2. Contaminants in Our Lives

Concepts

- Contaminants impacts on humans' health and environmental health through multiple pathways.
- The sources of contaminants in our environment.
- The pathways that contaminants flow through in the environment.
- The pathways that contaminants can enter human bodies.

Skills: critical thinking, decision making, observation

Materials

- Easel and poster board with markers
- Handout
- Powerpoint if not using easel and poster board

Time Consideration: Preparation 10-15 minute, one 45-minute period

Objectives

- Participants will describe where contamination is created in our lives.
- Participants will describe the multiple sources and pathways contaminants can enter the environment through.
- Participants will understand how humans can be exposed to contaminants from the environment.
- Participants will understand how societal and individual choices can increase or decrease an individual's exposure to contaminants.

Key terms: environmental health, contaminant, point source, non-point source, physical contaminants, biological contaminants, chemical contaminants, radiological contaminants

Background

Since the Industrial Revolution (1760-1840), there has been a fight for the balance of economic growth and environmental protection. As the economy and job market grew due to the expansion of industrial jobs, there was little governmental regulation on the by-products leaving these factories and energy production plants (1). After environmental disasters like the Cuyahoga River fire in Illinois (1952) and the release of Rachel Carson's book *Silent Spring* (1962), the United States began creating laws and regulatory agencies to protect its natural resources from misuse (Land and Water Conservation Act 1965, The Wilderness Act 1964, Clean Air Act 1970, Clean Water Act 1972). As technologies continue to improve through the 21st century, society has been able to reduce the number of contaminants that enter our environments to meet these governmental regulations.

There are multiple environmental and human exposure pathways an individual can experience while living in Burke County. It is important to recognize the multiple sources of contamination in our environment and understand the roles individuals play in the use and release of these contaminants. For example, in the early 1950s, there was little regulation on industry and its use of natural resources. This led to environmental disasters such as the Cuyahoga River fire in Illinois and the exposure of humans and wildlife to pesticides like DDT (6). We also used to do things like play with mercury from thermometers and use lead paint. Through research studies, we know that unregulated industrial contaminants are what caused the Cuyahoga River to catch fire, mercury can cause nerve damage (7), and lead is a harmful neurotoxin (8), especially to children. Through the

pathways discussed in this lesson, like soil and water, heavy metals and radionuclides can either be remediated or become a health hazard.

It is important to understand the pathways contaminants can enter the human body. These pathways include ingestion, dermal, inhalation, and direct. In some situations, we can mitigate our exposure to contaminants in the food that we eat through washing produce and ensuring good pesticide and fertilizer application. For drinking water, there are special filters that can help reduce contamination from heavy metals. There are also air filtration systems that can be installed in homes to improve air quality inside homes. However, for large sources of contaminants in the environment, governmental regulation of manufacturing and energy industries are the main safety mechanisms in place to protect human health.

While humans can be exposed in similar ways, age, health, and gender can play a role in how contaminants affect your life. Young children and older adults can experience different responses to environmental contamination than healthy adults. When young children were exposed to high levels of radiation, they had a higher risk of contracting brain cancer at 60 years of age than adults at 40 exposed to the same level of radiation (9). In healthy adults, reducing the concentration of air pollution by 10 $\mu g/m^3$ increased mean life expectancy by about 2 years (10). However, this value wouldn't hold for individuals who smoke or who live below the poverty line (10). Heavy metals like lead (11), mercury (7), and copper (12) are considered some of the main threats to human health (13). Additionally, in organisms like fish that bioaccumulate contaminants, it is important for women of childbearing age and pregnant women to reduce their intake of that organism to decrease the risk of negative health effects to herself and the baby (14). Medical studies on exposure to radiation, including diagnostic, therapeutic, and unnatural (bomb) exposures, show that guidelines for exposure can protect sensitive fetal stages and mothers from potential negative health effects (15). The dosage of tritium is also important to understanding potential exposure and health risks (16).

Contamination is a responsibility and concern for all citizens because not just one person or organization can reduce our use of natural resources. Environmental sustainability that includes maintaining a high-quality lifestyle as well as protecting environmental resources is the next step (17). One of the reasons why REMOP is here; to help educate Burke County citizens about environmental contamination and the pathways contaminants flow through in our environment.

Preparation

- Prepare easel and ensure that markers are working.
- Ensure all participants have a handout and writing utensil available.

