increase and consumption has led to the decline of fish stocks and increased meat production.
- Compare and contrast different types of food production in their impacts on extinction and climate.

EXTENSION

For additional interest, students can continue to keep their food logs for an additional one or two weeks.

- Choose a schedule for students to follow up the lesson to see if their dietary choices have changed and discuss why or why not. Depending on how long students keep their logs, they can track their data using graphical organizers such as pie charts or line diagrams.

For follow-up research and activities

- [NOAA Fisheries Education Program](#)
- [IDRC: Agriculture and Environment](#)