IN THE AIR

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Connecting Activity #3

"Tiptoe Through The Toxics"

6-8 EDUCATION MODULE

EPA

Missouri Botanical Garden

Correlation with Education Standards Summary

Connecting Activity #3
"Tiptoe Through the Toxics"

For a narrative description of these standards, please refer to the Teacher's Guide.

National Standards

SOURCE: www.education-world.com/standards

NS-5-8 .6
NM-DATA. 6-8 .1
NSS-G.K-12 .1 .5

Missouri Show-Me Standards

SOURCE: www.dese.mo.gov/standards

Performance Standards:
GOAL 2: 3
GOAL 3: 1
GOAL 4: 1, 4

Knowledge Standards:
HPE 5
MTH 1, 3, 6
SC 5, 8
SS 5

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Connecting Activity #3

Overview

"Tiptoe Through the Toxics"

Recommended Grade Level:
6-8
Preparation Time:
Time is needed to run photocopies, purchase cereal and gather other materials, determine the area appropriate for the activity, and to measure and pre-cut the strings for marking the grid.
Presentation Time:
Two 60-minute class periods.

In this activity, students will graph the fate of air pollutants to understand that air pollution contaminates not only air, but land, and water as well.

Air pollution comes from natural and man-made sources. Some examples of natural sources of air pollution are forest fires started by lightning, volcanic eruptions, and radon gas.

The man-made sources of air pollution are classified into three groups: mobile sources, such as cars, trucks, and buses; point sources, such as factories, and some electric power plants; area sources, such as homes and small businesses.

Air pollutants can contaminate land and water through a process called deposition. Deposition occurs when particles or droplets of pollution fall from the air or are washed from the air by precipitation onto land and water surfaces. As water travels on the surface of the land, it takes with it pollutants and deposits them into streams and rivers as it flows. Water can infiltrate and percolate into the soil transferring pollutants from the surface into the various layers of soil that drain down into underground bodies of water called aquifers. A watershed may be contaminated with air pollutants produced hundreds of miles away.

Many of these pollutants break down over time into less harmful chemicals. Some mix with others to form more harmful substances. Others remain unchanged and may persist in the environment for many years. Some pollutants enter the food chain and contaminate our food supply through the process of biological magnification.

Goal

- To provide a model for understanding air pollution deposition and transportation

Objectives

When this activity is completed, students will be able to do the following:

- Describe how air pollutants can pollute the water and land.
- Analyze the dispersion of "pollutants" in the environment by mapping a sample distribution.

Materials

The students will need the following on the day of the activity:

- Clipboards or other hard surface to write on.
- One copy of the "Student Grid Worksheet" sheet C for each student.
- Pen or pencil.

For the grid you will need an 8' x 10' area or larger, up to 40' x 50'.

To construct the grid you will need 2-4 people. Please refer to the "Sample Setup" sheet B, for more details. You will use the following:

- Enlarge and make two copies of the "Grid Location Signs" sheet A. Cut signs apart.
- Measuring tape (two will make the setup go faster). You can also pre-measure, mark, and cut strings ahead of time.
- String to mark gridlines, 60 yds for the smallest grid, approximately 300 yds for the largest grid.
- Scissors.
- Masking tape to tape the string to the floor if you are conducting the activity indoors.
- If you are outdoors, 36 stakes, rocks, or other heavy items that can be laid on the ground to weigh down string. (Student's books may work for this.)
- Location signs, attach to stakes with duct tape. If you are indoors the location signs may be taped to the floor.
- Four safety, or traffic cones to mark the corners of the field. You can also use four small empty trash cans turned upside down.

To represent toxics, use the following:

You will need four different shapes of cereal to represent four different pollutants

- 2-5 cups of Honeycomb type cereal (large flower shaped).
- 2-5 cups of Fruit Loop type cereal (doughnut shaped).
- 2-5 cups of Kix type cereal (spherical shaped).
- 2-5 cups of Captain Crunch type cereal (square pillow shaped).