Lesson

1. Ask participants to suggest some examples of when environment impacts health. Examples can include Gulf Oil spill, the tsunami in Japan that caused Fukushima disaster, and any other local or timely example from the news. Discuss how these examples might be one-time (acute) events like a natural disaster or a more long-term (chronic) exposures that might be more difficult to notice and link (like asthma and air quality).
2. Begin by creating four separate squares on the poster board. Describe the that there are two broad types of contamination in our environment: point source and non-point source. Write each of these terms above one of the columns (see Figure 1) while leaving the boxes clear.
3. Give the definition of point source pollution. Ask the participants if they can think of any examples of point source pollution. Examples include vehicles, homes, sewage treatment plants, industrial plants, and energy plants. Draw two of the examples participants give you in the boxes on the poster board under "point source".

4. Give the definition of non-point source pollution. Ask the participants if they can think of any examples of non-point source pollution. Examples include agriculture fields, urban runoff, sediments from erosion, bacteria from livestock. Draw two of the examples participants suggested in the boxes on the poster board under “non-point source”.
5. Ask participants how they would describe contaminants, what types of contaminants can you think of. After hearing a few suggestions, explain that there are 4 general groups of contaminants: physical, chemical, biological, and radiological.
6. Explain and define each type of contaminant. Give examples of each.
    a. Physical – litter, garbage
    b. Chemical – pesticides, fertilizers, waste from a manufacturing plant
    c. Biological – bacteria from livestock fields, sewage from humans
    d. Radiological – byproducts of weapons productions, waste from energy plants
7. Ask participants to describe how contaminants are released from each image in each of the four boxes. While going through each image, categorize the released contaminants as physical, chemical, biological, or radiological.
8. After going through each of the 4 squares and discussing where contaminants are released from each source, ask participants if they have any ideas about where contaminants go from those sources. Give hints to allow participants to answer along the lines of the environment, soil, or water.
9. Ask students to look at their handout at the diagram of the community. Ask participants to describe the movement of the arrows through the city. Point out that there are 3 main environmental pathways in the environment: water, air, and soil.
10. Remind students that each pathway plays a role in the remediation of contaminants as well as potential exposure routes to humans. For example, water can be very good at containing coal fly-ash, a by-product of burning coal for energy. However, if this water somehow escapes from its retention pond and enters the drinking water supply, it could be dangerous to humans to consume.
11. Explain that along with environmental pathways, there are also pathways for contaminants to enter the human body. Ask participants if they have any guesses about what those pathways might be. The 4 human exposure routes are skin, inhalation, ingestion, and direct exposures. While participants are discussing, draw a human on the poster board with a nose and mouth. If a participant states one of the exposure routes, define it while drawing and labeling an arrow on the human diagram. Help the participants by giving hints about the additional human exposure routes until all 4 routes are defined.
12. Explain that not all contaminants will complete a cycle through a pathway, and sometimes, this is on purpose by remediation efforts. Or by the time the contaminant enters the pathway, it has been remediated below regulations.
13. As a summary, discuss with participants how we all contribute to the whole picture, individuals, communities, cities, and businesses. That each of us has the responsibility to help reduce the risk of contaminants in our lives through the mechanisms that we can.

Activity

This activity highlights how contaminants are contained or not contained in our environment. As contaminants flow through environmental pathways, there are barriers to that flow. See Figure 2 for a diagram of how this experiment should be set-up.

Supplies: 8 clear containers, 4 types of substrate (gravel, sand, clay, compost), 4 funnels, large container, water, food coloring

1. Have 4 types of substrate (gravel, sand, clay, and compost) in 4 separate, clear containers with drainage into individual clear containers.
2. Make grape Kool-Aid or another type of colored, water-based solution.

3. Explain that the color is similar to contaminants in the water. That at a basic level, we know that certain types of contaminants will bind to the soil and will stay there. Explain that this is the idea behind many types of remediation of contaminants, like coal fly-ash and agricultural pesticides and fertilizers.
4. Ask participants which type of substrate they think will be best at holding the color from the liquid.
5. Ask a volunteer to help pour equal amounts of the colored liquid into each of the 4 cups.

Figures

Figure 1. Example of the diagram used to describe sources of contamination, types of contaminants, and examples of contamination.

