Raptor Detectives

Objective

The student will identify three threats to raptor populations.

Materials

per class:

- ❑ Library or internet access
- ❑ Raptor Population Puzzle funsheet
- ❑ Raptor Population Puzzle Answer Guide
- ❑ large bowl

Preparation

Photocopy the raptor population puzzle funsheet. Cut the puzzle cards, fold in half and place in a bowl for students to choose. Make sure there are enough cards in the bowl for each student group to have one.

Action

1. Explain that the students will be assigned to a particular raptor puzzle. The puzzle consists of several events that have taken place. The students will have to define various raptor terminology, identify the relationship between the events listed, and place the events in chronological order to solve the puzzle.
2. Divide the class into student groups of three or four. Instruct each student group to draw a raptor puzzle out of the bowl and allow time for student groups to collaborate.
3. Instruct students to present the results of their investigation to the class. The teacher will check the students' results using the Raptor Population Puzzle Answer Guide.

Raptor Population Puzzle 1

- Bacteria
- Decrease in raptor populations
- Human health ailments after eating fish
- Inorganic Mercury
- Increase in raptor populations
- Coal burning power plants
- Organic Methylmercury (MeHg) in fish tissue samples
- Carbon injection system installations

1. Define the following terms from the puzzle pieces above: methylmercury, carbon injection systems, bacteria, inorganic, organic, toxic and mercury.

2. What is the relationship between the puzzle pieces?

3. Place the puzzle pieces in the chronological order they probably occurred.

Raptor Population Puzzle 2

- DDT
- DDE
- Increase in pesticide usage
- Decrease in Eagle populations
- Eagle populations starting to rebound
- Thinning of egg shells
- Ban of DDT in United States
- Bio Magnification

1. Define the following terms from the puzzle pieces above: biomagnification, DDT, pesticide and DDE.

2. What is the relationship between the puzzle pieces?

3. Place the puzzle pieces in the chronological order they probably occurred.

Raptor Population Puzzle 3

- Decrease in raptor populations
- Increase in raptor populations
- PCBs
- The production of sterile raptor eggs
- Industrial dumping
- Fat tissue from fish has high toxicity
- Environmental Protection Agency enforces the Environmental Protection Act which regulates the disposal and destruction of PCBs.
- Biomagnification
- Insulation for transformers, rubber, plastics, flame retardants, paints, and dyes

1. Define PCBs, sterile, biomagnification, toxic, chlorination, and biphenyl.

2. What is the relationship between the puzzle pieces?

3. Place the puzzle pieces in the chronological order they probably occurred.

Raptor Population Puzzle 4

- Secondary poisoning
- Increase in California condor populations
- Decrease in California condor populations
- Lead
- Immune suppression, neurological and tissue damage in predator and prey
- Increased Hunting
- Non-toxic shot
- Lead contaminated soils
- Steel

1. Define the following terms from the puzzle pieces above: secondary poisoning, lead, neurological, immune response, immune suppression, and non-toxic shot.
2. What is the relationship between the puzzle pieces?
3. Place the puzzle pieces in the chronological order they probably occurred.

Raptor Population Puzzle 5

- Increase in raptor populations
- Aspiration
- Decrease in raptor populations
- Increased oil spills
- Hypothermia
- Petroleum ingestion
- Feathers reduced thermal properties
- Contaminated prey
- Refined oil toxic to avian embryos
- Increased risk management measures and clean-up procedures such as booms, skimmers, sorbents, chemical dispersants, in-situ burning, and vacuum trucks

1. Define the following terms from the puzzle pieces above: petroleum, booms, skimmers, sorbents, chemical dispersants, in-situ burning, vacuum trucks, aspiration, hypothermia, hydrocarbon, and viscosity.
2. What is the relationship between the puzzle pieces?
3. Place the puzzle pieces in the chronological order they probably occurred.

Raptor Population Puzzle 6

- Collection of raptor eggs, nests, or feathers
- Decrease in golden eagle populations
- Increase in golden eagle populations
- Migratory Bird Treaty Act
- Raptor hunting because they are viewed as competitors for domestic animals
- Invasion of golden eagle nesting trees
- Bald Eagle Act

1. Define the following terms from the puzzle pieces above: Migratory Bird Act, Bald Eagle Act, raptor, and identify the range of the golden eagle.
2. What is the relationship between the puzzle pieces?
3. Place the puzzle pieces in the chronological order they probably occurred.

