



What is an Oil Spill?

An oil spill occurs when liquid petroleum (also known as fossil fuels or commonly, oil) is accidentally released into the environment. Oil spills can occur during the extraction or transport of oil and can occur on land or in bodies of water such as lakes, rivers, and oceans. Oil spills are a form of pollution and they can have serious environmental, economic, and social impacts. These impacts can either be immediate or long-term, meaning that they persist for a long time. Oil spills negatively impact ecosystems in a variety of ways. Oil spills can either affect wildlife directly, or they can damage wildlife habitat. If oil washes ashore, it can cover beaches, marshes, and sensitive marine areas. There are also long-term impacts of oil spills. For instance, oil takes a long-time to degrade, or break down, which allows oil to persist in the environment for many years, even decades. Long-term impacts include the accumulation of toxic compounds into food chains.

The following pages contain more information on these immediate and long-term impacts and a set of questions. Read through the information and study the diagrams and pictures to answer the questions.

Immediate Impacts

Oil spills in marine areas often impact wildlife species such as birds. Oil is especially damaging to bird feathers and can immediately affect birds if they are exposed to oil. Read through the diagram below and answer the following question.

Dirty wings kill birds

Healthy duck wing

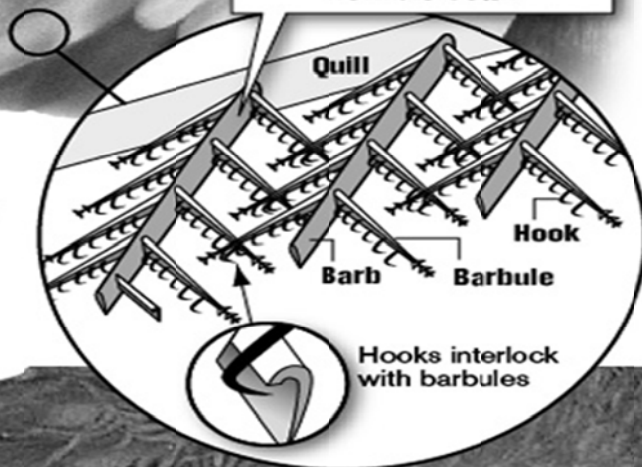
Birds spend a considerable amount of time every day preening and aligning their feathers to ensure a waterproof and airtight seal around their body to stay insulated from the cold. If the feathers are not perfectly aligned, the bird will die from exposure.

Oil-soaked wing

Oil mats feathers and separates the tiny barbs, impairing the waterproofing and exposing the bird to temperature extremes

Feathers overlap each other like shingles on a roof to create a waterproof covering for the bird

Millions of tiny barbs on individual feathers gently interlock with each other to form a flexible seal.



Source: International Bird Rescue

JOHN BLANCHARD / *The San Francisco Chronicle*

This graphic was produced by John Blanchard for the San Francisco Chronicle. Image and article can be found at:

<http://www.sfgate.com/green/article/For-birds-coated-with-oil-a-medical-exam-then-a-3301324.php>



Q1) How does oil affect the ability of a bird to regulate its body temperature?



<http://www.earthmagazine.org/article/gulf-oil-spill-threatens-subsurface-biodiversity>

Workers with the International Bird Rescue Research Center clean a brown pelican covered in oil during the 2010 British Petroleum Oil Spill in the Gulf of Mexico. Image is retrieved from Earth Magazine, under the American Geosciences Institute. Notice how the worker is keeping the bird covered with a towel to keep it warm while its feathers are cleaned.

