POLAR TREC
Learning Resources

Details

Completion Time: Less than a week

Permission: Download, Share, and Remix

Why Can't I Eat this Fish?

Overview

Students will discover how a simple action such as turning on a television will lead to toxins in our food supply. Many of these toxins concentrate in the Arctic because of long-range transport of pollutants in the atmosphere. Scientists in the OASIS project (http://www.polartrec.com/ocean-atmosphere-sea-ice-and-snowpack-interactions) study these pollutants in the Arctic. Students will learn about actions that they can take to reduce these pollutants.

Objectives

Methylmercury and POPs (Persistent Organic Pollutants) are toxins that bioaccumlate in organisms. These toxins have entered our food supply and most people don't understand the situation. After this lesson, students will understand:

- What is happening to the fish and wildlife
- How it is affecting them
- How it is affecting the people and animals in the Arctic
- What government and industry are doing about it
- What they can do about it

Lesson Preparation

Before starting the WebQuest, the teacher should use the "Bioaccumulation of Toxins" assignment to give the students background in toxins, methylmercury, POPs and the concept of bioaccumulation.

1. Show the students how to access the WebQuest on the Internet.
2. Review the following parts of the WebQuest with the students:

a. Introduction
b. Task
c. Process
d. Evaluation

Materials

- WebQuest Worksheet (attached to lesson)
- Computer with Internet Access
- Poster Paper
- Markers
- Crayons
- Glue
- Scissors

e. Conclusion
f. Vocabulary
g. Attachments
3. Part I of the "Process" section contains all of the questions that are one the student worksheet. Each question contains a reference or link to where the student can find the answer. Demonstrate the resources available for the questions:
a. Resources typed in Green Text are available as documents at the bottom of the WebQuest webpage under "Attachments."
b. The pages listed in the EPA POPs pdf file are numbered as seen in the toolbar for the pdf viewer, they are not the page numbers at the bottom of each page.
c. The resources typed in Red Text are available as links to other websites.

Procedure
1. Students will work individually to answer all of the questions within the WebQuest worksheet, utilizing the resources on the WebQuest webpage.
2. Once the research is complete and the worksheet completed, students will work in pairs to create posters.
3. The posters will be used to inform the community about the situation. It will include the following information:
a. How do POPs and Mercury get into our environment?
b. How do POPs and Mercury get into wildlife and our food supply?
c. What are the health effects of ingesting these toxins?
d. What are the EPA recommendations for eating fish?
e. Why is the Arctic at risk?
f. What are the fish advisories for Arizona?
g. What can we do to reduce toxins in our environment?

Extension
N/A

Resources
Webquest address:
http://sites.google.com/site/bioaccumulation/Home

Assessment
The worksheet can be graded for correctness based upon the attached answer key.
Poster: The requirements and grading rubric for the poster is given in the "Evaluation" section of the WebQuest webpage.

Credits
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Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard C: Life Science
d. Populations and ecosystems

Content Standard F: Science In Personal and Social Perspectives
a. Personal health
b. Populations, resources, and environments
d. Risks and benefits
e. Science and technology in society

Content Standards, Grades 9-12

Content Standard F: Science In Personal and Social Perspectives
a. Personal and community health
d. Environmental quality
e. Natural and human-induced hazards
f. Science and technology in local, national, and global challenges

Other Standards

Arizona State Science Standards Grade 7
Strand 3: Science in Personal and Social Perspectives
Concept 1: Changes in Environments
Describe the interactions between human populations, natural hazards, and the environment.
PO 1. Analyze environmental risks (e.g., pollution, destruction of habitat) caused by human interaction with biological or geological systems.
PO 3. Propose possible solutions to address the environmental risks in biological or geological systems.
Concept 2: Science and Technology in Society
Develop viable solutions to a need or problem.
Strand 4: Life Science
Concept 3: Populations of Organisms in an Ecosystem
Analyze the relationships among various organisms and their environment.

Name_____ Period _____ Date_____

Bioaccumulation WebQuest Worksheet

Answer questions in complete sentences. The addresses listed in bold are to help you find the answers within the WebQuest.
Each question is worth 4 points for a total of 100 points.

Background Information

POPs

1. What are POPs? Explain the acronym (abbreviation) and what are the sources of POPs. **Grannas POPs.pdf**

2. What are 4 characteristics that are a main concern of POPs? (Briefly explain each) **EPA POPs.pdf page 5**

3. Where are PCB's intentionally used? **EPA POPs.pdf page 4**

4. Dioxins are unintentionally produced. What processes can produce these on a large industrial scale and what process can produce these in your backyard? **EPA POPs.pdf page 4**

5. What is DDT? (You don't need to give the name for the abbreviation, just what it is used for.) **EPA POPs.pdf page 4**

6. DDT persists in the environment. There was widespread contamination and accumulation of DDT. Who brought this phenomenon to public attention in 1962, and how was it done? **EPA POPs.pdf page 4**

