



Environmental Protection & Money Management

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Student: _____ Partner: _____

Group Name: _____ Date: _____

Learning Objectives:

1. Understanding contour maps, including elevation, relief, river flow, lines of latitude and longitude
2. Developing a research strategy to find sources of river contamination using sediment samples and test solution to determine levels of toxicity
3. Budgeting resources efficiently
4. Effectively managing grant-based research projects
5. Developing teamwork and collaboration skills

Overview:

The EPA has awarded the NYHS Marine Biology Research Program a Citizen Science grant project, whereby groups of students will be given an allowance of \$9000 (in Monopoly money) to locate the source of river contamination in the *Oh-Be-Joyful* river. The *Oh-Be-Joyful* region of the United States is a center of numerous industrial enterprises, including hydraulic fracturing, mineral extraction, coal mining, heavy metal refinery, medical technology, mobile communication, nuclear power generation, oil drilling, plastics production, soft-drink manufacturing, and pharmaceutical research. The EPA has determined that there are high levels of industrial contamination in the *Oh-Be-Joyful* river, but the exact source of the contamination, and the industry responsible, remains unknown.

Using the EPA funds, knowledge of maps and environmental science, and money management skills, students will develop a research strategy, purchase materials, test samples of riverbed sediment, and locate the source of contamination. Upon completion of their research, students will present their findings in a final report to the EPA.

STEP ONE: Assemble a complete map of *Oh-Be-Joyful*

Mapping projects often involve piecing together numerous slates, cut from massive-sized maps. Your first task is to assemble a map of the *Oh-Be-Joyful* river, using the six slates provided. Use features on the map as clues to how they fit together. Trim the slates as needed, and reconnect them with scotch tape.

STEP TWO: Review the EPA Grant Announcement

Research funding sources, such as the Environmental Protection Agency, will often announce grant opportunities, whereby institutions or groups can compete for money to carry out projects that advance research in various fields. The EPA recently announced an opportunity for research in the *Oh-Be-Joyful* river, which the MBRP applied to, and won! Students must now implement the project that was awarded. Review the grant announcement for details.

STEP THREE: Collect your cash allowance and purchase your materials

Collect your grant allowance (\$9000 in Monopoly money per group), and purchase your equipment from the depot. There is a lump sum fee of \$200 for the materials. Handle them with care, as replacements must be purchased at an additional cost!

- 1 bottle of Test Solution
- 1 plastic spoon
- 1 funnel
- 1 beaker
- paper towel
- gloves

STEP FOUR: Strategize

Review the map and the various points along the river. Take note of contour lines, points of elevation, and river flow. Each point numbered 1-70 is a site from where samples were collected. Each sample costs \$500. Consider how you will go about selecting samples to purchase, keeping in mind that you do not have nearly enough money to buy a sample from every point along the river. Your knowledge of contour maps will prove vital here! Develop a strategy *before* you start purchasing, so that you have enough money to purchase more samples as you zero in on the source of contamination. If you run out of money and fail to report back to the EPA with at least one source, you will be disqualified from future EPA grant opportunities, so use your science AND money management skills!

STEP FIVE: Purchase and test your samples

1. Bring your plastic spoon and some paper towel to the sample center, and indicate which sample you wish to purchase (#1-70). You will be given a scoop of sediment, as well as a piece of filter paper. Don't forget to wear protective gloves!
2. *Carefully* carry the sample and filter paper back to your research station. Carry the spoon over paper towel to avoid spilling potentially toxic sediment all over the lab!
3. Test your sample using the following method: line the funnel with the filter paper, and insert the sediment sample. Drip the test solution through the sample, and observe the color of the fluid that is discharged from the filter. Review Figure 01. carefully to interpret your findings.

