

Subjects/Target Grades
Science and Social Studies
Grades 7-12

Duration/ Location
1- 2 class periods
Classroom and outdoor
setting

Materials
Per class

- Examples of Outreach Materials teacher resource
- Information & Education Strategy to Address Nutrients teacher resource

Per student / small group

- What Nutrients Are in Fertilizers? student activity
- Fertilizer Bag Samples student page
- What Can You Do: in your home
- What Can You Do: in your yard

Lesson Four Elaborate: Managing Excess

Nutrients- page 11 from lesson 4

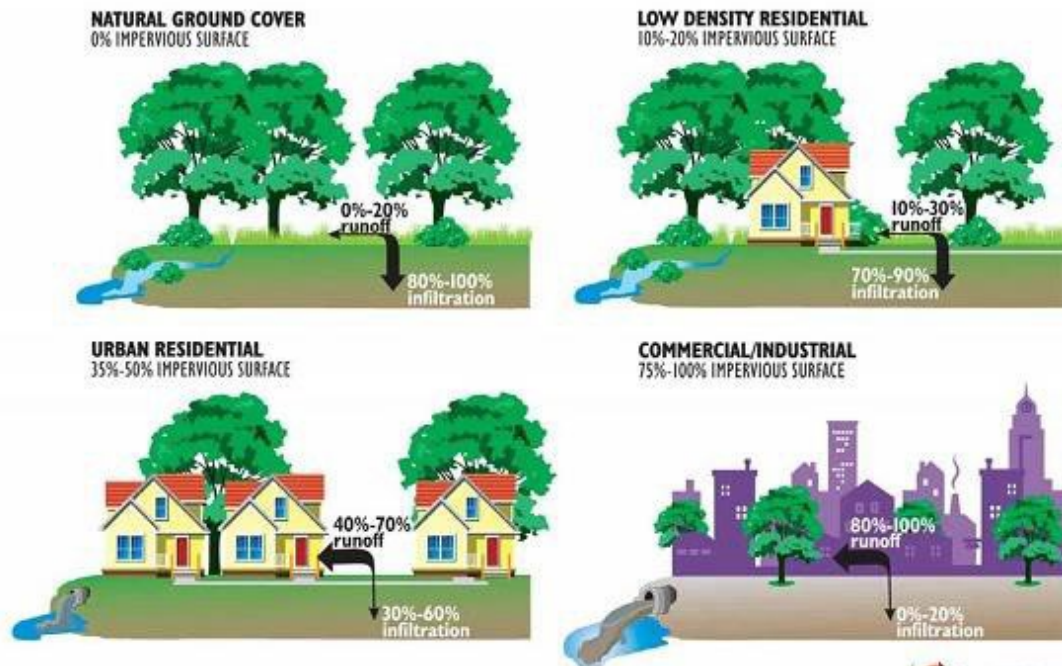
Activity Overview

Students formulate a plan to reduce nutrient loads on their school grounds.

Lesson Procedure

- 1) Take students outside to observe their school grounds and engage them in the *Increase in Stormwater with Urbanization* student activity. Make sure to make the connection that runoff from the school could eventually reach the Lower Grand River. Review ideas about stormwater best management practices and nutrients.
- 2) Using the *What Nutrients Are in Fertilizers?* student activity as an example of nutrients that could get into stormwater, have students look at fertilizer bags at home, at a store, or on the *Fertilizer Bag Samples* student page and report the nutrient content of these products. Discuss the questions in that activity as a class or in groups. Follow up with the *Examples of Outreach Materials* teacher resource to illustrate how people could be informed about over or improper use of fertilizers.
- 3) Revisit the nutrient patterns in the Lower Grand River Watershed and ask students how they think the nutrient load in the Lower Grand River Watershed could be decreased overall. Present how the LGRWMP's *Information & Education Strategy to Address Nutrients* addresses this issue (see the teacher resource).
- 4) Have students design an outreach plan that supports the priorities of the *Information & Education Strategy to Address Nutrients* in the LGRWMP.
- 5) Additional ideas are found in *What Can You Do: in your home* and *What Can You Do: in your yard* resources.

INCREASE IN STORMWATER RUNOFF WITH URBANIZATION



<http://greatlakesresilience.org/case-studies/infrastructure/resilient-stormwater-planning-takes-time-and-pays>



Visualize rain falling on a field. Where does the rain go? Now visualize rain falling on an asphalt parking lot. Where does the rain go? Not all surfaces within a watershed respond to water in the same way. Surface type can be roughly broken down into two categories:

- 1) **Pervious surfaces** (wetlands, fields, forests, boardwalks, wood-chipped walkways) allow water to soak into the ground (a process called infiltration). **Infiltration** decreases the amount of surface runoff, reduces the flow of water over the landscape, and increases groundwater recharge.
- 2) **Impervious surfaces** (roads, rooftops, parking lots, and other hard surfaces) do not allow water to soak into the ground, which means more water flows over the surface of the landscape. Increased surface runoff also increases the speed at which water moves through the watershed.

