Bacteria in your watershed
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Human activities can result in pollution of water resources such as streams, lakes and groundwater. Pollution results from two sources: **POINT SOURCES** and **NON-POINT SOURCES** (see figures). A pipe that carries storm water, municipal wastewater or industrial waste, and drains directly into a water body is considered a **point source** of pollution. On the other hand, water from rainfall and snowmelt that flows over the landscape to reach surface water bodies can pick up contaminants from the landscape and carry them to streams and lakes. This contaminated **runoff** serves as a **non-point source** of pollution.

Urban and agricultural runoff are non-point sources of pollution

Sewage outfalls are point sources of pollution

Farm runoff carries sediments, fertilizer, pesticides, and bacteria

**Environmental stewardship** measures such as adding **cover** to barren soil or leaving **residue** on crop lands can reduce the ability of rainfall to pick up and carry pollutants. Other **conservation practices** such as **grass buffers** can hold sediments and prevent pollution of surface water.

**Pollution** in a waterbody can be due to activities by humans such as landuse changes such as building cities, farming, or discharge of waste, but it can also occur from natural events such as volcanoes, extreme storm events, or earthquakes. Pollution is often due to changes in the **chemical, biological** or **physical** properties of the water such as the introduction of specific chemicals (such as pesticides, nitrogen or phosphorus) or bacteria or changes in the physical properties such as an elevated temperature.

Bacteria are everywhere, and **many bacteria are good for us**. Good bacteria grow in your body and help your digestive system work – they also inhibit growth of bad bacteria that can make you sick. Bacteria are also used to make foods such as yogurt.

Some bacteria are also **pathogens**, and when pathogens get into waters, they pose an immediate risk to human health. **Waterborne diseases** are estimated to be responsible for 900,000 illnesses and 900 deaths per year in the United States. When a person is exposed to a pathogen while swimming in a lake or stream they can run a high fever, get a rash, or have an upset stomach. To protect people from pathogens, we collect water samples and test them to make sure the water is clean. It is difficult to analyze a water sample for pathogens, so instead, we test for the presence of ***E. coli***, a bacteria that is often found in the same places as pathogens. If *E. coli* is present in a sample, then pathogens might also be present.

Pathogens are passed from one human or animal to another. Pathogens can be found in many different places in a watershed and can end up in a stream as either a point or nonpoint source of pollution. Many farms that raise animals apply manure (also called **POOP**) to fields to recycle nutrients. These nutrients help crops grow but the manure can contain pathogens. Care must be taken to prevent pathogens from running off into surface waters after a rainfall event when manure is applied to the land. Pathogens can also be added to waters by **wildlife, pets, and humans**.

Cattle manure can be applied to the land or directly deposited on the land by the animals. Sometimes cattle are allowed to have access to streams.

Chickens and pigs can live in confined barns called animal feeding operations or outside.




When animals live in barns, their manure is collected and applied to crops. Manure can be spread on the surface or injected in the soil so nutrients are closer to the plant roots.


For this activity you will build a watershed and place several farms on the landscape. The farms will have animals so you will need to apply the manure to the land. For this activity our poop will be candy pieces, pudding, sprinkles and syrup! After you apply the manure you can simulate a rainfall event and watch how the manure (and bacteria in the manure) move from upland areas to the water. Next, add some conservation practices to your farm. How effective were your conservation practices? What would you do differently in the future? How do the choices that farmers make have an impact on people who use waters for swimming, fishing, and drinking? Why this is important for society?

**Step 1: Shape your watershed**

Collect your starting supplies for each group:

1 Plastic tub
1 Gallon bag of clay
1 Wire watershed shape
1 Foam board bedrock form

Additional supplies for your watershed:

1 bag of gravel
1 bag of colorful sediment

To make the starting shape for your watershed:

- Place the foam board bedrock at one end of your plastic tub
- Place the wire watershed shape over top of the bedrock form
- Mold the clay over your watershed shape, covering the entire form evenly. Make sure your watershed slopes so that the water will flow toward the center.

Now form a stream through the center of your watershed:

- Press the clay down where the indentation in the middle of the watershed form was
- Add gravel and sediment along the stream and press down gently to hold everything in place

**Step 2: Add your farms and land cover (2 or 3)**

Decide what types of farms you would like in your watershed, then collect the supplies you will need to make your farms.

Some of the available supplies:

Farm animals (cows, pigs, chickens, horses, goats)
Popsicle sticks, String, Toothpicks

Work together to build your farms in your watershed.

**Step 3: Add manure and observe what happens in your watershed when it rains**

Now that you have your farms in place, you can see where you will have manure (and maybe pathogens). Apply the different kinds of animal manure to the different farms. Where would the animals' manure be applied? Do the animals have access to your stream? Observe what happens in your watershed when it rains. Use a watering can to make rainfall over your watershed. Where does the water go? What happens to the manure?

**Step 4: Apply some conservation practices to reduce your "manure runoff"**

Now that you have observed where the manure goes, think of ways to reduce the amount of manure getting into your stream. Add these conservation practices to your watershed. Be creative, and use any of the additional supplies that you think will be useful including trees, fence panels, and grass.

