Unit 5: Stormwater

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Unit Summary

In this unit, you will be helping your school do its part to stop the spread of pollution to your creeks, streams, rivers, and oceans through storm drains. The activities in this unit will help you ensure your school is doing its best to label storm drains properly, comply with stormwater regulations, and prevent pollution from entering waterways. See below for how you can map the connection between storm drains, litter, and water pollution for students.

Actions *Here are some actions you will take to complete the green@school checklist and reduce your school's environmental impact.*	1. Become campus storm drain detectives—explore your walkways, parking lots and other concrete areas to determine the location and vulnerability of your storm drains. 2. Interview relevant school and district staff to find out, what policies are in place to keep storm drains free of litter and debris? 3. Investigate existing outdoor cleaning practices, field management, and pest control methods at your school and evaluate whether safe practices are in place to keep pollutants out of storm drains. Suggest improvements where needed.
Campaign Opportunities *There are several opportunities for student teams to raise awareness and educate their teachers and peers about the impacts of stormwater management.*	1. Implement a storm drain initiative to install the storm drain labels discouraging illegal dumping. 2. Educate your teachers and peers on why it is important to keep the grounds and the storm drains clean. Consider a" Flows to Bay" campaign that explains when it rains, it drains. 3. Conduct a campus clean-up and collect as much litter as possible to keep it out of the storm drains. 4. Create a map of the storm drains on your school campus and show how water will flow into local waterways.
Skills *Each team will build & apply different skills to accomplish their green@school goals. Here are some specific skill sets students may exercise across this program.*	1. Become a local advocate—educate your peers and teachers about stormwater and wastewater management and encourage them to protect their local waterways. 2. Explore your creativity—design effective signage to discourage litter on campus and prevent trash from entering the storm drains. 3. Find your inner detective—investigate any practices contributing to pollution on campus and interview relevant staff.
Contacts *To evaluate campus stormwater practices, here are the people you may want to contact.*	Grounds-Custodial Manager, Your School District **Who else? Write any others contacts you can think of:**

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Certification Checklist

As described in the green@school Handbook, each Unit corresponds with a targeted resource conservation goal and a specific section of the California Green Business Program's checklist, designed so that students will use this tool (the checklist) to assess their current campus environmental actions and identify opportunities for improvement (learn more at http://www.greenbusinessca.org/). This will occur following their deep dive into the subject through the lessons and activities shared in this chapter that seek to build their baseline knowledge on the subject before they are asked to become subject matter experts assessing their school's operations and practices. The checklist is included at the beginning of each unit so you can see what you're building towards, but again, know that its expected use will follow the activities and lessons shared below. Further, completing the actions in this checklist will enable your school to receive statewide recognition for your environmental leadership (bonus!). To assess the stormwater management practices on your campus, walk through this list with your students, administrators, or other resource-relevant school site staff.

green@school Certification Checklist						
#	Measure/Action/Practice	Does your school meet this measure?			Controlled by school staff administrator (SA), school district (D) or Students (ST)	Investigation Notes and Status
		YES	NO	DON'T KNOW		
Stormwater Management						
Storm Water Pollution Prevention						
Required						
1	Keep dumpsters closed and impermeable to rainwater. Keep them from overflowing and keep dumpster/parking areas clean					

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green@school Certification Checklist

#	Measure/Action/Practice	Does your school meet this measure? YES	NO	DON'T KNOW	Controlled by school staff administrator (SA), school district (D) or Students (ST)	Investigation Notes and Status
Stormwater Management						
2	Clean private catch basins annually (by October 15th), before the first rain and as needed thereafter					
3	Ensure that no wastewater enters a storm drain					
4	Do not wash cars, equipment, floor mats or other items where run-off water flows straight to the storm drain					
5	If using water to clean parking or other outdoor areas, hire a BASMAA-certified mobile cleaner. Contractor must use equipment that collects wash water and disposes to sanitary sewer					
Complete at Least 2:						
1	Provide containment for large amounts of liquid supplies such as cleaners and paints					
2	Store all potentially hazardous materials securely, control access, rotate stock to use oldest material first					
3	Store deliveries and supplies under a roof					

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green@school Certification Checklist