7. The Environmental Protection Agency (EPA) took action in 1972 on DDT. What animal species made a dramatic comeback over the years? **EPA POPs.pdf page 4**

Mercury

8. Why do we have an increased amount of mercury in our environment? **EPA Mercury Background**

9. What is the major source of mercury emissions in our country? List the 3 largest contributors of mercury in our atmosphere. **Why Files Background**

10. According to the chart from the USGS, where are the concentrations of mercury emissions the greatest in our country? **Why Files USGS**

<u>Health Effects</u>

11. What is methylmercury? **EPA Mercury Exposure**

12. What is the main way that people are exposed to methylmercury and POPs? **EPA Mercury Exposure, EPA POPs.pdf page 8**

13. What are the health effects of methylmercury and POP exposure? **EPA Health Effects EPA POPs.pdf page 8**

14. What are 5 factors that determine the severity of the health effects of methylmercury and POPs? **EPA Health Effects** (Ignore first factor that only deals with mercury)

Connections

Arctic

15. Why does the Arctic have a high concentration of POPs and mercury in the environment if there are few sources of these pollutants in the Arctic? **Grannas POPs.pdf, EPA POPs.pdf page 5 (Transboundary Travelers), WWF**

16. What is Dr. Amanda Grannas (OASIS and Villanova University scientist) studying in Barrow, Alaska? **Grannas POPs.pdf**

17. What is Dr. Sandy Steffen (OASIS and Environment Canada scientist) studying in Barrow, Alaska? **Steffen Mercury.doc**

18. Why are indigenous (native) people in the Arctic at risk because of POPs and mercury in the environment? **EPA POPs.pdf page 9, Grannas POPs.pdf, Steffen Mercury.doc**

Local

19. What are the EPA recommendations for eating fish? **EPA Advisories**

20. What are the latest two large recreational lakes where the Arizona Game & Fish department has issued fish advisories and what are the advisories? **AZ G&F Advisories**

Taking Action

21. What was a step that was taken in May 2001 to reduce the POPs around the globe?
EPA POPs.pdf page 3

22. Burning coal for electricity is a large source of mercury in the environment. What are ways that you as an individual can reduce the amount of mercury released by coal utility companies?

23. Compact fluorescent light bulbs contain small amounts of mercury. According to the EPA why are they still a good choice to help reduce mercury in the environment?
MSNBC

24. What should you do to prevent CFLs from adding mercury to the environment?

25. What is one way that you can prevent dioxins from entering the environment?

Name_____ Period _____ Date_____

Bioaccumulation WebQuest Worksheet

Answer questions in complete sentences. The addresses listed in bold are to help you find the answers within the WebQuest. Each question is worth 4 points for a total of 100 points.

Background Information

POPs

1. What are POPs? Explain the acronym (abbreviation) and what are the sources of POPs. **Grannas POPs.pdf**

The acronym POPs is short for Persistent Organic Pollutants. POPs come from many sources, including industrial chemicals, pesticides, and various consumer products.

2. What are 4 characteristics that are a main concern of POPs? (Briefly explain each) **EPA POPs.pdf page 5**

The main concerns of POPs are as follows:

Toxicity – POPs can cause adverse health effects in people and wildlife

Persistence – POPs can stay in the environment for a long time.

Long-Range Transport – POPs can travel a long way from where they are released via wind, water and migratory species.

Bioaccumulation – Toxins can accumulate in higher concentrations in an organism as they move up the food chain.

3. Where are PCB's intentionally used? **EPA POPs.pdf page 4**

PCB's are intentionally used in some industrial applications such as electrical transformers and large capacitors, hydraulic and heat exchange fluids, and as additives to paints and lubricants.

4. Dioxins are unintentionally produced. What processes can produce these on a large industrial scale and what process can produce these in your backyard? **EPA POPs.pdf page 4**

On an industrial scale dioxins are unintentionally produced by burning of municipal and medical waste. In your backyard burning trash can produce them.

5. What is DDT? (You don't need to give the name for the abbreviation, just what it is used for.) **EPA POPs.pdf page 4**

DDT is a pesticide. It is still used in some countries to control malaria-carrying mosquitoes.

6. DDT persists in the environment. There was widespread contamination and accumulation of DDT. Who brought this phenomenon to public attention in 1962, and how was it done? **EPA POPs.pdf page 4**

In 1962 Rachel Carson wrote a book Silent Spring that raised awareness about the widespread contamination and accumulation of DDT in the environment.

7. The Environmental Protection Agency (EPA) took action in 1972 on DDT. What animal species made a dramatic comeback over the years? **EPA POPs.pdf page 4**
The bald eagle made a dramatic comeback after the EPA took action in 1972 to restrict the use of DDT.

Mercury
8. Why do we have an increased amount of mercury in our environment? **EPA Mercury Background**
According to the EPA we have an increased amount of mercury in our environment because of "Human activities, such as burning coal and using mercury to manufacture certain products, have increased the amount of mercury in many parts of the environment including the atmosphere, lakes and streams."