For classroom follow-up:

- Four copies of the "Grid Outline" sheet D, copied onto transparencies. Each team will record their results onto one of these.
- One copy of the "Watershed Map" sheet E on a transparency.
- Overhead projector.
- Four colors of overhead markers.

Vocabulary

adverse health effects

A negative impact on human health that results from exposure to pollutants, ranging from mild and temporary eye and throat irritation, and chronic conditions such as asthma, to permanent or serious conditions such as birth defects and cancer.

airborne toxic

A harmful chemical air pollutant that can cause adverse health effects. Also known as an air toxic or a hazardous air pollutant (HAP). See adverse health effects.

area source

A stationary source of air pollution producing less than ten tons per year of one hazardous air pollutant or less than twenty-five tons per year of all HAPs. Examples include road dust, farm dust, fireplaces, dry cleaners, etc. A pollutant that cannot be traced to a point or mobile source is attributed to an area source.

biological magnification

Refers to the process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into rivers or lakes, and are eaten by aquatic organisms such as fish, which in turn are eaten by large birds, animals or humans. The substances become concentrated in tissues or internal organs as they move up the chain.

mobile source

Vehicles are mobile sources of air pollution. They are sub-divided into on-road and off-road vehicles. Some on-road sources include automobiles, motorcycles and trucks. Some off-road sources include tractors, bulldozers, boats and airplanes.

multi-media approach

Joint approach to several environmental media, such as air, water, and land. USEPA uses the word media to refer to a specific type of environment. A multi-media approach is where efforts and actions are orchestrated to consider and address impacts on multiple environments.

point source

Point sources are stationary, specific points of origin where air pollutants are emitted into the atmosphere. One example is a factory smokestack. Point source refers to a source that produces greater than 10 tons of one hazardous air pollutant or greater than 25 tons of all HAPs produced, combined, and emitted per year.

watershed

A watershed is the land that drains into a common set of creeks, streams, and rivers that connect to a standing body of water, such as a lake, ocean, or underground aquifer.

Procedure

1. Designate an area in which to conduct the activity. You may use an area as small as 8’ x 10’ or as large as 40’ x 50’. After determining the size of the grid, measure and cut strings to mark length and width. Mark every foot if you are using an 8’x 10’ space, and every five feet if you are using a 40’ x 50’ space. If conducting the activity outdoors, mark the corners of the grid area with safety cones or trash cans so they are easily seen. Place stakes or other markers along all edges of the grid so that students can determine the grid squares *see* “Sample Setup” sheet B .

2. Introduce or review the water cycle and the term watershed. To help students understand watersheds, trace your hand, wrist, and part of your lower arm on the board as in the drawing below. Color the spaces between your fingers and label your arm the “The Big River.” The spaces that are between the fingers represent the land and the fingers represent the smaller rivers that feed into “The Big River.” Watersheds typically are named by the largest stream or river. So in this case, it would be called “The Big River Watershed.”

3. Explain that we also have a body of air that is shared with other places. Just as a pollutant can be transported throughout a watershed, an air pollutant can travel through the air far from where it was first introduced.

4. Explain that deposition occurs when pollutants fall from the air or are washed from the air by precipitation and deposited onto land and water surfaces.

5. Divide the class into four teams and assign each team a pollutant which is represented by a type of cereal. Distribute copies of "Student Grid Worksheet" sheet C.

6. Select four students (one from each team), and give them one type of cereal to distribute at the various locations as shown on the "Sample Setup" sheet B. Students are to gently toss the cereal in the general areas marked. To duplicate the two circular areas on the grid, students can spin in a circle to achieve the proper pattern.
   The "pollutants" do not have to fall exactly as shown on the grid but in the same area.
   Note: You may choose to distribute the cereal yourself or have the four students distribute it out of view of the rest of the class.
   If you are conducting the activity outdoors, the wind may change the locations in which the cereal lands. Keep the wind direction and strength in mind when discussing results.

7. After the cereal is distributed, have the teams record on their worksheets with a pen or pencil where their pollutants have landed. Tell them they should *approximate* how many pieces of cereal there are. They do not need to count them. The team members should cover all sections of the grid.

8. Ensure that all of the surveying has been completed and recorded.

9. Clean up.

End of First Session.