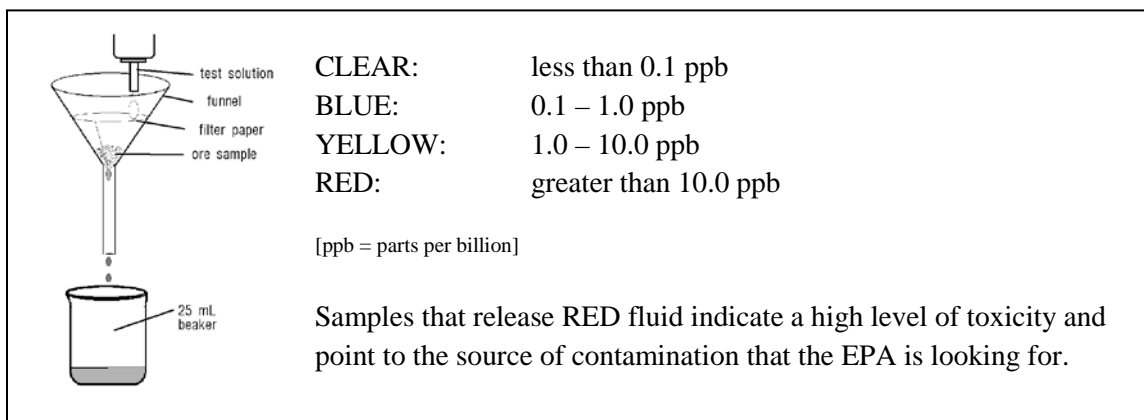


Figure 01.

4. After testing your sample, *carefully* discard it together with the filter paper in the hazardous waste bucket which is provided. Dry the plastic spoon and funnel thoroughly with a paper towel.

5. Continue to test samples until you find the source of contamination (eg, the extract fluid turns red). You must find *at least one* source of contamination, extra credit if you find more than one! Remember to use your money wisely and purchase samples strategically.

STEP SIX: Complete your EPA Findings Report

The EPA grant requires that all project participants complete a Findings Report, with specific information to be included. Complete a report, to be typed and submitted electronically, which thoroughly answers the following questions:

1. What is the exact location of the source of contamination, indicated by a point on the map, #1-70? If you found more than one source, list them all.
2. What is the elevation of the highest mountain in the *Oh-Be-Joyful* region? What is the elevation of the lowest point? Find the topographic relief - the highest minus the lowest elevation.
3. To the nearest whole degree, what is the latitude of this map? The longitude? Using a latitude and longitude coordinate finder, what State in the US is *Oh-Be-Joyful* located? *Hint*, the following links will be helpful:

http://en.wikipedia.org/wiki/Category_talk:Lines_of_latitude

http://en.wikipedia.org/wiki/Category_talk:Lines_of_longitude

4. When contour lines cross streams, they often make a V-shape. Which way do the 'Vs' point, upstream or downstream? What does this indicate about elevation and river flow?
5. What method or strategy did you use to narrow down your research to the exact source of contamination? Be specific and explain how you arrived at the source.
6. Did you notice a pattern in the way the contamination spread? (eg, the way the different sediment samples along the river released blue, yellow and red pigment?) Explain.
7. Did you notice a pattern in quality of the sediment at different points along the river? (eg rockier vs smoother sediment?) What is the pattern? How is erosion responsible?
8. How much Monopoly money did you spend in conducting your research? Did you budget efficiently, or could you have been more diligent in selecting your samples? Explain.
9. Consider how ubiquitous industrial activity is in the modern world: Everything from the clothes we wear, to the food we eat, the buildings we live in, the way we heat our homes and power our appliances, our means of transportation, our digital devices, hygiene products, medications, even the water that comes out of our faucets, all of it depends on some form of industry. And industry can create an enormous amount of waste, which contributes environmental contamination.

Review the list of industries below, and select ONE, which you will pretend was the culprit that caused the contamination. Research how the industry can negatively impact the environment. Include at least one paragraph in your report of your findings (see next page for list).

- a. Hydraulic fracturing - <http://www.dangersoffracking.com/>
 - b. Plastic Manufacturing - <http://www.motherearthliving.com/health-and-wellness/harmful-effects-of-plastic-ze0z1205zsch.aspx#axzz2iSofRNYJ>
 - c. Pharmaceutical developments - http://www.noharm.org/us_canada/issues/pharmaceuticals/
 - d. Cellular technology - <http://www.greeniacs.com/GreeniacsArticles/Consumer-Products/Cell-Phones-and-the-Environment.html>
 - e. Off-shore oil drilling - <http://science.howstuffworks.com/environmental/energy/offshore-drilling-controversy2.htm>
 - f. Coal mining - http://en.wikipedia.org/wiki/Environmental_impact_of_the_coal_industry
 - g. Nuclear power - <http://www.thedailygreen.com/environmental-news/latest/nuclear-power-pro-con>
10. Industry is not the only cause of river contamination. Individuals are also responsible for ensuring that we do not contribute to pollution. Include one paragraph in your report of five specific ways that individuals can lighten their “footprint” on the planet. The link below has some ideas, or you can find others.
- <http://dsc.discovery.com/tv-shows/curiosity/topics/steps-mankind-can-take-to-save-the-environment.htm>



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