1. Is Fish Safe to Eat, Or Is It a Toxic Risk?

Teacher Overview
Answer Key Parts 1 & 2
Student Guide Part 1: K-W-L Chart
Student Guide Part 2: Toxic Fish in the News
Student Response Sheet: Part 1
Student Response Sheet: Part 2
Investigation I: Is Fish Safe To Eat, Or Is It A Toxic Risk?

Purpose
The purpose of this activity is to prepare students to learn about the dynamics of food chains and webs, bioaccumulation vs. biomagnification of a toxin within a food web, and how the introduction of an invasive species can affect all of the above.

Overview
This introductory activity will help students to see the relevance of the unit through a connection with a major current event. They will first be asked to consider the driving question of the activity by using a K-W-L chart to brainstorm how eating fish could be considered dangerous to humans. Students will then be asked to read a news article regarding the Gulf oil spill and how it is projected to impact marine food webs within that region. Students will be asked to complete reading comprehension questions at the end of the article.

Student Outcomes Specific to this Investigation

National Research Council’s (NRC) National Science Education Standards for grades 9-12

• Humans have a major effect on other species. For example, one influence of humans on other organisms occurs through land use—which decreases space available to other species—and pollution—which changes the chemical composition of air, soil, and water.

Time
Part 1: KWL chart – one 45 minute class period
Part 2: Reading “Toxic Fish in the News” – one 45 minute class period

Level
Secondary (9-12)

Materials and Tools

• White board/dry erase markers (or any other tool used for large group visual display such as GoogleDoc, SmartBoard, etc.)
• Yahoo!News Associated Press article
• Student Guide and Student Response Sheets

Preparation
Make copies of article and Student Guide as necessary
**Prerequisites**
None

**Background**
The food web that is being focused on in this unit is found in the Calumet Harbor in Chicago, Illinois (Figure 1). It is a part of the Port of Chicago, which is found along the southern portion of Lake Michigan, and is dominated mainly by invasive species. Most of the life that exists within the harbor consists of zebra mussels, quagga mussels, and the round goby—all organisms considered invasive aquatic species in the Great Lakes. To a lesser degree, native organisms such as smallmouth bass and crayfish have also been found within the harbor. Besides being so inundated with non-native life, the harbor is also considered to be heavily polluted with several toxins, one being polychlorinated biphenyls (PCBs). This is due to the industrial activity associated in and around the Port of Chicago over time.

![Figure 1. Google Earth image of Calumet Harbor location in Chicago, IL](image)

**Teaching Notes**

**Part 1: the KWL Chart**
A K-W-L chart is a visual tool to help students organize their previous knowledge/ misconceptions about a topic (K), questions or ideas that they’re interested in learning more about in regards to a topic (W), and what new information they’ve learned or walked away with from the lesson in regards to a topic (L). Some teachers may also call this type of chart a “What do I know/What do I want to know/What have I learned” chart. To get the activity started, construct a large K-W-L chart on a white board like the one shown below and allow the students to fill in the “K” and “W” columns.
<table>
<thead>
<tr>
<th>What do we already know?</th>
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You can revisit the “L” portion of the chart at the end of the reading assignment, or at the end of the unit to help summarize the information collected by the students.

**Part 2: Reading “Toxic Fish in the News”**

It is suggested that the article chosen for this investigation should be reviewed ahead of time to check for any vocabulary that may prove challenging to your students.
Investigation I: Is Fish Safe To Eat, Or Is It A Toxic Risk?

Part 1: K-W-L

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<td>Student answers will vary</td>
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<td>Student answers will vary – should be revisited and filled out at the end of the unit/investigations</td>
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Part 2: Toxic Fish in the News

Q1. Before reading through the article, how do you think the oil spill in the Gulf of Mexico will affect the organisms that call it home? Will humans end up feeling the effects of these changes? Explain.

Students should suggest that the oil will have polluted the water, making it difficult for some organisms to survive in their natural habitats. They may suggest that this will affect humans who depend on this natural resource for food (fish, shrimp and other shellfish) and those who visit the beaches. Students may also predict that this spill may cause drilling regulations to become stricter in the coming years, affecting oil supply in the U.S.

Q2. How will the already visible impacts of oil contamination to a few organisms, such as pyrosomes and young crabs, have larger side effects?

The loss of pyrosomes will affect the endangered sea turtle population and the young crabs now holding oil under their shells will affect fish, turtles, and shorebird populations.

Q3. What is the prediction for the seafood industry following this spill? Has this prediction been backed up by any evidence yet?

It is predicted by some that the seafood industry will be impacted by the oil spill as predators eat contaminated marine life, possibly tainting seafood. It is also predicted that the organization of sea life in the Gulf will be reshuffled, or changed, and that this could negatively impact the ecosystem and the fishing industry over time. No evidence had been found at the time of the article to support these predictions.
Q4. How has the base of the food web in the Gulf of Mexico already been changed by the oil spill? Is this a good change for the food web or a bad one? Explain.