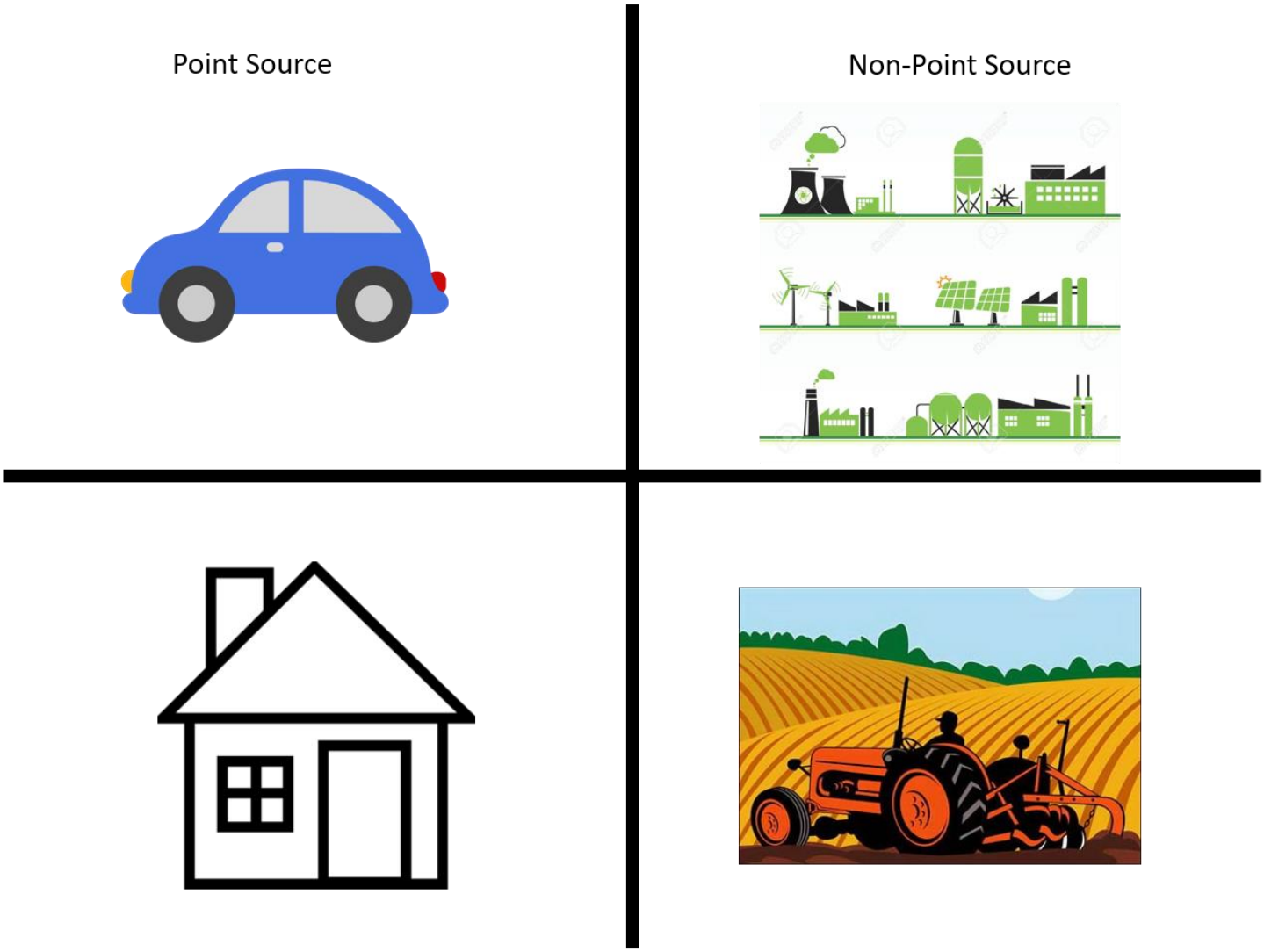


Figure 2. Example diagram of the human body with the labeled exposure routes.