Raptor Population Puzzle Answer Guide

Puzzle 1 Answers

1. Decrease in raptor populations
2. Coal burning power plants
3. Inorganic mercury
4. Microbes
5. Organic methylmercury (MeHg) in fish tissue samples
6. Human health ailments after eating fish
7. Carbon injection system installations
8. Increase in raptor populations

Definitions:

Methylmercury—A dangerous form of organic mercury. Microbes in the environment process sulfate (SO4) and take up inorganic mercury; through a metabolic process, it converts to methylmercury. This dangerous organic form of organic mercury potentially causes damage to the brain, spinal cord, kidneys, and liver.

Inorganic—Being or composed of matter of other than plant or animal origin.

Organic—Relating to or derived from living things.

Toxic—Relating to or caused by a poison or toxin.

Carbon injection systems—A method for controlling mercury emissions into the environment. (Mercury adheres to activated carbon).

Mercury—Mercury is a heavy metal that naturally occurs in soil and water. It may be present in both organic and inorganic forms.

Bacteria—Unicellular microorganisms

Relationship between Puzzle Pieces:

When there is a decrease in animal population size, researchers want to identify the causes. In this puzzle, there was a decrease in raptor populations around an area that had several coal burning power plants. These power plants were releasing inorganic mercury into the air. This inorganic mercury was taken up by various sulfate processing microbes (bacteria) that metabolized these elements and turned them into organic methylmercury (MeHg). MeHg is a toxic compound that accumulates in the muscle tissue of fish. Humans may consume the contaminated fish and become ill. Additionally, raptors that consume fish as part of their diet may accumulate toxic levels of MeHg in their bodies. As a result the raptor populations decrease. Methylmercury can cause severe damage to the brain, spinal cord, kidneys, and liver.

Once the carbon injection systems are installed in the coal-burning plants, this reduces the amount of mercury emitted into the air. Thus, reducing the amount of MeHg produced and increasing the raptor populations.

Raptor Population Puzzle Answer Guide cont.

Puzzle 2 Answers

1. Increase in pesticide usage
2. Biomagnification
3. DDT
4. DDE
5. Thinning of egg shells
6. Decrease in eagle populations
7. Ban of DDT in United States
8. Eagle populations starting to rebound

Definitions:

DDT— (dichlor-diphenyl-trichloroethane) is a chemical that was used as a pesticide after World War II. Problems related to extensive use of DDT began to appear in the late 1940s. Many species of insects developed resistance to DDT, and it was also discovered to have a high toxicity toward fish. Additionally, DDT is not metabolized rapidly by animals; instead, it is deposited and stored in the fatty tissues. The biological half-life of DDT is about eight years (takes about eight years for an animal to metabolize half of the amount it consumes). DDT builds up within the animal over time if ingestion continues steadily. DDT was banned in the United States in 1973, although it is still in use in some other parts of the world.

DDE—(1,1-dichloro-2,2-bis(chlorophenyl) ethylene) DDT in soil usually breaks down to form DDE. DDE is a stable chemical that remains in the environment for an extended period of time. This chemical can have similar health related concerns as DDT.

Biomagnification—A process that results when a poison or toxin is continuously concentrated as it passes up the food chain.

Pesticide—chemical used to kill animals or plants.

Relationship between Puzzle Pieces:

There is a direct correlation between pesticide usage and the amount of DDT located in the environment. As one of these factors increases or decreases so does the other. DDT was widely used as a pesticide after World War II. However this chemical seeps into the soil and ends up in waterways (through natural filtration, drainage systems and rain). This chemical is consumed by various aquatic animals. Biomagnification occurs when a poison or toxin (such as DDT) becomes concentrated as it passes up the food chain. DDE is the chemical that results when DDT breaks down in the environment and can have similar health related concerns to DDT. Raptors such as eagles ingest high quantities of DDT through their prey such as fish once the amounts have been biomagnified up through the food chain. This results in raptor eggs having very thin egg shells that crush under the weight of the female raptor incubating them. The raptor populations decrease because fewer eggs are being hatched. Once the ban of DDT was put into effect (1973 for the United States), eagle populations as well as other raptors started to rebound.

Raptor Population Puzzle Answer Guide cont.