Impervious surfaces also decrease groundwater recharge. Whether or not water ends up as groundwater or surface water is a big deal. Water in the ground creates what we call “groundwater” and the “water table.” This water is our source of well water, and it provides water (“baseflow”) to our streams, rivers, and lakes during the winter and in between rainstorms in the summer. Without it, streams could stop flowing during droughts and over winter.

Cities build lots of roads, buildings, houses, driveways, parking lots, etc. All of these things are impervious surfaces and they prevent rainwater from soaking into the ground and reaching the groundwater. When rain hits these surfaces, the water flows rapidly across them and into storm drains, instead of soaking into the ground and becoming groundwater. All of this

water greatly alters the natural flow of the stream, making the flow more dependent on intermittent rainfall than on the steady flow of groundwater.

In many cases, storm sewers empty into streams and lakes, carrying any pollutants picked up along the way. **Stormwater** in these pipes does not get treated by the wastewater treatment plant- it goes straight into natural waters. Anything that the stormwater picks up while flowing across lawns and parking lots or down streets, such as pet waste, fertilizer, soil, motor oil, and pesticides will directly enter into streams, rivers, or lakes.

Stormwater also enters streams and rivers in high volumes and fast velocity during a storm. This causes erosion of stream banks, which destabilizes the channel, muddies the water, and degrades habitat for plants and animals. Soil in the water clogs the gills of fish; fills in the area around rocks where all the bugs, young fish, and crayfish live; and blocks light needed for plants to photosynthesize. The soil also settles to the bottom, filling in the channels of streams, lakes, and reservoirs.

Impervious and Pervious Walking Tour

(Note: Questions for you to answer and areas that your need to write down observations/comments are in the bold text.)

1. You are going on an impervious surface hunt! You are looking at how many impervious surfaces exist around the school or where you live.
2. Make a map of your schoolyard (or where you live). Or obtain a map of your area from a site such as Google Earth.
3. Take a cup of water outside and pour some of it onto to different surfaces. **Make observations about what happens. Can you tell what is pervious or impervious?**

4. Now look at your map. **Predict which surfaces around the school will be pervious or impervious in the table below.**

Pervious	Impervious

5. Using the cup of water, explore different surfaces to see if they are pervious or impervious. **When you find an impervious surface, color that part of the map. Put a check mark on your chart above if you were correct in your prediction for that surface.**
6. **Are there more pervious or impervious surfaces around the school?**

7. Where does water go when it rains on impervious surfaces? Find an impervious surface. Pour water on it and watch where it goes.
8. **Do you see any storm sewers anywhere, if so, where?**

9. **Where do storm sewers go?**

10. **Why is it important to know if this water goes directly to river, streams, and lakes?**

11. Look for potential pollution problems from stormwater (pet or wildlife waste, soil erosion, evidence of fertilizer, car oil, leaves clogging up the storm drain) in your schoolyard.
12. **Estimate the percentage of impervious surface on your map.**

Advanced lesson: Calculate the area of impervious surfaces then determine the volume of water that would flow off the site during a 1 inch rainfall.

Source: Adapted from *A very impervious surface*, Science Institute 2012-2013.

What nutrients are in fertilizers?

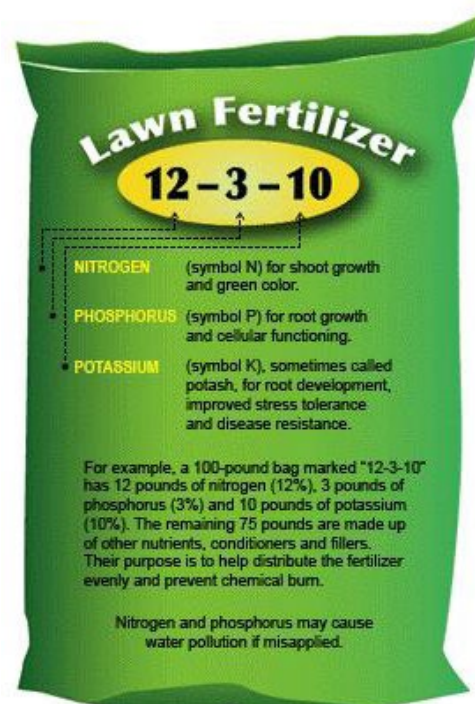
Many people use fertilizer to make their lawns and gardens grow. Did you know that fertilizers have different amounts of nutrients and that there are three numbers on the bag or bottle that tell you how much of each nutrient is in the bag?