Second Session

10. Assign each type of pollutant a marker color and distribute a marker to each team. Each group will compile its results on an overhead transparency by placing the transparency over its worksheet, aligning the corners, and marking the results. (Four photocopies on transparencies of the "Grid Outline" sheet D will be needed. One copy per team.) Review point, area, and mobile sources. Looking at the their individual results, have each team determine the type of source their pollutant represents. The patterns should be discernable: Along the bottom edge = mobile, two circular areas = point, pollutants scattered all over = area.)

11. Using the overhead projector, display one group's results from the grid worksheets. Where does the class think the sources of each pollutant were located? (Some along the bottom edge, one scattered throughout the entire grid, two in circular areas at opposite

ends of the map.) Do the pollutants on the map represent an area, point, or mobile source?

12. Overlay a second color result on top (aligning corners) and continue until all results are displayed. The students will see a representative map showing the distribution of pollutants on land. Do any patterns appear? Was the wind blowing on the day of the activity? If so, did it affect your results?

13. We know from the activity where on the surface the pollutants landed. Look at the following locations on the map: H-1, A-2, D-5, and G-10. (Depending on your results other locations may better illustrate the movement of pollutants). Make a list of what pollutants are present.

14. Overlay the map transparency (Copy "Watershed Map" sheet E onto a transparency) on the overhead aligning corners with the other transparencies. How has the watershed affected the disbursement of pollutants?

15. Review the final map showing all the pollutants on the watershed. Trace several of the smaller rivers or tributaries into the river and note which pollutants the water would be carrying. (This would include any pollutants that fell on the river itself as well as any that would have washed into the water from the land in that area.) Water, land and air are referred to as environmental media. When an air pollutant contaminates more than one of these media it has a multimedia impact. (Some pollutants can evaporate from land and water to contaminate the air.)

    Sometimes, making choices to lessen the impact on one media by transferring waste to another is possible, for example, a dry cleaner may switch processes to a wet-clean method in order to decrease air emissions, but may increase its discharges into water. When pollution occurs, it is most effective to take an approach to addressing all three media of air, land, and water, to assess where the least damaging impact occurs.

16. Assume the watershed represents the area you live in. Talk through the discussion questions found at the end of this activity, identifying what affects our drinking water and what we can do to reduce air pollution.

Discussion Questions

1. What does the cereal represent? *(air pollutants.)*

2. When pollution is deposited from the air onto the land, does it stay in one spot? *(No. It is carried throughout the watershed on the land through the mixing of water.)*

3. What does this mean for people who live downstream from pollution or live by large lakes or by the ocean? *(Pollution can affect people, plants, and animals up to thousands of miles away and can affect those in other parts of the world.)*

4. Where do we get our drinking water from? *(Our watershed)* What is our local source of water and how might air pollutants affect it? *(Determine your local water source. Almost every water source is affected by pollution. Identify some local or regional air pollution sources or human activities that affect your air and watershed.*)

5. If water testing was conducted using water from the locations in procedure step 13, which pollutants would be found in the sample? Compare these results with your previous results. *(Water testing would show what pollutants may have traveled to the area from another location.)*

6. Our activities affect the air quality which we have learned impacts our land and water. What can we do to reduce air pollution? *(Solicit ideas. Refer to web sites listed in the Teacher's Guide and to the materials in the Core Activity "Cleaner Air Everywhere!".)*

Conclusion

Air pollutants can travel far from where they were first produced contaminating the air, land, and water. To effectivly reduce pollution all parts of the environment must be considered, land, air, and water.