9. What is the major source of mercury emissions in our country? List the 3 largest contributors of mercury in our atmosphere. **Why Files Background**
The major source of mercury emissions in our country is burning coal to make electricity. The three largest contributors are coal utility, coal industrial and municipal waste.

10. According to the chart from the USGS, where are the concentrations of mercury emissions the greatest in our country? **Why Files USGS**
The highest concentrations of mercury emissions are in the Northeastern section of our country.

<u>Health Effects</u>
11. What is methylmercury? **EPA Mercury Exposure**
Microscopic organisms convert inorganic mercury into methylmercury.

12. What is the main way that people are exposed to methylmercury and POPs? **EPA Mercury Exposure, EPA POPs.pdf page 8**
The main way that people are exposed to methylmercury by eating fish and shellfish. The primary way that people are exposed to POPs is by eating contaminated food.

13. What are the health effects of methylmercury and POP exposure? **EPA Health Effects, EPA POPs.pdf page 8**
Methylmercury affects the neurological system. In people, POPs can affect their, reproductive, developmental, behavioral, neurologic, endocrine, and immunologic systems.

14. What are 5 factors that determine the severity of the health effects of methylmercury and POPs? **EPA Health Effects** (Ignore first factor that only deals with mercury)
The 5 factors that determine the severity of the health effects from toxins such as methylmercury and POPs are:
- The dose
- The age of the person exposed (the fetus is the most susceptible);
- The duration of exposure;
- The route of exposure -- inhalation, ingestion, dermal contact, etc.

- The health of the person exposed.

Connections

Arctic

15. Why does the Arctic have a high concentration of POPs and mercury in the environment if there are few sources of these pollutants in the Arctic? **Grannas POPs.pdf, EPA POPs.pdf page 5 (Transboundary Travelers), WWF**

POPs enter the atmosphere and the water and travel a long distance and are deposited into the snow, ice, rain and tundra. They eventually make their way into wildlife.

16. What is Dr. Amanda Grannas (OASIS and Villanova University scientist) studying in Barrow, Alaska? **Grannas POPs.pdf**

Dr. Grannas is studying how POPs move or cycle through the atmosphere, snow, ice and water and how they might change chemically throughout the process.

17. What is Dr. Sandy Steffen (OASIS and Environment Canada scientist) studying in Barrow, Alaska? **Steffen Mercury.doc**

Dr. Steffen is studying mercury levels in the air, snow and ice over the ocean in order to understand how it moves between them and how the Arctic tolerates chemicals such as mercury.

18. Why are indigenous (native) people in the Arctic at risk because of POPs and mercury in the environment? **EPA POPs.pdf page 9, Grannas POPs.pdf, Steffen Mercury.doc**

Native people are at risk from POPs and mercury in the environment because they rely on subsistence hunting for a large portion of their diet. The animals they eat can have high concentrations of these toxins that have bioaccumulated in them.

Local

19. What are the EPA recommendations for eating fish? **EPA Advisories**

The EPA recommendations for eating fish are:

"1. Do not eat Shark, Swordfish, King Mackerel, or Tilefish because they contain high levels of mercury.

2. Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury.

* Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.

* Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. So, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of albacore tuna per week.

3. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week."

20. What are the latest two large recreational lakes where the Arizona Game & Fish department has issued fish advisories and what are the advisories? **AZ G&F Advisories**
On April 24, 2009 the Arizona Game & Fish department issued advisories for largemouth bass at Lake Pleasant, and largemouth bass and channel catfish at Lake Roosevelt because of high mercury levels.

Taking Action

21. What was a step that was taken in May 2001 to reduce the POPs around the globe? **EPA POPs.pdf page 3**
In May 2001 the U.S. teamed up with 90 other countries to sign a treaty called the Stockholm Convention. The countries agreed to eliminate the use, release and production of 12 key POPs.

22. Burning coal for electricity is a large source of mercury in the environment. What are ways that you as an individual can reduce the amount of mercury released by coal utility companies?
As an individual I can reduce my use of electricity. This will reduce the amount of coal that a utility company has to burn to provide me with electricity. This will reduce the amount of mercury released into the environment by burning coal.

23. Compact fluorescent light bulbs contain small amounts of mercury. According to the EPA why are they still a good choice to help reduce mercury in the environment? **MSNBC**
Compact fluorescent light (CFL) bulbs are a good way to reduce mercury in the environment because according to the EPA coal-fired power plants release four times more mercury to power an incandescent bulb than to power a CFL.

24. What should you do to prevent CFLs from adding mercury to the environment?
You can prevent CFLs from adding mercury to the environment by properly recycling them when they burn out. If one breaks, carefully pick up and dispose of the bulb.

25. What is one way that you can prevent dioxins from entering the environment?
You can prevent dioxins from entering the environment by not burning trash that can release them.