*Oil and natural gas consuming bacteria have been found to be thriving in the Gulf waters. This is not projected to be a good change for the food web as it can impact fishing and introduce contaminants into the food web.*

Q5. How is phytoplankton being impacted by the oil spill? Will this change in conditions necessary for phytoplankton survival have a large side effect? Explain.

*The surface slick of oil is preventing sunlight from passing through to the phytoplankton, which need sunlight to survive (for photosynthesis). If the numbers of phytoplankton decrease, this could negatively impact smaller fish populations, such as the menhaden, that feed on the phytoplankton. If the menhaden fish population drops, this could impact the tuna, red snapper, and other fish populations as well.*

Q6. Are the conditions of the aquatic ecosystem of the Gulf of Mexico expected to return to normal over time or not? How so?

*Yes, it is predicted that the conditions of the ecosystem will rebound over time. Scientists expect that fish and other organisms living in untainted waters (and those that left the spill area for uncontaminated waters immediately after the spill) could eventually return to the impacted areas to repopulate them after the oil is cleaned up.*
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Well...what do you think? Is fish safe to eat, or is it a toxic risk? Have you ever considered that when eating that tuna fish sandwich for lunch or enjoying a dinner of locally caught trout? Can what you eat make you sick? How can this happen? This unit will hopefully help you to answer some of these questions by the end.

In Part 1 of this Investigation, you will be asked to think about how fish can be considered “toxic” and what can possibly lead them to be described as so. You’ll brainstorm individually and share with your classmates information that you may already know about this topic, as well as some questions you hope to have answered by the end of the unit.

In Part 2 of this Investigation, we’ll look at a recent environmental catastrophe that will help us better set the stage for some of the upcoming investigations. The Gulf of Mexico oil spill that has finally come to an end will unfortunately impact the marine ecosystems of the region for many years to come. You will be asked to read a news article describing how scientists predict the oil spill will affect aquatic organisms within the Gulf.
Part 1: K-W-L

In this section you will fill out the following K-W-L chart with your classmates about the driving question to this Investigation. First, think about what you already know about fish being described as “toxic”. What would cause us to be able to describe them as such? How could they become “toxic”? Put your answers to these questions in the first column. Then, come up with some questions about the overall theme to the unit that you’d like to have answered and put them in the second column. We will leave the “L” portion of the chart blank until the end of the Investigation to see what questions you were able to actually answer and what new information you learned.

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Part 2: Toxic Fish in the News

On April 20, 2010 the Deepwater Horizon oil rig owned by BP exploded and sank into the Gulf of Mexico. During the months that followed, an estimated 207 million gallons of crude oil were released into the water. Fortunately, the leaking well was capped on July 15th and stopped releasing oil into the Gulf. However, the impacts of such a large amount of oil being spilled into such a biologically diverse body of water will last for a long time.

In this part of the Investigation, you will be asked to read the following Associated Press article from early on in the spill to understand how scientists predict the oil spill will impact the marine ecosystems that exist in the Gulf of Mexico.

Question:

Q1. Before reading through the article, how do you think the oil spill in the Gulf of Mexico will affect the organisms that call it home? Will humans end up feeling the effects of these changes? Explain.
Scientists say Gulf spill altering food web
By MATTHEW BROWN and RAMIT PLUSHNICK-MASTI, Associated Press Writers

This June 15, 2010 photo provided by the University of California Santa Barbara, shows pyrosomes—cucumber-shaped, gelatinous organisms fed on by endangered sea turtles, pulled up after a deep cast in the vicinity of the oil spill in the Gulf of Mexico. Scientists are seeing early signs that the massive Gulf spill is altering the food web, by killing or tainting creatures that form the foundation of marine life and spurring the growth of others more suited to a fouled environment. (AP Photo/David L. Valentine, Department of Earth Science, University of California Santa Barbara)

Wed Jul 14, 9:04 am ET

NEW ORLEANS – Scientists are reporting early signs that the Gulf of Mexico oil spill is altering the marine food web by killing or tainting some creatures and spurring the growth of others more suited to a fouled environment.

Near the spill site, researchers have documented a massive die-off of pyrosomes—cucumber-shaped, gelatinous organisms fed on by endangered sea turtles.

Along the coast, droplets of oil are being found inside the shells of young crabs that are a mainstay in the diet of fish, turtles and shorebirds.

And at the base of the food web, tiny organisms that consume oil and gas are proliferating.

If such impacts continue, the scientists warn of a grim reshuffling of sealife that could over time cascade through the ecosystem and imperil the region’s multibillion-dollar fishing industry.
Federal wildlife officials say the impacts are not irreversible, and no tainted seafood has yet been found. But Rep. Ed Markey, D-Mass., who chairs a House committee investigating the spill, warned Tuesday that the problem is just unfolding and toxic oil could be entering seafood stocks as predators eat contaminated marine life.