#	Measure/Action/Practice	Does your school meet this measure?			Controlled by school staff administrator (SA), school district (D) or Students (ST)	Investigation Notes and Status
		YES	NO	DON'T KNOW		
Stormwater Management						
4	Do not apply pesticides or fertilizers before it rains (pollutants may be washed into the storm drain)					
5	Maintain green waste or food compost area to prevent leaks or spills to storm drain					
6	Label all storm drains with No dumping, Drains to Bay message					
7	Clean outdoor surfaces by dry sweeping					
8	Routinely check for and address leaks, spills, and emissions of chemicals, paints, and cleaners. Repair any deficiencies					
9	Regularly check and maintain storm drain openings and basins. Keep litter, debris and soil away from storm drains					
10	Use dry cleanup methods as a norm, and sweep prior to mopping floors. If necessary, use spot mopping only					

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green@school Certification Checklist

#	Measure/Action/Practice	Does your school meet this measure?			Controlled by school staff administrator (SA), school district (D) or Students (ST)	Investigation Notes and Status
		YES	NO	DON'T KNOW		
Stormwater Management						
11	Post signs at targeted trouble spots (e.g., loading docks, dumpster areas, outside hoses) to explain proper practices/prevent pollutants from reaching storm drain					
12	Use pipes or hoses for transferring cleaners or other chemicals to prevent spills and splashes					
13	Mulch, use ground cover, use barrier to prevent soil from washing landscaped areas into storm drain					
14	Keep a spill kit handy to catch/collect spills from hazardous materials, grease, or leaking vehicles. Make sure there is adequate absorbent material to contain the largest possible spill					
15	Locate all potential pollutants away from food preparation, service, storage areas, sewer/storm drains					

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Student Learning Outcomes

In this unit, students will become proficient in the vocabulary and concepts describing storm drains and stormwater. After completing this unit, students should be able to:

1. Identify storm drains on and around campus and determine if they are labeled appropriately.
2. Articulate the concept of urban runoff and its impact on waterways.
3. Name one or more regulatory policies related to stormwater management.
4. Provide solutions to keeping storm drains clean, preventing polluted runoff, and keeping their campus free of litter.

Lesson Plan

This Unit will guide you through the basics of storm water management and help you learn how reduce your school's impact on waterways. You will audit your school's storm drains; identify runoff sources at or near your school; find creative solutions to keeping the storm drains clear; and become experts in Bay Area water pollution facts affecting you, your school, family, and community. Ultimately, you will be able to fill in the storm water management checklist and determine which items you wish to rally student support for change.

LESSON 1: WHAT'S THE BIG DEAL ABOUT A LITTLE RAIN WATER?

LESSON 2: WHAT'S THE DIFFERENCE?

LESSON 3: GETTING TECHNICAL

LESSON 4: WHAT CAN YOU DO?

A note to instructors: the plug-and-play activities shared throughout all green@school units are framed for your students, with the hope that you can simply offer/print these activities for their direct use. No extra prep time required!

Lesson 1: What's the Big Deal about a Little Rain Water?

The water from your school, neighborhood, parks, and streets flows through storm drain systems directly to local creeks and out to San Francisco Bay without any treatment. Pollutants make their way into the storm drains when carried by rain or other runoff. For example, if someone leaves their lawn sprinkler on and it overflows onto the sidewalk, the water runs into the gutter and into a storm drain. The pesticide and fertilizer used on that grass will also wash into the storm drain. It's crucial to remember that storm drains do NOT lead to the sanitary sewer system but go directly to waterways: when it rains, everything on the ground will make its way into waterways if not picked up.

Common stormwater pollutants include:

- Motor oil and leaks of other automotive fluids.
- Automotive fluids, paint or household cleaners dumped or rinsed into the gutter.
- Soap and dirt from washing cars in the driveway or street.
- Litter and trash debris from overfilled waste containers.
- Soil from construction or landscaping that erodes or blows into the street.
- Pesticide and fertilizers from landscaped areas washing into the gutter along with rain water or landscape watering.

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➢ Discussion Activity | *Video: Don't Let Trash Ruin Your Scene*

Watch this short clip: Don't Let Trash Ruin Your Scene:
http://cfpub.epa.gov/npstbx/embededpopup.cfm?VideoID=13468

Answer these questions in a group:

1. How much litter do you see on the ground at your school? Around your school? Around your home? In your community?
2. What kinds of materials do you see littered?
3. Have you ever picked up someone else's litter? Have you seen anyone litter in or around your school?
4. Have you seen overflowing dumpsters in your community or at your school? Where?
5. Where does the trash end up that's lying on the ground?