Puzzle 3 Answers

1. Increased industrial dumping
2. PCBs
3. Insulation for transformers, rubber, plastics, flame retardants, paints and dyes
4. Biomagnification
5. Fat tissue from fish has high toxicity
6. The production of sterile raptor eggs
7. Decrease in raptor populations
8. Environmental Protection Agency enforces the Environmental Protection Act
9. Increase in raptor populations

Definitions:

PCBs—(Polychlorinated biphenyls) Is a category, or family, of chemical compounds formed by the addition of Chlorine molecules to Biphenyl (C12H10), which is a dual-ring structure comprising two 6-carbon Benzene rings linked by a single carbon-carbon bond. PCBs may be in liquid or solid form.

Sterile—Having no reproductive capability.

Biomagnification—A process that results when a poison or toxin is continuously concentrated as it passes up the food chain.

Toxic—Relating to or caused by a poison or toxin.

Chlorination—The addition of chlorine molecule (s) to a compound.

Biphenyl—(C12H10) An organic molecule that is made by the attachment of two phenyl rings (each phenyl ring is composed of 6 carbon molecules). It is a colorless solid.

Relationship between puzzle pieces:

There is a direct relationship between industrial dumping the PCBs found in the environment. As one of these factors increases or decreases so does the other. PCBs or polychlorinated biphenyls are generally found in industrial waste such as rubber, plastics, flame retardants, insulation for transformers, paints and dyes. PCBs have been carelessly disposed of for many years. As a result, large amounts of PCBs have been introduced into the environment through open burning or incomplete incineration; by vaporization from paints, coatings and plastics; by direct entry or leakage into sewers and streams; by dumping in non-secure landfill sites and municipal disposal facilities, ocean dumping, etc; which did not destroy material.

PCBs are stored in body fat of animals. Through the process of biomagnification the concentration of PCBs in fat tissue increases as it passes up the food chain. When toxic levels of PCBs accumulates in raptor fatty tissues, it causes many to produce sterile eggs. The raptor population decreases because fewer eggs are being hatched. The Environmental Protection Agency enforces the regulations set forth by the Environmental Protection Act. Within this act, there are guidelines that regulate the disposal, destruction, and accidental spill reporting policies of PCBs. These guidelines have decreased the amount of PCBs in the environment and have allowed raptor populations to rebound.

Raptor Population Puzzle Answer Guide cont.

Puzzle 4 Answers

1. Increased hunting
2. Lead
3. Lead contaminated soils
4. Secondary poisoning
5. Immune suppression, neurological and tissue damage in predator and prey
6. Decrease in California condor populations
7. Non-toxic shot
8. Steel
9. Increase in California condor populations

Definitions:

Secondary poisoning—A process that results when a predator ingests poisoned prey and becomes poisoned itself.

Non-toxic shot—Bullets composed of steel

Lead—A soft, heavy, gray metallic element (symbol Pb).

Neurological—Having to do with the nervous system

Immune response—The body's way of defending itself from invading foreign substances that may cause infection or disease.

Immune suppression—The decreased capacity of the immune response.

Relationship between the puzzle pieces:

There is a direct relationship between increased hunting and the concentration of lead found in the environment. As one of these factors increases or decreases so does the other. One of the main uses of lead was for making bullets. Shotguns are packed with dozens of small lead balls. Some of these balls would hit the intended target and others would land on the ground. The lead bullets that land on the ground are sometimes ingested by small animals that mistake them for food items. Once lead is ingested, the stomach acid dissolves the metal and the lead is absorbed into the blood stream causing immune suppression, neurological damage, tissue damage, or death. Secondary poisoning is when a predator ingests poisoned prey and becomes poisoned itself. This may occur when a raptor or other animal ingests prey that have lead shot embedded in their tissues or that have consumed lead. The predator may then experience the same symptoms as the prey animal (immune suppression, neurological damage, etc.). This results in a decrease in raptor populations such as the California condor. Lead poisoning is one of the leading causes for condor populations dropping. This is because many raptors are able to release some concentrations of lead by excreting non-digestible parts of their prey (feathers, bones, etc.) in pellets. Eagles for example excrete pellets quite regularly, whereas California condors excrete them less frequently.

The United States Fish and Wildlife Service now requires non-toxic shot on most of the National Wildlife Refuges. The non-toxic shots are composed of steel rather than lead and don't have negative environmental implications associated with them. The increased usage of non-toxic shot increases the number of healthy California condors that are able to reproduce and therefore increases their population.

