

The teachFASTly.com resources are not intended as a complete curriculum. The activities are designed to be woven into your existing teaching. This Quick Stop Lesson Plan is therefore not a single lesson plan, but rather a quick way of exploring the themes of an Activity Map. It includes one Discover activity, one Delve activity, and one Debrief activity. Together, these may take more than a class period, and you may want to add other activities between them. For more information, visit www.teachfastly.com.

Water, Ecology, and Neighbors

Water, ecological science, justice, and the Golden Rule—are they connected? If so, how? This Activity Map explores the connections between these concepts. Water is essential to the flourishing of all living creatures; when our water supplies become polluted, our well-being and our ecosystem's well-being are threatened. Water pollution is a concern that should engage our willingness to care for creation, and call us to focus on how our actions affect others. Who lives downstream from us, and who lives in the places where pollution accumulates the most? Loving our neighbor and seeking justice both become relevant when we realize that the effects of our actions on our watershed can have damaging effects on others. Science is a necessary tool to employ, as we take responsibility for understanding and ameliorating any harmful results of our actions.

This Activity Map aims to help students to see how something as simple as water, and something as central to faith as the call to love one's neighbor as oneself, can intersect with science learning. It facilitates engagement in thinking carefully about our ecological responsibility toward others.

It is recommended that work on this topic be coordinated between science and Bible teachers, and that good communication with parents be practiced.

This Quick Stop Lesson Plan on **Water, Ecology, and Neighbors** contains the following activities and attachments from www.teachfastly.com, which are combined for your ease of use in a downloadable ZIP file:

DISCOVER Activity: Hand Watershed

DELVE Activity: Design a Watershed

Activity Attachment

- *Design a Watershed Handout*

DEBRIEF Activity: Ecological Diagram

Activity Attachments

- *Ecological Diagram 1 Handout*
- *Ecological Diagram 2 Handout*

DISCOVER

Activity: Hand Watershed

Time: 10 minutes

In Brief

This activity engages students in a practical, experiential introduction to the concept of a watershed, and to how pollutants can travel within a watershed. It also helps students to see how the idea of loving our neighbor as ourselves might be relevant to the workings of a watershed.

Goals

Students will understand what a watershed is and where water moves to and from within a watershed.

Students will understand how surface runoff carries pollutants to waterways, and will connect this understanding to the idea of love of neighbor.

Thinking Ahead

A watershed is an area of land that drains water to a common point, whether creek, river, lake, or ocean. This can seem very basic; it is easy to focus on the water and forget that the water is interacting with the land. Understanding that a watershed is an *area of land* that drains is important to understanding pollution.

Most countries have laws against factories dumping pollution directly into waterways, yet waterways continue to face pollution from surface runoff. Stormwater runoff picks up pollutants from the surface of the landscape and carries them to the waterways, making unhealthy conditions for the plants, creatures, and people living nearby.

Pollutants may not be obvious at first. For example, bacteria from animal and human waste is not noticeable to the human eye, but can cause sickness and odor. Sediments, rapidly changing hydrology (flash flooding), heat from parking lots, trash, toxins leaching from old industrial sites, and excess nutrients from fertilizers or yard waste are more examples of how properties of the landscape change water conditions.

The difficulty with this nonpoint source pollution is that everyone who lives, works, or travels through the watershed is responsible. The way the land is used and developed is reflected in the water, and the water coming out of the watershed tells us a lot about how people there are using the land. As we affect the water passing through a watershed, we also affect those downstream from us. The connections between yard waste or lawn fertilizer, water quality, and love of neighbor might not appear immediately obvious to students, but helping them see and make such connections is an important part of teaching FASTly. This activity introduces these connections for further study later.

Preparing the Activity

Needed:

- Spray bottles containing water (one for each group of 4 or 5 students in the class)
- Towels (cloth or paper)

Teaching the Activity

Instruct students to cup their hands together with their palms up and tilted a little, one way or the other. Explain that their cupped hands represent their own little topographical map of a watershed: an area of land with mountains, hills, streams, and maybe a lake.

Ask students to look at their cupped hands and reflect on the following questions:

- Is your watershed flat, or does it have high and low points?
- What could those lumps and creases in your watershed be?
- What do you think would happen if it were to rain on your watershed?
- If water were sprinkled onto your hands, in what directions would it move?
- Where would it go?
- Why?

Group students and choose someone reliable in each group to use a spray bottle to spray a little water onto each student's hands. Instruct students to hold their hands still as this happens.

Ask students to observe what happens, and to compare it to what they had imagined.

- Where does the water flow as it collects on the skin and runs into the creases and finally drips from the hand?
- What happens to water that falls either side of the highest point?