Check out this bag:

All fertilizer labels have three bold numbers. The first number is the percent of available nitrogen (N), the second number is the percent of available phosphate (P_2O_5) and the third number is the percent of available potash (K_2O). These three numbers represent the primary nutrients: (nitrogen (N) – phosphorus (P) – potassium (K).

Fertilizer Detectives

See if you can locate some fertilizer or house plant food (or use the student resource *Fertilizer Bag Samples*) and fill in the following along with the pounds of each nutrient. See the sample in the first row using the bag to the right.



Fertilizer Brand/ lbs in bag	Nitrogen	Phosphorus	Potassium
Lawn Fertilizer/ 100 lbs	12% / 12 lbs	3% / 3 lbs	10% / 10 lbs

In 2012, a Michigan law was passed banning phosphorus in lawn fertilizers for most domestic (residential) and commercial uses. The new law also regulates applying phosphorus-containing fertilizers on frozen ground, water-soaked soil or near any surface water. The law also indicates phosphorus can be used if there is a recent soil test to indicate it is needed.

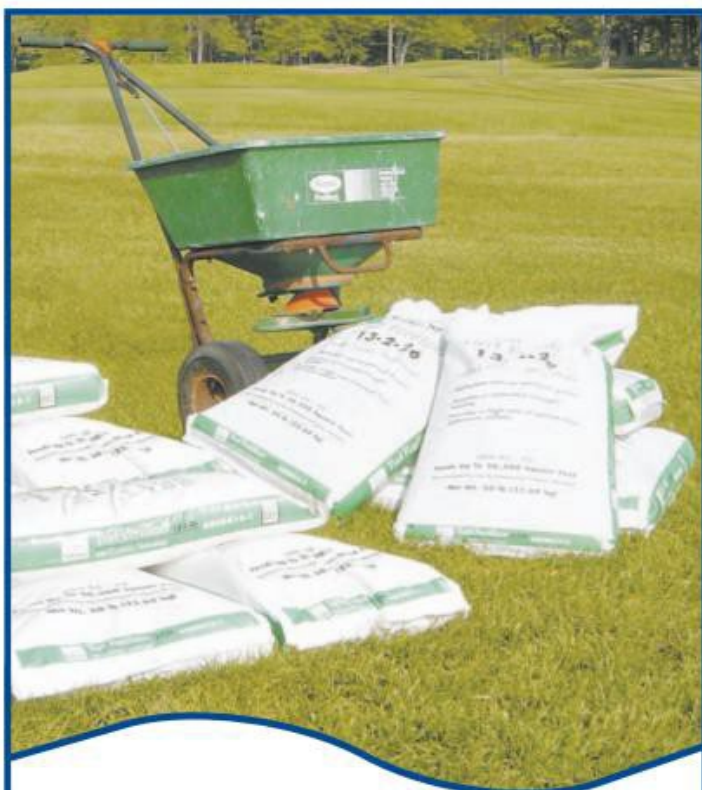
1. Is there phosphorus in any of your fertilizer examples?
2. What are some examples of the appropriate use for fertilizers that have phosphorus?

Extra: Use the Michigan State University's fertilizer calculator to determine how much nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O) (in lbs./1000 ft.²) the fertilizer analysis you choose will supply. <https://homesoiltest.msu.edu/tools/fertilizer-calculator>

Fertilizer Bag Samples



Examples of Outreach Materials



Spreading It On Too Thick?

Because we all want lush green grass and abundant gardens, it's easy to be seduced into using more fertilizer than is necessary. But using more fertilizer than recommended can actually kill your plants.

Compost your yard waste and make free fertilizer. You'll spend less on trash bags, fertilizers, and have the best blooms on the block!

Instead of spreading fertilizer go swimming! By using less (or no) fertilizer, you are protecting your waters! Because when it rains all that extra fertilizer is washed straight into your lake. No filters, no treatment.

Ready for a rainy day?



A Citizen's Guide to Lawn Fertilizer

True or False:

"More is better" when applying lawn fertilizer.

False! Over-fertilizing is a problem contributing to stormwater pollution in most rivers. Without realizing it, many landowners are applying fertilizers and pesticides when their lawns don't even need them! While applying an appropriate amount of fertilizer is usually okay, it's important to take care when adding chemicals to your lawn so that we can keep our rivers and streams healthy.



Source: Previous publications from the Michigan Department of Environment, Great Lakes, and Energy.

Information & Education Strategy to Address Nutrients

Source: Lower Grand River Watershed Management Plan

Goals: Restore and maintain waterbodies for other indigenous aquatic life and wildlife use, for coldwater fishery use, and for warmwater fishery use.

Pollutant 3: Nutrients

Objectives:

- 1) Implement manure management planning and implementation,
- 2) Implement livestock management practices at access sites,
- 3) Implement vegetative buffering practices,
- 4) Encourage proper septic tank management,
- 5) Implement proper fertilizer application practices,
- 6) Implement EGLE population management practices for waterfowl, and
- 7) Implement sanitary sewer maintenance practices.