Raptor Population Puzzle Answer Guide cont.

Puzzle 5 Answers

1. Increased oil spills
2. Feathers have reduced thermal properties
3. Hypothermia
4. Contaminated prey
5. Aspiration
6. Petroleum ingestion
7. Decrease in raptor population
8. Increased risk management and clean-up procedures
9. Increase in raptor populations

Definitions:

Booms—An oil clean-up method that act as floating barriers to oil dispersal.

Skimmers—An oil clean-up method that utilizes boats that skim spilled oil from the water surface.

Sorbents—An oil clean-up method that act as a sponge to absorb oil.

Chemical Dispersants—An oil clean-up method that breaks down oil into its constituent parts.

In-situ burning—An oil-clean-up method that burns freshly-spilled water while its on the water surface.

Vacuum trucks—An oil clean-up method that vacuums spilled oil off the beaches or the water surface.

Aspiration—The act of breathing.

Hypothermia—The abnormal lowering of body temperature.

Hydrocarbon—A compound containing only hydrogen and carbon.

Viscosity—The property of fluids by which they offer resistance to flow or to change in the arrangement of their molecules.

Petroleum—An oil, liquid mixture of hydrocarbons found in scattered subterranean deposits, and used as a source of fuels.

Relationship between puzzle pieces:

Oil spills have multiple devastating effects on animal species (including raptors). After an oil spill, many aquatic birds and mammals are soaked in oil. This reduces the thermal capabilities of fur and feathers causing hypothermia and in some cases, death. In addition, raptors or other predators may ingest oil-soaked carcasses. This consumption of contaminated prey leads to the predator ingesting petroleum. Petroleum ingestion usually results in death because petroleum based products (such as gasoline, kerosene, fuel oil and lighter fluid) have a low viscosity and contain hydrocarbons. Compounds with a low viscosity can spread easily and quickly when aspirated. This results in the oil deeply penetrating the lungs. Ingested hydrocarbons may also produce toxic effects in the pulmonary system. These detrimental effects of oil spills cause raptor populations to decrease. Increased risk management works to reduce the probability that an oil spill will occur. Increased risk management and multiple clean-up measures such as booms, sorbents, chemical dispersants, etc. helps reduce the number of animals soaked in oil and subsequent ingestion of oil. Therefore raptor populations increase.

Raptor Population Puzzle Answer Guide cont.

Puzzle 6 Answers

1. Collection of raptor eggs, nests, or feathers
2. Invasion of golden eagle nesting trees
3. Raptor hunting
4. Decrease in golden eagle populations
5. Migratory Bird Treaty Act
6. Bald Eagle Act
7. Increase in golden eagle populations

Definitions:

Migratory Bird Treaty Act—(Passed in 1918) Prohibits the taking, killing, or keeping of any native bird (birds found in North America), its parts, or its nest, without a permit or license. All raptors are protected by this law.

Bald Eagle Act—(Passed 1940) This law protects both bald and golden eagles, their nests, and nesting trees. Prohibits the killing or disturbing of either species.

Raptor—Raptors are predators that have hooked beaks, excellent eyesight, sharp talons, and strong legs and feet.

Identify the range of the golden eagle—Open country, desert grasslands; western U.S. and across Canada and Alaska; winter in North America from south-central Alaska to central Mexico

Relationship between Puzzle Pieces:

The collection of raptor eggs, nests, or feathers can greatly reduce raptor populations including golden eagles. The collection of eggs is prohibited because it is taking potentially viable offspring out of the population. The collection of nests and feathers is prohibited because a wildlife official would not know how those items were collected. Was a raptor harmed in the acquisition of those items? Golden eagles are very particular to the areas they choose to nest in. They shy away from populated areas. Any disruption to a nesting site could cause the eagle to abandon its nesting tree. Therefore reducing the amount of potentially viable offspring to the population. Raptor hunting used to be widespread because they were viewed as competitors for livestock. Education has helped dispel this misconception.

Raptors have additional protection from the Migratory Bird Treaty Act anyone from collecting, harming or killing any bird native to the United States. All raptors native to the United States are protected by this law. Additionally, bald eagles and golden eagles are protected by the Bald Eagle Act that prohibits the collecting of eagle nests and their nesting trees. These methodologies have increased the number of golden eagles as well as other raptors.