➢ Research Activity | *Do Your Storm Drains Keep the Ocean Trash-Free?*

Did you know that scientists estimate that there are millions of pounds of plastic in the ocean? Investigate and devise a way of improving storm drains at your school and in your community so that plastic and other trash stays out of waterways (that eventually lead to the ocean!). For inspiration, check out this project that can be done by you and a group of friends to determine whether plastic litter is entering waterways in your community through storm drains (http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvEng_p031.shtml#summary).

Lesson 2: Sources of Wastewater

Protecting our planet's water is an interconnected issue and crosses several green@school units. This lesson will specifically address the different kinds of wastewater we produce.

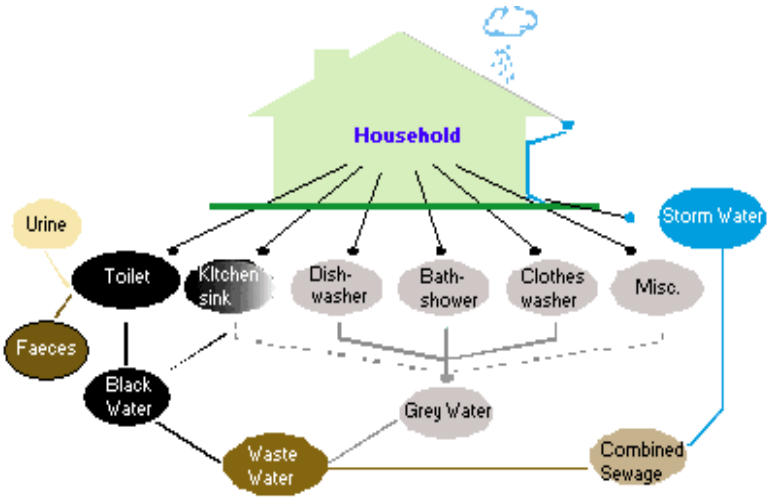

Figure 1: A range of possible sources of household wastewater showing wastewater from toilet, kitchen, bathroom, laundry and others

- **Wastewater:** The water that goes down drains inside our homes and businesses from washing dishes and clothes, showering, flushing toilets, and industrial processes.
- **Blackwater:** Wastewater from the toilet which can be separated into fecal materials and urine.[1]
- **Graywater:** Water from washing clothes, and from bathing and showering.[2]
- **Wastewater Treatment Facility:** A facility responsible for cleaning our wastewater before flowing back into the environment.

Cupertino Watershed Facts

Watershed area: 20.3
Number of tributary creeks: 6
Miles of natural creek bed: 12.9
Miles of Engineered Channel: 14.1
Local cities: Santa Clara County, Los Gatos, Saratoga, Cupertino, San Jose, Sunnyvale, Santa Clara

[1] United Nations Environment Programme, accessed on 11/11/14 at http://www.unep.or.jp/ietc/publications/freshwater/sb_summary/2.asp

[2] United Nations Environment Programme, accessed on 11/11/14 at http://www.unep.or.jp/ietc/publications/freshwater/sb_summary/2.asp

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- **Stormwater:** Water that flows across the surfaces of buildings and paved areas like roads, driveways, footpaths, or yards, into the stormwater system. The stormwater system includes street gutters, drains, underground pipes and channels that transport rainwater to waterways and groundwater. Stormwater is NOT treated to remove pollutants.[3]
- **Urban runoff:** This is the result of urbanization where impervious surfaces allow rainwater to carry pollutants and increase the chance of flooding, instead of allowing the water to percolate through the soil.
- **Catch Basin** A storm drain, sewer, well, or other drainage system that catches excess rain and groundwater from paved streets, parking lots, sidewalks, roofs, etc.
- **Stormwater system:** A storm sewer system that includes storm drains and gutters on your street and the pipes where the stormwater enters the water body such as a creek, river, or bay. Stormwater enters the water bodies without being treated.
- **Point source pollution:** Water pollution coming from a single, traceable source (e.g. a single factory).
- **Non-point source pollution:** Pollution coming from many sources over a broad area, that can't be traced to a single source (e.g., agricultural runoff).

Protecting waterways is crucial to human health and the health of our environment, and so there are many policies and regulations designed to keep pollutants out of storm drains. For example, here in Cupertino it is illegal to dump anything at all in a storm drain, cars must be washed on grassy areas or a special car wash kit must be used, and you can even be fined for littering. Local jurisdictions are required to inspect commercial property regularly to make sure there are no threats to stormwater. Take a look at this factsheet to get a sense of how closely cities are regulated for taking care of their waterways (http://www.swrcb.ca.gov/water_issues/programs/stormwater/docs/stormwater_factsheet.pdf).