Next ask students:

- If you had peanut butter, bike grease, dirt, germs, or other pollutants somewhere on your hands, what would happen to these pollutants?
- Where would they end up?
- How would you feel about drinking the water that dripped from other students' hands?
- If you had to drink it, what would you want to know about their hands?
- What is a real-life parallel—what washes into the water system from streets and yards when it rains?

Ask students what the process they have just observed might have to do with the biblical call to love our neighbor as ourselves. This may be a surprising question after the focus on observing water flow. Nudge students to imagine their hands again as a watershed, and to think about what happens when some people live downstream from others and pollutants from one group of people flow down into the living areas of others. Do not turn this into a long or heavy discussion; the purpose for now is simply to introduce the connection between watersheds and our responsibility toward others.

In conclusion, write the words "watershed," "land," "water body," and "drain" on the board and ask students to come up with a definition of "watershed" that includes those words. To follow up, ask students to find out in which watershed their home and/or their school is located.

DELVE

Activity: Design a Watershed

Time: 30-45 minutes

In Brief

Students will each design their own plot of land and then connect their plots to make up a watershed. This leads to a definition of “watershed” and a discussion about what happens when it rains and stormwater washes over their landscape and down into the waterways. What are the implications for the natural resources, community, and downstream neighbors?

Goals

Students will understand how water moves across a landscape and defines a watershed.

Students will understand that water quality is affected by land use, and that land development and stormwater management are environmental justice issues.

Students will develop ideas for how to care for streams and rivers and downstream communities.

Thinking Ahead

This activity puts students in the role of developing their own plot of land and then looking at what happens when rainfall makes their land just another piece of a watershed puzzle. It gives students increased awareness of how their choices affect others around them as well as the creek specifically. Finally, it allows students to make adjustments to their land use to protect waterways and downstream neighbors.

Watersheds work as unifying natural boundaries whether or not they are recognized by human boundaries. Within the same watershed, many governing bodies (cities, counties, townships) may coexist, each often making different rules without consulting those downstream who are directly affected by the regulations as the water washes all things downhill. In some communities, people identify themselves by their watersheds or valleys, while in other communities people do not even know that there is water running underneath their streets. Becoming aware of watersheds and running water helps make people aware of how their land-use choices and other choices impact the quality of life for creatures and people living downstream from them, if not for those in their own community. Christians can gain from improved awareness of past broken choices regarding land use and water in order to learn to care well for the land, the water, and their downstream neighbor. As Wendell Berry puts it, “Do unto those downstream as you would have those upstream do unto you.”

Preparing the Activity

Needed:

- Copies of the watershed (30 sheets, 8.5x11 is suggested), printed from the **Design a Watershed Handout**. If you want to make a watershed puzzle in the shape of your local watershed, lay out a grid of office paper (tape the sheets down) and draw a shape sim-

ilar to the watershed onto the grid, including outlining the major waterways and tributaries. Then number the sheets so that you can reconstruct it later. Define the lines with a thick marker. Finally, make a master copy of each sheet, so that you can reproduce the grid on future occasions as needed.

- Markers, colored pencils, or crayons (or instruct students to bring their own). Make sure to have lots of green, blue, brown, and black, as these are the most frequently used colors.
- Pictures of pollution (these are optional, but helpful) printed from free online clip art sites or magazines. You can laminate these if you wish to reuse them. Suggestions: oil, poop, cows, piles of leaves, heat waves, soap containers, toilets, salt bags, dirt piles, creepy looking monsters (bacteria), trash cans or piles of trash, piles of food waste, plastic bags, pets/pet waste, geese, etc.
- Chalk (if doing this lesson outdoors on pavement).
- A large, clear area on the classroom floor to put the puzzle together with enough space for students to congregate around it and discuss it.

Teaching the Activity

Hand out the watershed pieces randomly, so that students sitting next to each other cannot put their sheets together and start formulating the idea that they are neighbors (that should come later). Do not tell students what the activity is, or why they are doing it, or anything that will give them any preconceived notions of what is going on beyond logistics. Do not tell them what the numbers are for. If you wish, you can tell the students a framing story: “You have just stumbled upon a piece of property. It is all yours and you can use it however you want. Your imagination is your only limitation. You only need to decide what to do with it and show us this with images, words, or symbols on your property. You may consider how you will live off of your property and what you will pass on to your children.”

Provide logistical information: “If you have black lines on your land, they represent waterways, creeks, lakes, streams. If you have no black lines, you do not have any surface water on your land. You all have about 10 minutes to dream and draw your ideas. If it is helpful, think about what your property will look like from space or Google Earth when you draw it; you don’t have to make things 3-D. You may not have enough time to make careful drawings with pencils, so just go for it and capture your ideas.”