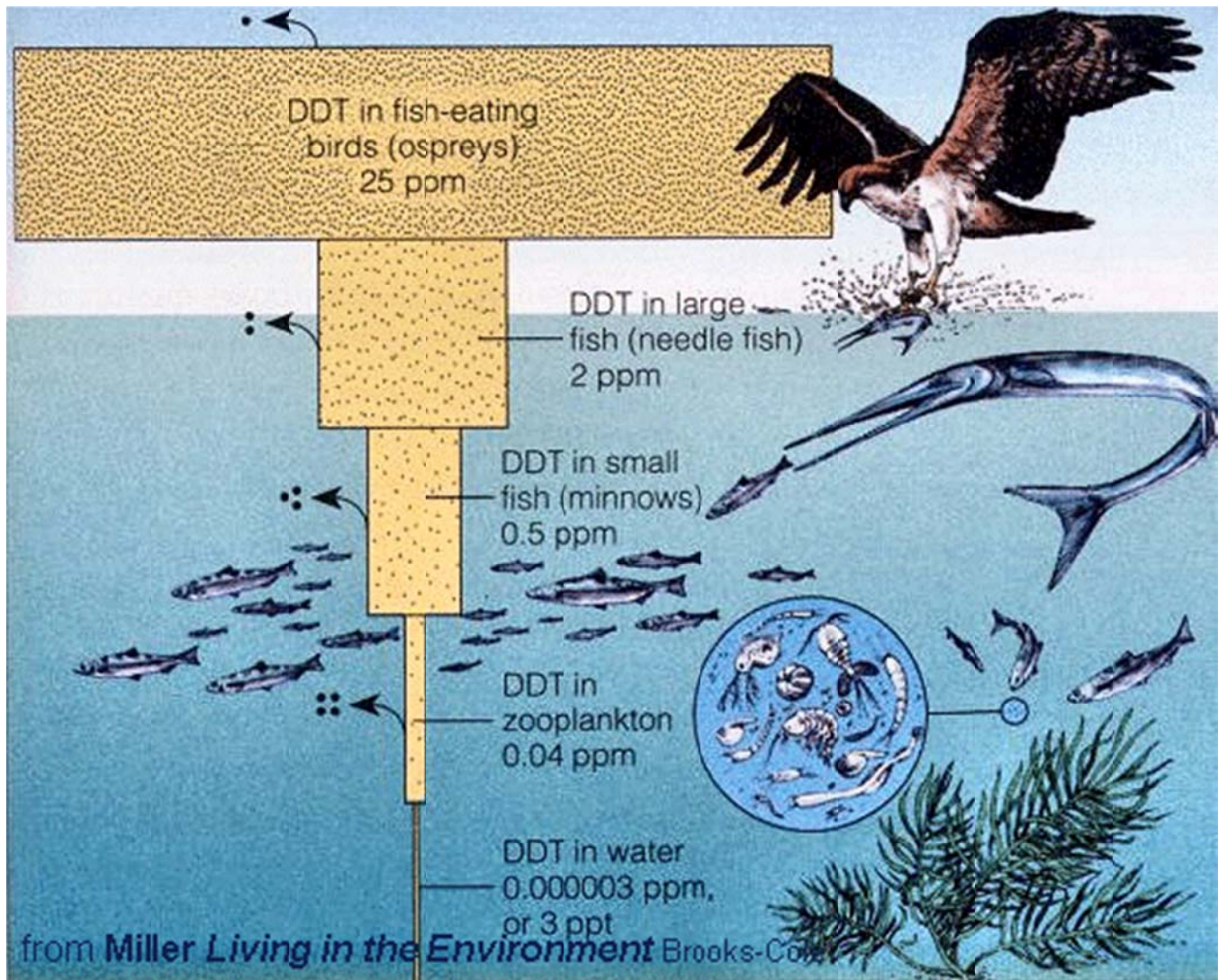


Long Term Impacts

Bioaccumulation is a process by which toxic chemicals from oil spills or other types of pollutants (such as mercury) accumulate, or build-up once they enter the food chain. Species at the top of the food chain, such as whales, salmon, and birds, consume large amounts of smaller animals such as zooplankton and krill. If these smaller animals contain trace amounts of toxic compounds, eventually, these compounds will accumulate in the tissues of the species at the top of the food chain. Many of these pollutants are fat-soluble, meaning once they are ingested they will remain in the fatty tissues of animals, such as in the blubber of whales.