**Step 5: Observe what happens when it rains with your conservation practices in place**

Apply some more manure to your watershed if most of your manure washed away with your last rainfall. Remember to only apply the manure in the areas where it would likely be (where the animals go, where the manure is stored, or where the manure is placed as fertilizer). Then make it rain again over your watershed. Do you see any differences in what happens to when it rains now? Is your water cleaner?

Picture references:www.garthlenz.com; http://commons.wikimedia.org/wiki/File:Liquid_Manure_Application_Machine_-_geograph.org.uk; http://extension.usu.edu/waterquality/htm/agriculturewq/manuresolutions; http://seedstock.com/wp-content/uploads/Wallace-Farms-Feature.jpg; http://www.wallacefarms.com/media/img/photos/nick-working-on-fence.png; http://www.nrcs.usda.gov/Internet/FSE_MEDIA/nrcs142p2_004349.jpg; http://www.google.com/; http://upload.wikimedia.org/wikipedia/commons/e/e0/Free_Range_Hens_-_geograph.org.uk_-_342791.jpg;http://amestrib.com/sites/files/article/321697_web_hogs01.jpg; http://www.eucalyptusmagazine.com/Blogs/Earth-Talk/May-2010/The-Bane-of-Hog-Farming-Operations/EarthTalkHogFarms.jpg;http://1.bp.blogspot.com/_eAPV4mkJdeU/TGxF11-vuSI/AAAAAAAAAYg/_FAzQaChCfk/s1600/IMG_2372.JPG

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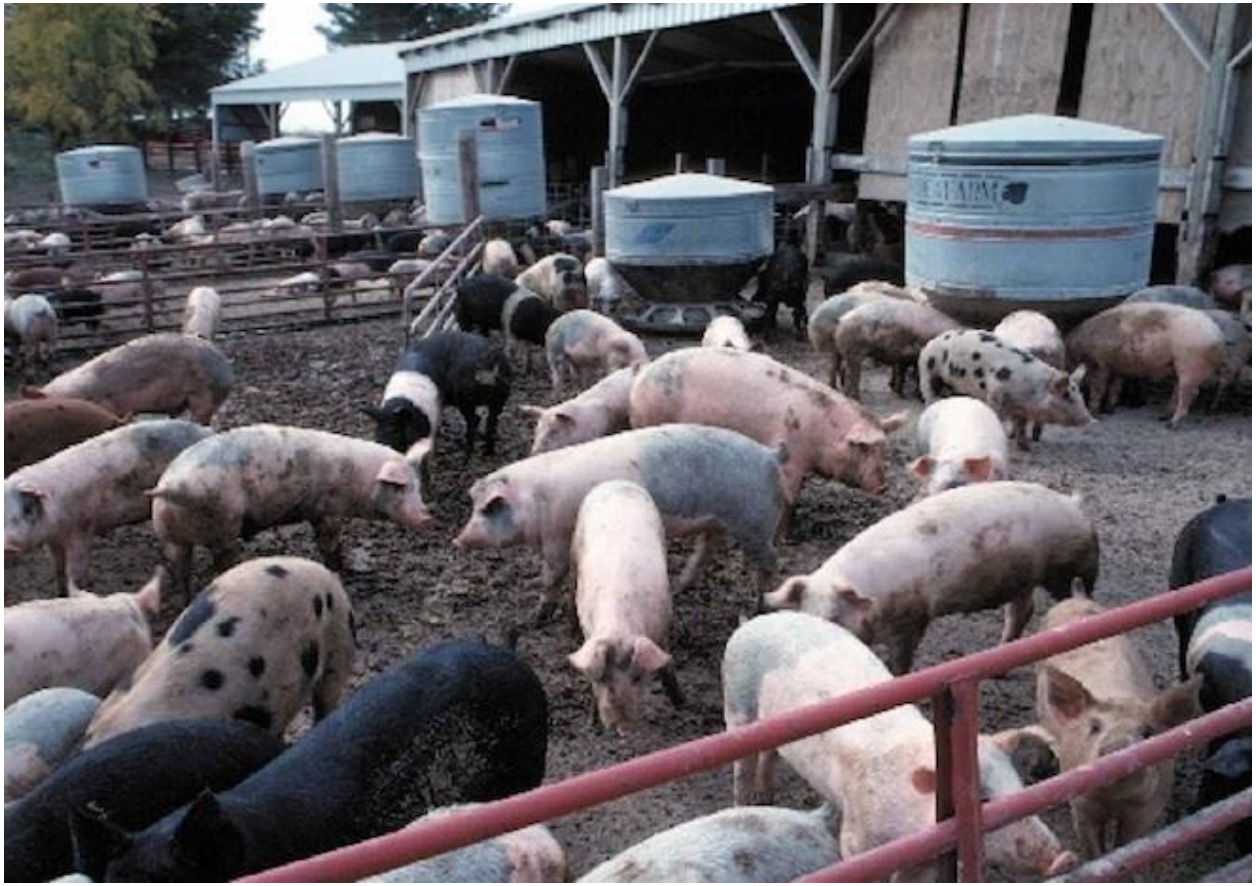

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