Do not give students ideas of what to draw unless they are really stuck. If so, then ask them what they are passionate about or interested in: sports? shopping? video games? food? Suggest they do something along those lines. Or ask them what their favorite place to visit is: What is their dream vacation activity? Where do they go to relax? Suggest they use this to create a piece of landscape.

Sometimes if a class is being very uniform in their ideas (e.g., 15 farms or soccer fields), it may be helpful to ask if anyone has thought about how to supply energy, or community gathering areas (e.g., library, school, town hall, church), or entertainment, or restaurants.

After 10-15 minutes, give a 1-2 minute warning and ask students to start gathering in an open area with space to put the puzzle together and enough room for everyone to stand around it.

If you have a large enough piece of butcher paper, you could make a grid that is numbered to indicate where students should place their property, but this isn't necessary if you don't mind helping to place them in the order you created. The provided watershed sheets are to be laid out in a grid like this:

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

Tell students not to worry about the different styles of the drawings. Explain that we have now laid our properties out and created a watershed. Ask students to help you come up with a working definition of a watershed (an area of land that drains to a common body of water or common point). They could imagine that the edges of the map are raised like hills or mountains and that the waterways are the low points flowing out to the very lowest point, where the river meets the next body of water.

Ask for volunteers to explain how they developed their property. This can take as long as you want. Look at your watershed and try to choose sharers who have chosen a variety of ways to develop property. As they are sharing, drop pieces of pollution on their sites. Since the common sources of pollution in the particular watershed depicted here are mostly from storm-water that washes pollutants into streams, drop oil blobs on parking lots and roads or cars. Drop trash bags and other trash in areas of heavy traffic or parks with woods. Put dead fish in a creek that is downstream from factories or other heavy polluters. Put cows and manure on farms or in yards that might have pets. Put salt on roads, etc. Nonchalantly keep the conversation going as you do this, avoiding giving the impression that students are being punished for sharing their creations; you are just describing reality. Do something to each site if possible so no one feels singled out.

Ask questions to help students think further through the effects of their properties and to help students connect their property to the properties up or downstream from them:

- How does your property affect the river? The downstream neighbor?
- How does the cow farm upstream affect your kayak business?
- How big will the parking lot need to be for your shopping mall?

Next, briefly discuss stormwater runoff. Ask students to help define stormwater runoff (excess surface water that flows across the land into the waterways from snowmelt and rain), and then think about what else might wash from their properties when it rains. Where do those things end up? As you talk, move the pollutants from the land into the stream and down the creek. Talk about accumulation, and how the pollutants accumulate in the stream, so that as the water continues downstream, water quality gets worse and worse. We can learn a lot about how the land is being used by the quality of the water leaving the watershed. What does this water tell us about the watershed we have developed?

After visualizing the pollutants washing downstream, ask the downstream property owners how they feel about all of those things washing down to them. They will have a variety of answers, but people who actually live in these downstream communities will have the most poignant comments. Ask the downstream puzzle property owners what they would want to communicate to the upstream owners if they had the chance. They usually say something like, “Stop sending that stuff down here! Quit polluting!”

Tell students that they did not get a choice today about where their property would be; it was randomly assigned. Ask them where they would choose to live if they had a chance to choose, and why. They usually choose the headwaters or edges of the watershed, because water is clean there.

Offer a hypothetical situation where the land is distributed in a different way; people can bid on the land, and the plots can be purchased. Who would live in the headwaters of this developed watershed? The people with more money would outbid the others (this part may need to be adjusted to fit different cultural situations, but generally, wealthier people get the better living locations, while lower income people live where they can afford, often in compromised and/or dangerous areas). Who would live downstream? The people with the least money would live on the least desirable plots, probably facing pollution. People of color and lower income neighborhoods are typically located downstream, and receive a disproportionate amount of the pollution from polluted waterways. The land values of polluted areas are lower.

Next, discuss solutions. How can we make this a healthy watershed for all the residents (including plants and animals)?

Here the activity can be taken in various directions. One option is to focus on stormwater management. Slowing stormwater and allowing it to sink into the groundwater cleans it before it reaches the creek. Sediments settle out, bacteria die off, plants absorb nutrients, even some chemicals can be broken down by the process of soaking through the ground.