How do we know that bioaccumulation occurs? Scientists have taken tissue samples from large species such as whales and from smaller species such as crustaceans and mollusks and they have detected the presence of toxics at different levels. The amount of toxic compounds is much higher in species at the top of the food chain than it is lower on the food chain. As the diagram below illustrates, levels of the chemical pollutant DDT are several orders of magnitude higher in the top predators than they are at the bottom of the food chain.

Bioaccumulation is a concern because of the effects that these chemicals can have higher up in the food chain. For example, the chemical DDT weakens the shells of birds and causes them to break open, killing the developing embryo. Similarly, toxic hydrocarbon compounds in oil can also bioaccumulate in the food chain. One type of these toxic compounds are PAHs (which stands for polycyclic aromatic hydrocarbons). PAHs have been shown to accumulate in mollusks, shrimp, and other shellfish, which puts species higher up the food chain also at risk. The diagram on the following page depicts how DDT accumulates the higher you go up the food chain.



Living in the Environment: Principles, Connections, and Solutions 16th Edition; Miller and Spoolman

Q2) Following the Gulf Oil Spill, the Food and Drug Administration, a federal agency that is responsible for regulating the safety of food and drugs, enacted warnings and temporary closures of marine fisheries in the Gulf of Mexico. Fishermen were not allowed to catch shrimp or collect shellfish and sell them to the public until it was safe. Based on what you just learned about bioaccumulation, why would the FDA make this decision?



Q1)

Once oil coats a bird's feathers, feathers lose their ability to form the waterproof seal that keeps a bird warm even though it may spend most of its time in the water.

Q2)

Since the FDA monitors the health and safety of food, there were concerns that toxic compounds from the oil spill would be incorporated into the food chain, putting humans (a top predator) at risk. Following the oil spill, Gulf residents were warned to avoid eating seafood. This had a devastating impact on local economies and the industry took months to recover.



Imagine that you are a part of a group of environmental engineers. As an environmental engineer, your job is to create solutions for environmental problems. As a group, you have been asked to contain an oil spill. You have been provided with an assortment of materials and you must as a group plan and construct a containment device.

There are 3 phases to this laboratory:

- 1) Planning Phase: Collect your materials and as a group, build a containment device.*
- 2) Testing Phase: Now you can put your device to the test and attempt to clean up the oil spill.*
- 3) Evaluation Phase: Once you are done, you will evaluate the effectiveness of your device.*

1) Planning Phase

As a group, decide which materials you will use to design your apparatus. You will have 15 minutes to design and build your apparatus. You may sketch out your device before you begin constructing it if you wish. Do not start testing your device until instructed to do so. Before you test your device, answer the following questions:

Q1) Why did you choose the materials you did?

Q2) Why do you think these materials will be effective?

Q3) Form a hypothesis and predict what will happen:



2) Testing Phase

Use your apparatus to contain, trap, or remove the oil spill from your bin. You have 15 minutes to remove as much of the oil as possible. As you are removing the oil, answer the following questions:

Q4) How easy or difficult was it to remove the oil?

Q5) How much oil were you able to remove from your bin? Check the appropriate box.

Water is completely clear of all oil.	About 25% of the oil remains	About 50% of the oil remains	About 75% of at the oil remains	No change, the water is as oily as at the start.

3) Evaluation Phase

Now that you tested your device, take a few minutes to evaluate how successful your device was at removing/containing the spill oil by answering the following questions:

Q6) Which of the materials that you chose worked the best and why?

Q7) Which of the materials that you chose did not work as well as you planned?



Q8) If you could have designed your device differently, what features would you have changed and why?

Q9) Did you decide to revise your plan while actually doing the containment or clean-up? Why? How?

Q10) What kinds of factors would complicate cleanup of oil at a larger scale, like in an ocean or in a lake?

Q11) If you were an environmental engineer, what do you think would be the most effective way to clean up an oil spill in a open body of water like the ocean?