Message: Human actions increase nutrients in waterbodies. Nutrient-rich waters encourage excessive plant growth, deplete oxygen, and impair aquatic habitats.

Critical Areas: Impaired Uses: Lake Creek, Deer Creek, Upper Thornapple River (low dissolved oxygen); Threatened uses: Bass River, Buck Creek, Coldwater River, Plaster Creek, Upper/lower Rogue River, Spring Lake/Norros Creek, Sand Creek

Information and Education Examples:

Topics: proper use and application of fertilizers, management of yard and pet waste, benefits of buffer strips along streams, septic system maintenance, not feeding waterfowl, use of phosphorus-free products including fertilizer, soil testing before using fertilizer	
<ul style="list-style-type: none"> • Brochures • Social media • Postcards • Create videos • Websites 	<ul style="list-style-type: none"> • Participation in public events (Earth Day, water festival) • Workshops for riparian landowners • Tree planting for runoff filtration • Demonstration projects

What You Can Do: In Your Home

Cleaning Supplies-Detergents and Soaps

- Choose phosphate-free detergents, soaps, and household cleaners.
- Select the proper load size for your washing machine.
- Only run your clothes or dish washer when you have a full load.
- Use the appropriate amount of detergent; more is not better.



Pet Waste

- Always pick up after your pet.
- Avoid walking your pet near streams and other waterways. Instead, walk them in grassy areas, parks or undeveloped areas.
- Inform other pet owners of why picking up pet waste is important and encourage them to do so.
- Take part in a storm drain marking program in your area to help make others aware of where pet waste and other runoff goes when not disposed of properly.

Septic Systems

- Inspect your septic system annually.
- Pump out your septic system regularly. (Pumping out every two to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often).
- Do not use septic system additives. There is no scientific evidence that biological and chemical additives aid or accelerate decomposition in septic tanks; some additives can in fact be detrimental to the septic system or contaminate ground water.
- Do not divert storm drains or basement pumps into septic systems.
- Avoid or reduce the use of your garbage disposal. Garbage disposals contribute unnecessary solids to your septic system and can also increase the frequency your tank needs to be pumped.
- Don't use toilets as trash cans. Excess solids can clog your drainfield and necessitate more frequent pumping.
- When installing a septic system, maintain a safe distance from drinking water sources to avoid potential contamination. Avoid areas with high water tables and shallow impermeable layers.
- Plant only grass in the drain field and avoid planting trees, bushes, or other plants with extensive root systems that could damage the system's tank or pipes.
- [Visit EPA's Septic Smart website](https://www.epa.gov/septic-smart) to learn more about how your septic system works and simple tips on how to properly maintain it. You can also find resources to launch a local septic education campaign.

Source: U.S. EPA, <https://www.epa.gov/nutrientpollution/what-you-can-do-your-home>

What You Can Do: In Your Yard

Lawn care:

- Apply fertilizers only when necessary and at the recommended amount.
- Don't apply fertilizer before windy or rainy days.
- Apply fertilizer as close as possible to the period of maximum uptake and growth for grass and other plants, which is usually spring and fall in cool climate, and early and late summer in warm climates.
- Avoid applying fertilizer close to waterways.
- Do not overwater lawns and garden; use a soaker hose, a porous hose that releases water directly to the ground, which can reduce overwatering that carries away fertilizers that would otherwise enrich lawns and gardens.
- Fill fertilizer spreaders on a hard surface so that any spills can be easily cleaned up.
- Properly store unused fertilizers and properly dispose of empty containers.
- Maintain your lawn mowers, snow blowers, chain saws, leaf vacuums and similar outdoor power equipment to reduce nitrogen oxide emissions.

Garden care:



- Plant a rain garden of native plants, shrubs and trees that reduce the amount of fertilizer needed and provide a way for water to soak into the ground.
- Install a rain barrel to collect rainwater; the rainwater can later be used to wash your car or water your plants and lawn.
- Adopt techniques that utilize natural processes to manage stormwater runoff and reduce the impact of impervious surfaces on water quality.
- Use pervious pavers for walkways and low traffic areas to allow water to soak into the ground.
- Install a green roof on your home or business.
- Incorporate best management practices, such as grassed swales, filter strips, or buffer strips on your property to control and temporarily store stormwater runoff.
- Use yard waste, which includes grass clippings and leaves, in mulch or compost for your garden. If this is not an option, prepare all clippings and leaves for community composting, or in barrels or secured papers bags for disposal, which keeps them from washing into streams.

Source: U.S. EPA, <https://www.epa.gov/nutrientpollution/what-you-can-do-your-yard>