"You change the base of the food web, it's going to ripple through the entire food web," said marine scientist Rob Condon, who found oil-loving bacteria off the Alabama coastline, more than 90 miles from BP's collapsed Deepwater Horizon drill rig. "Ultimately it's going to impact fishing and introduce a lot of contaminants into the food web."

The food web is the fundamental fabric of life in the Gulf. Once referred to as the food chain, the updated term reflects the cyclical nature of a process in which even the largest predator becomes a food source as it dies and decomposes.

What has emerged from research done to date are snapshots of disruption across a swath of the northern Gulf of Mexico. It stretches from the 5,000-feet deep waters at the spill site to the continental shelf off Alabama and the shallow coastal marshes of Louisiana.

Much of the spill — estimated at up to 182 million gallons of oil and around 12 billion cubic feet of natural gas — was broken into small droplets by chemical dispersants at the site of the leaking well head. That reduced the direct impact to the shoreline and kept much of the oil and natural gas suspended in the water.

But immature crabs born offshore are suspected to be bringing that oil — tucked into their shells — into coastal estuaries from Pensacola, Fla., to Galveston, Texas. Oil being carried by small organisms for long distances means the spill's effects could be wider than previously suspected, said Tulane professor Caz Taylor.

Chemical oceanographer John Kessler from Texas A&M University and geochemist David Valentine from the University of California-Santa Barbara recently spent about two weeks sampling the waters in a six-mile radius around the BP-operated Deepwater Horizon rig. More than 3,000 feet below the surface, they found natural gas levels have reached about 100,000 times normal, Kessler said.

Already those concentrations are pushing down oxygen levels as the gas gets broken down by bacteria, Kessler and Valentine said. When oxygen levels drop low enough, the breakdown of oil and gas grinds to a halt and most life can't be sustained.

The researchers also found dead pyrosomes covering the Gulf's surface in and around the spill site. "There were thousands of these guys dead on the surface, just a mass eradication of them," Kessler said.
Scientists said they believe the pyrosomes — six inches to a foot in length — have been killed by the toxins in the oil because there have no other explanation, though they plan further testing.

The researchers say the dead creatures probably are floating to the surface rather than sinking because they have absorbed gas bubbles as they filtered water for food.

The death of pyrosomes could set off a ripple effect. One species that could be directly affected by what is happening to the pyrosomes would be sea turtles, said Laurence Madin, a research director at the Woods Hole Oceanographic Institution in Cape Cod, Mass. Some larger fish, such as tuna, may also feed on pyrosomes.

"If the pyrosomes are dying because they've got hydrocarbons in their tissues and then they're getting eaten by turtles, it's going to get into the turtles," said Madin. It was uncertain whether that would kill or sicken the turtles.

The BP spill also is altering the food web by providing vast food for bacteria that consume oil and gas, allowing them to flourish.

At the same time, the surface slick is blocking sunlight needed to sustain plant-like phytoplankton, which under normal circumstances would be at the base of the food web.

Phytoplankton are food for small bait fish such as menhaden, and a decline in those fish could reduce tuna, red snapper and other populations important to the Gulf's fishing industries, said Condon, a researcher with Alabama's Dauphin Island Sea Lab.

Seafood safety tests on hundreds of fish, shrimp and other marine life that could make it into the food supply so far have turned up negative for dangerous oil contamination.

Assuming the BP gusher is stopped and the cleanup successful, government and fishing industry scientists said the Gulf still could rebound to a healthy condition.

Ron Luken, chief scientist for Omega Protein, a Houston-based company that harvests menhaden to extract fish oil, says most adult fish could avoid the spill by swimming to areas untainted by crude. Young fish and other small creatures already in those clean waters could later repopulate the impacted areas.

"I don't think anybody has documented wholesale changes," said Steve Murawski, chief scientist for the National Marine Fisheries Service. "If that actually occurs, that has a potentially great ramification for life at the higher end of the food web."
Questions:

Q2. How will the already visible impacts of oil contamination to a few organisms, such as pyrosomes and young crabs, have larger side effects?

Q3. What is the prediction for the seafood industry following this spill? Has this prediction been backed up by any evidence yet?

Q4. How has the base of the food web in the Gulf of Mexico already been changed by the oil spill? Is this a good change for the food web or a bad one? Explain.

Q5. How is phytoplankton being impacted by the oil spill? Will this change in conditions necessary for phytoplankton survival have a large side effect? Explain.

Q6. Are the conditions of the aquatic ecosystem of the Gulf of Mexico expected to return to normal over time or not? How so?
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Part 2: Toxic fish in the news?

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