Extensions

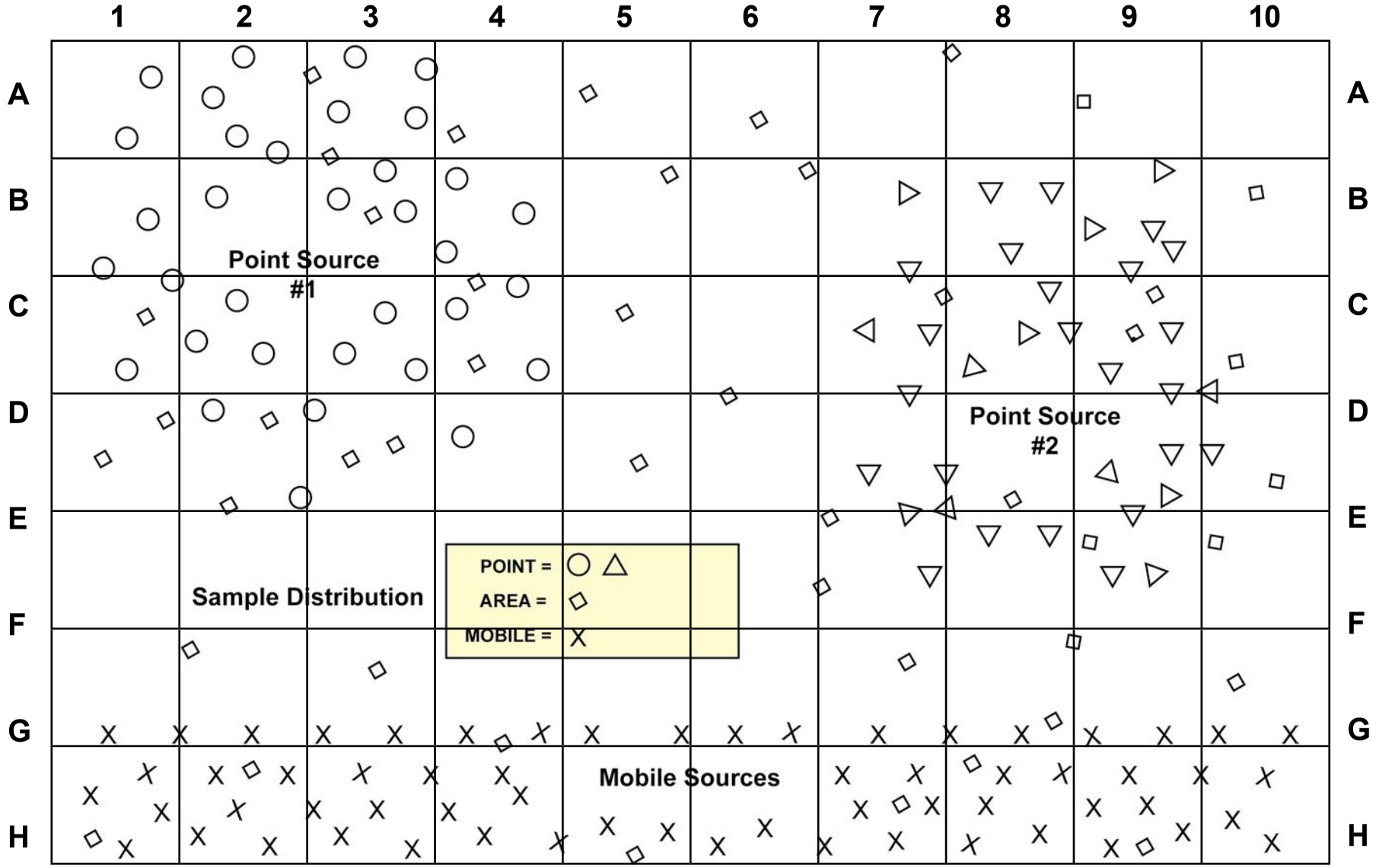
- Expand this activity to include a fifth pollutant that is shared by more than one source. Mix a fifth type of cereal in with the cereal used, one for each of the point sources. This pollutant will show in the results of the water test. Is it possible to identify where the pollution came from at each of the testing sites? *(No, not entirely, with multiple reasons why this is so.)*

- Investigate pollution control methods used by point sources by building your own wet scrubber or electrostatic precipitator. *See* Texas Natural Resource Conservation Commission Web site at: www.tnrcc.state.tx.us/air/monops/lessons/airpollutionlesson.html for complete lesson plans. On the same site, you will find plans to construct your own black carbon sampler and calculate the volume of your sample.