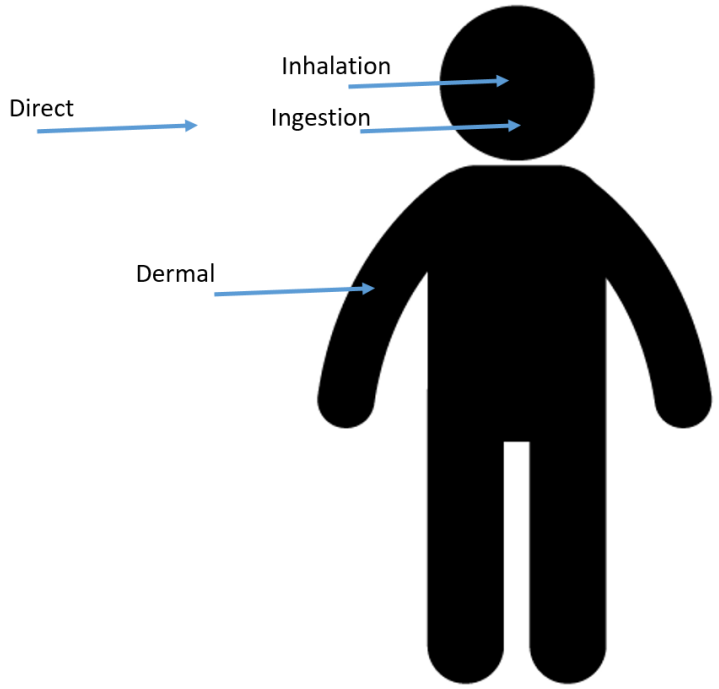
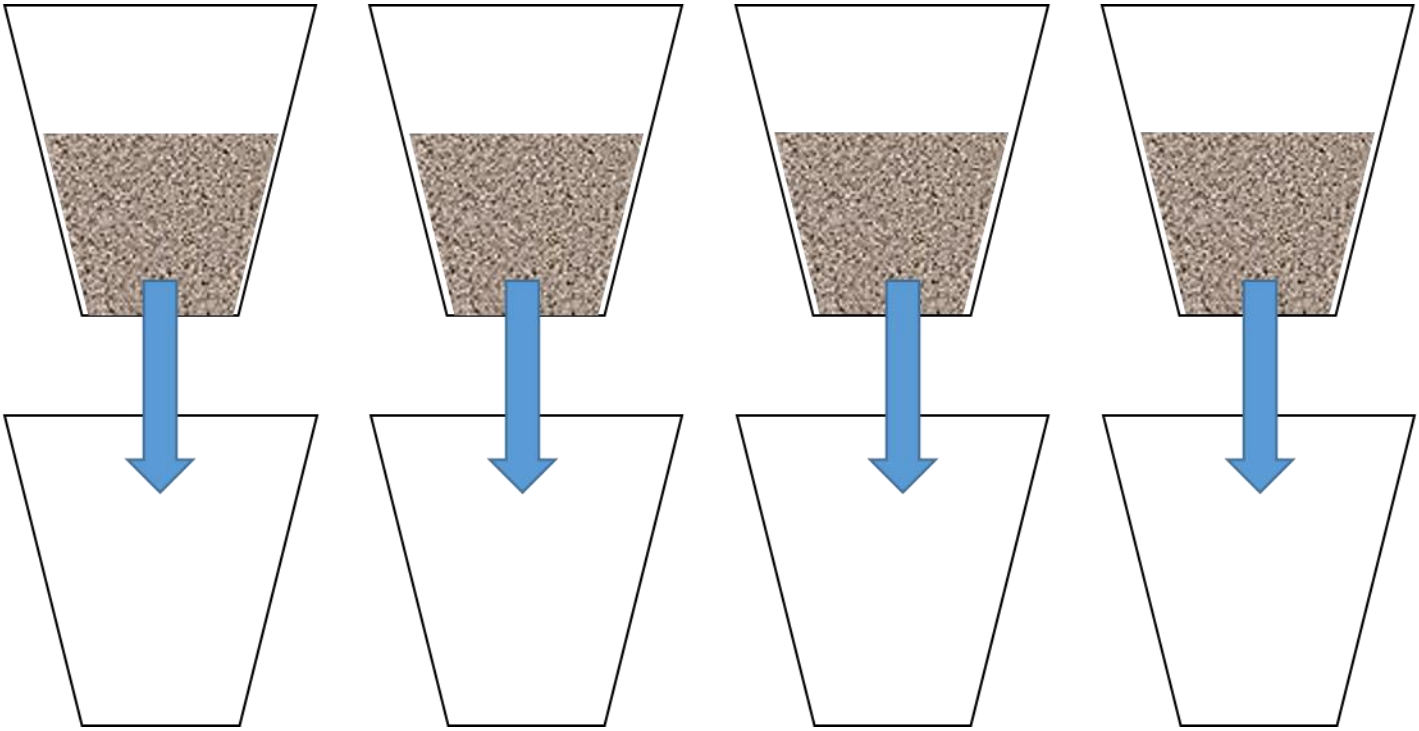


Figure 3. Example of how the activity should be set up.



Resources

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Disclaimer

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Data collected under REMOP will not meet the requirements of a legally authorized monitoring program. For example, data collected under REMOP will not be gathered in compliance with the geographic, statistical, or site selection procedures required by a legally authorized monitoring program conducted by or on behalf of any regulatory agencies.

If you have any questions, please call 803-725-2649 or email remop@srel.uga.edu.

Handout

02: Contaminants in Our Lives

The Radiological Education, Monitoring, and Outreach Project
University of Georgia Savannah River Ecology Laboratory

This handout is to follow along with the presentation, Contaminants in Our Lives. If you have questions while participating, please let us know.