You could also focus on land use. Changing some of our land uses can help restore health and beauty to the creek. Some ideas include:

- planting trees
- restoring the edges of streams so they are covered and surrounded by native plants and trees
- capturing stormwater off of hard surfaces with rain gardens before the water runs into the storm drain (and into the creek)

The students may come up with other ideas like reducing trash by reusing bags, and taking the bus or biking to reduce air emissions and pollution from cars. They could fence off domestic animals to keep them from going into the creek, and compost animal waste before applying it to farm fields. Discuss with students how to give the downstream communities a voice to speak up about pollution and how to mobilize the community to value its resources and promote change.

After some brainstorming, send students back to make some changes to their properties to protect the water and show some love to their downstream neighbor. You can optionally extend this work into brainstorming exercises and research projects.

End the activity with the challenge to “Do unto those downstream as you would have those upstream do unto you.” Tell students that this is a quotation from Wendell Berry, and ask them if they can identify the more famous saying on which it is based. (Jesus’s formulation of the Golden Rule is found in Luke 6:31.)

Optional Outdoor Chalk Option

Sometimes you need an outdoor activity. If there is cement and chalk on hand, “Design a Watershed” can be altered and done outdoors.

Draw a big random shape (large enough for the entire group to have a good section of cement to draw on, but not so big that there would be blank areas between people), with a definite drain at one point. Using blue chalk, draw a waterway with a few tributaries inside the shape.

Introduce the activity as above. Have the students stand with their toes on the outline of the shape and tell them that they are standing on the hills or mountains surrounding a valley where they are all going to live now.

They can all use the chalk to develop their new home, but should keep in mind how they are going to provide for themselves and their children. Recommend that they draw things the way a bird would see them if flying over the valley. Let them know that the blue lines represent waterways. Remind them that they must develop their land only within the shape.

As compared to the paper version, students are more aware of each other and how their properties connect. You could suggest someone make roads to connect businesses and properties. When the development is finished, the conversation that follows is the same as with the paper watershed puzzle.

DEBRIEF

Activity: Ecological Diagram

Time: Extended

In Brief

This activity engages students in visually representing scientific information, and teaching it to an adult conversation partner with an emphasis on both clarity, and respectful and supportive communication. It can be used to assess student understanding.

Goals

Students will create an accurate visual representation of stormwater concepts.

Students will practice explaining scientific information to an adult conversation partner, with an explicit focus on respectful, supportive communication.

Thinking Ahead

This assignment fosters parent-student interaction, or interaction between the student and another adult, related to the topics being covered in science class. It invites you and your students to see faith and science questions as matters involving a wider community. Teaching FASTly includes valuing relationships.

School learning can increase distance in family relationships, as students' learning goes beyond their parents' and relatives' knowledge. Parental involvement can be reduced to helping monitor homework deadlines. This activity invites students to consider how sharing their learning can strengthen relationships. It involves practicing good communication with family members on scientific topics.

If you plan to regularly involve parents and other adults in homework activities, it is advisable to communicate with them early in the school year about why this is happening, so that expectations are clear. (See the Activity Map on Engaging Parents.)

Preparing the Activity

Needed:

- A copy of **Ecological Diagram 1 Handout** and a copy of **Ecological Diagram 2 Handout** for each student. Each is a half-page in length.

Directions:

Plan to assign the activity over enough days for students to be able to arrange a conversation with an adult.

Teaching the Activity

Explain to students that they must illustrate the concepts that they have been studying relating to watersheds and ecology. Give students the **Ecological Diagram 1 Handout**, which lists the following items:

- bacteria
- flashy flow
- heat
- land use
- nitrogen
- phosphorus
- pollutants and nonpoint source pollution
- sediments
- stormwater
- toxins and trash
- water cycle
- watershed

Instruct students to create a clear diagram illustrating these concepts, specifying that it has to both be **accurate** in its representation of the scientific information, and **accessible**, in the sense that it is suitable for teaching that information to another person. It should, for instance, be large enough to show to another person while explaining what it represents. Allow time in class for students to create their illustration (or assign as homework), and check the students' work for accuracy and clarity.

Once the diagrams have been completed, tell students that they will now use their illustration to teach the material to a parent or other adult. Allow a few minutes in class for students to rehearse sharing their illustration with a partner. Instruct students to give feedback to their partner on the clarity and pace of his/her explanation and the supportiveness of his/her demeanor as he/she teaches.

Give students a few days to arrange to meet with a parent or other adult to explain the science behind their illustration. Discuss explicitly with students what might count as supportive, respectful behavior while teaching another person (e.g., no eye-rolling if points are not understood at first), and specific strategies for showing interest in a person's questions ("That's a great question. I wondered about that myself..."). Give students a copy of **Ecological Diagram 2 Handout** and tell them to have their adult conversation partner fill it out. The student should bring back the completed paper. Once the assignment is complete, allow a few minutes in class to debrief about how the conversations went.