- Learn about an air monitoring project in St. Louis. See http://www.stlcap.org.

A	B	C	D	E
F	G	H		
1	2	3	4	5
6	7	8	9	10

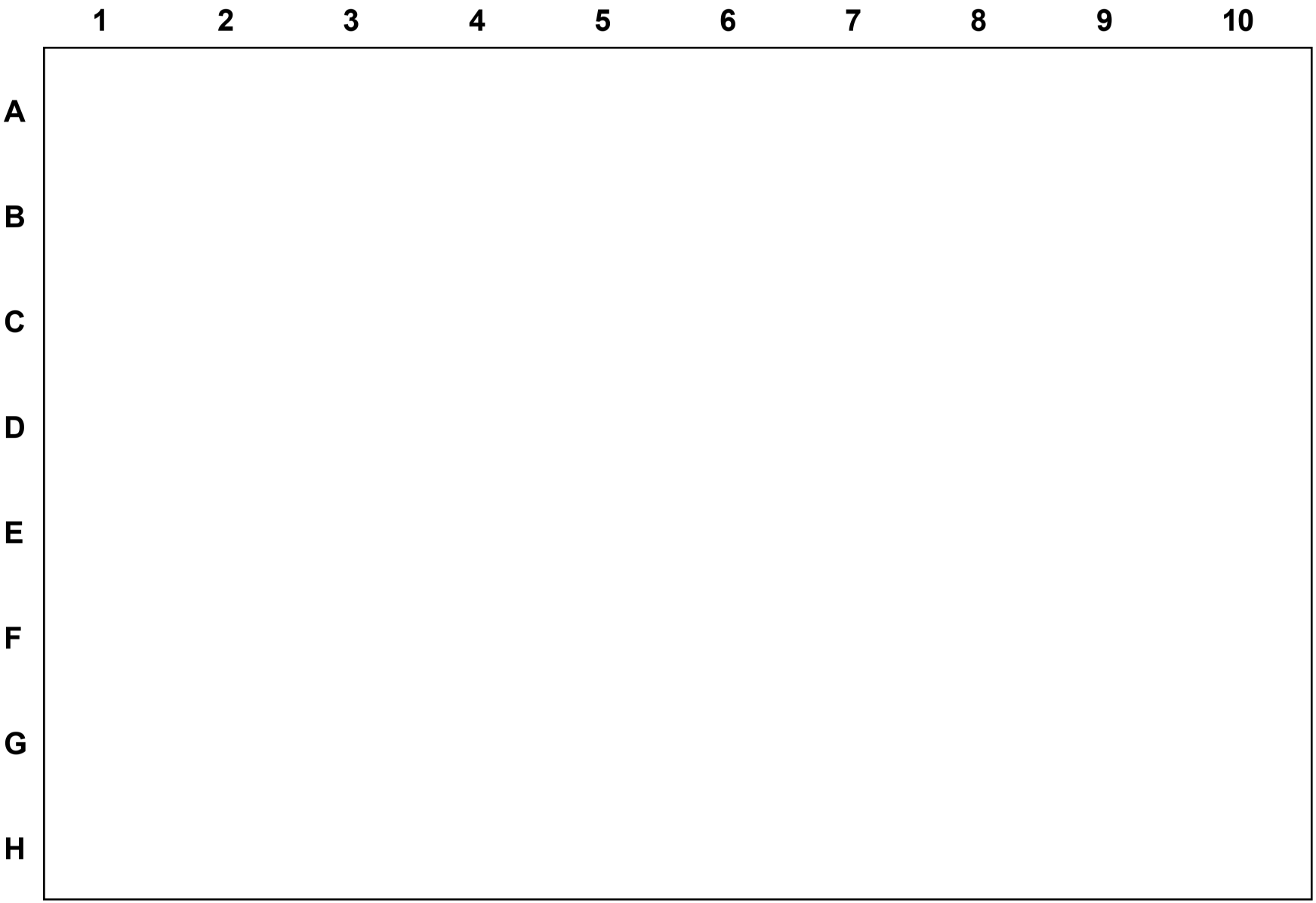
“Grid Location Signs” sheet A



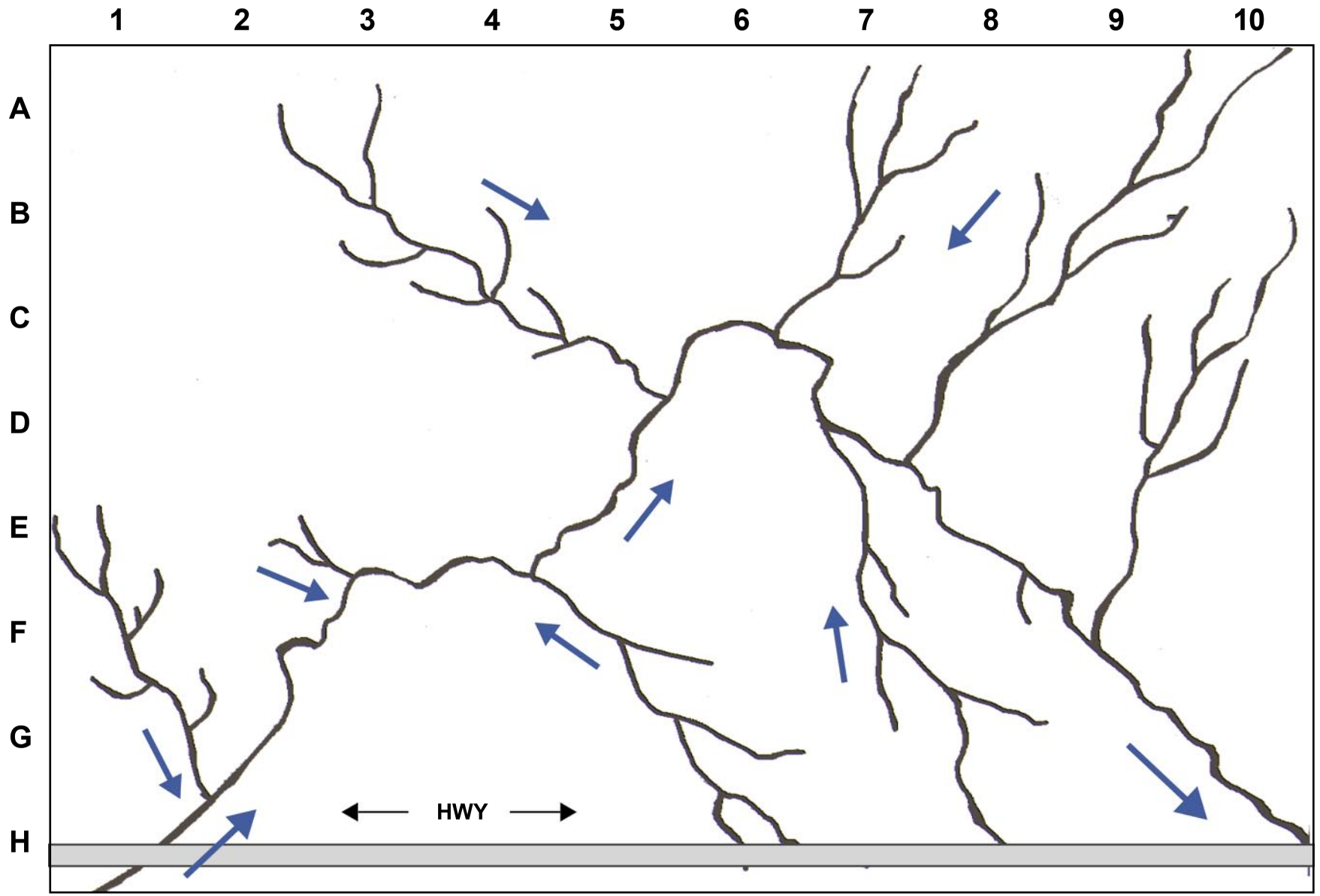
"Sample Setup" sheet B

	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E										
F										
G										
H										

“Student Grid Worksheet” sheet C



“Grid Outline” sheet D



“Watershed Map” sheet E