Sustainability of our food chain – Teacher Guide

Overview of activities:

These activities encourage students to investigate links between food production and species extinction across the world. Students explore the scale of global extinctions by watching the Racing Extinction video clips. Activities include analysing their own diets by keeping a food log and quantifying the carbon footprint of their dietary choices. Students also consider the environmental impacts of modern agriculture and investigate the correlation between the growing human population and the decline of wildlife.

Curriculum links:

- Geography: Globalisation
    - Positive and negative repercussions of the global search to meet the increasing demand for food
- Geography: Sustainable management
    - Sustainability of eco-systems and the disruption of food webs and nutrient cycles, which can lead to extinction
- Biology: Extinction
    - Causes of extinction including changes to the environment and new predators
- Food Technology: Social, ethical, economic, and environmental issues
    - Consider sustainability in the use of scare resources and factors that influence food production

Racing Extinction video clips:

Links to these videos can be found within the “Lesson resources” download, via http://www.discoveryeducation.co.uk/racingextinction.

- **Video clip 1: *Destroying our oceans***

    This clip reveals how human activities — such as 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.

Objectives:

Students will…

- Describe the relationship between food production and species extinction.
- Use data to show environmental impacts of modern agriculture.
- Explain how increased human population impacts modern agriculture.
- Discuss the correlation between human population increase and the decline of fish stocks and increased meat production.
- Examine their dietary choices and consider how different types of food production methods differ in their impacts on climate change and species extinction.

Questions:

- How might food production impact the environment?
- How has agriculture evolved over time?
- What factors affect fish stocks?
- How does change in human population affect agriculture?
- How do different methods of food production compare, considering impacts on (i) the environment (ii) species extinction?
- What are the connections between climate change and species extinction?

Teacher preparation:

- Watch the Racing Extinction video clips
- A week before the lesson, ask students to keep a log of the food they eat during one week. Consider keeping your own log as an example to students. There are numerous websites and smart phone apps for creating an online food log. Alternatively, students write their food log in a spreadsheet or in their notebooks.

  Ensure that the log includes:
  - date
  - meal type / time (i.e. breakfast, lunch, dinner, or snack)
  - items eaten
  - food quantities (optional)

Background information:

In the Racing Extinction video clips, the producers examine the causes for the dramatic fall in the populations of wildlife across the globe. In particular, they focus on human activities as a significant contributing factor. Geologists are now considering officially calling the current geological era the Anthropocene, in recognition of the extensive impact of human activities on the world's ecosystems. In these activities students evaluate the evidence for causal links between human practices and environmental change.

Key learning points:

- Scientists consider agriculture and commercial fisheries to be among the primary drivers of the fall in wildlife populations and potential extinctions.
- Some methods of food production have long-lasting effects on the environment, causing habitat loss, increased carbon dioxide emissions and pollution, declines in crop diversity, and rapid soil erosion.
- The rapid growth of the human population has negatively impacted many wildlife populations, including fish stocks. As the human population increases so does total food consumption.

- Types of food production methods differ significantly in their impacts on the environment and species extinction. Such differences offer potential solutions to reduce the negative effects of food production, if people can be persuaded to shift dietary preferences.

  For example:
  - The 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 litres of water, compared with 3500 litres for a kilogram of chicken and 500 litres for a kilogram of potatoes.
  - Aquaculture (the farming of aquatic organisms under controlled conditions) 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 fish food.

Starter activity

1. Bring your favourite food into class and discuss how the ingredients were sourced.
2. Ask students to write a list of their favourite foods and discuss how ingredients could be sourced.
3. Show the class the Racing Extinction video clip: *Destroying our oceans.*
4. Students write in their notebooks three things that they could personally do 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. 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 affect the environment and organisms in our world?'.

Main activity 1

1. Students watch the Racing Extinction video clip: *Change your diet, save the world*. Working in small groups, they role play a team of advisors to a chef at a 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 (e.g. a chicken curry), they track the resources that go into that item (e.g. grain to feed chickens, water, farmland, transportation, etc.).
2. Each group then presents their dream meal to the class and votes are cast for the best meal, on the criteria of appeal and low environmental impact.
3. Students work in groups to estimate their total annual animal protein consumption. Encourage students to consider various units to quantify their impact, including biomass, calories or kilograms.
4. Groups research the environmental impacts of modern agriculture, gathering data online. Ensure that each group's table of environmental impacts includes commentary on the effect on:
    - habitats
    - pollution including carbon dioxide emissions
    - crop diversity
    - soil erosion
5. Each group develops a concept map, table of results, or other graphic organiser to present their findings. Ensure that each group includes answers to the guiding questions, as well as supporting evidence. Encourage groups to quantify their findings, using graphs and other graphical representations of data.
6. Each group presents its graphic organiser to the class, stating how their evidence supports the reasoning behind their conclusions. Allow groups to interact and discuss each other's graphics, sharing findings and critiquing answers to the guiding question, as well as their evidence.
7. Return to the lesson's objectives with the guiding questions and lead a discussion about various answers to the guiding questions.

Main activity 2

1. Students watch the Racing Extinction video clip: *An encounter with a manta ray*. In some parts of the world, manta rays are hunted for their flesh and have become a lucrative trade.
2. They should then write a short passage on the connection between human activities and resource depletion. The passage could mention 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 consequences of human population growth, with a focus on sustaining food supplies. Websites with information to support:
    - New Scientist: Europe is rapidly losing its biodiversity and wildlife habitats
    - GRID-Arendal / United Nations Environmental Programme (UNEP): Impacts on biodiversity and ecosystems from conventional expansion of food production
    - 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:
    - Nature: Fisheries: What's the catch?
    - New Scientist: Top 10: Conservation successes and failures
    - Texas A&M University, Department of Geosciences: Desertification in the Sahel

Plenary activities

- Write a short passage describing the connection between food production and species 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.
- Give three bullet points describing how modern agriculture might have to change to become more sustainable.
- Compare and contrast the food production of meat with vegetables.

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 organisers such as pie charts.

If time allows, students can also investigate the concept of the 'tragedy of the commons'; an economic theory in which shared resources deplete as a result of the self-interested behaviour 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

For follow-up research

- Defra: Department for Environment, Food & Rural Affairs
- National History Museum: Angela Marmont Centre for UK Biodiversity