But most pollution does not come from point sources where the water quality can be tested against a certain standard and remedied if necessary. Runoff into storm drains, for example, accounts for 80% of all San Francisco Bay discharge. That non-point source pollution is difficult to control, and requires that we all do our part to keep pollution from going down the storm drains.

[3] City of Belmont, accessed on 11/26/14 at http://www.belmont.wa.gov.au/Business/BusinessSupport/Documents/LightIndustry_01_Storm_Water[1].pdf.

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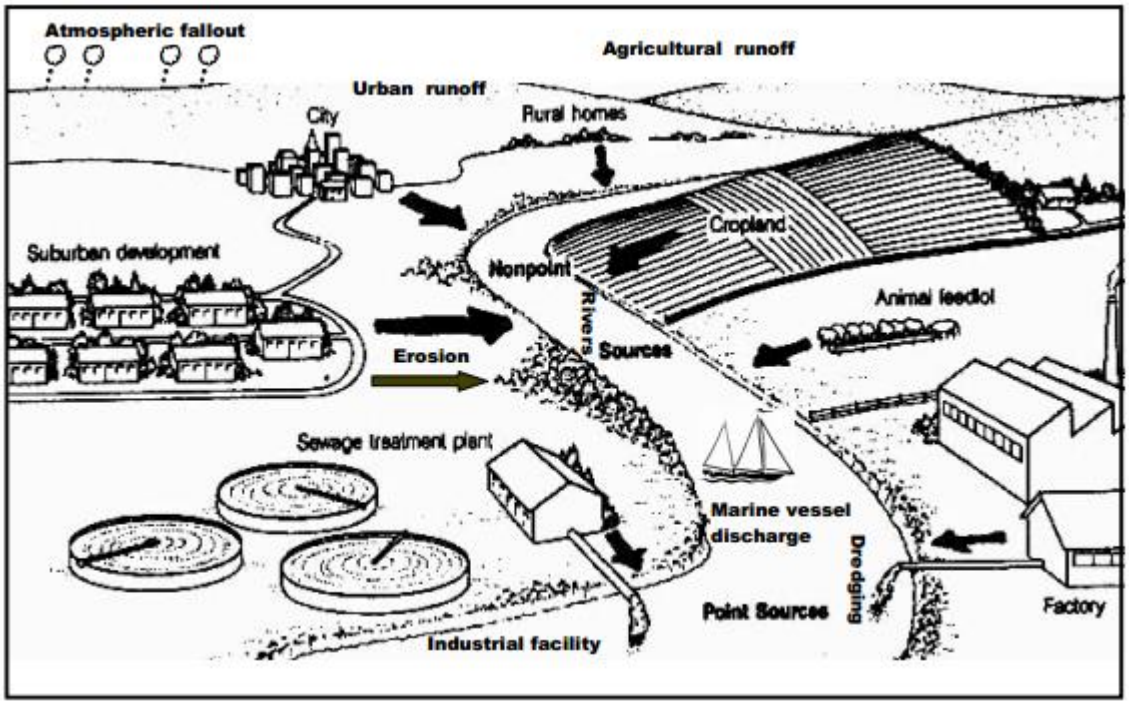
Take a look at the below diagram for an illustration of the different sources of water pollution, both point source and non-point source.



➢ Research Activity | *Survey Says: How Much Do We Know about Our Stormwater system?*

Use this survey to test the knowledge of your peers, family, school staff, or community about where those storm drains lead.

1. What is the number of creeks within the City of Cupertino?

- ○ 1
- ○ 6
- ○ 7
- ○ 12

2. What is the estimated number of IMPAIRED (polluted or degraded) water bodies within and adjacent to the San Francisco Bay?

- ○ 3
- ○ 5
- ○ 7
- ○ 12

3. Which of these pollutants are found in the San Francisco Bay waters?

- ☐ Mercury
- ☐ Nitrogen
- ☐ Dioxins
- ☐ Sediment
- ☐ Phosphorus
- ☐ Nitrate-N
- ☐ Bacteria
- ☐ PO4-P

- ☐ Arsenic
- ☐ Cadmium
- ☐ Lead

5. Briefly describe the differences between WASTEWATER and STORMWATER.

6. Which of the following do you NOT want to find in Bay waters or nearby stream after a rain storm?

- ☐ Pet waste
- ☐ Large clumps of fallen leaves and grass clippings
- ☐ Fish
- ☐ Salt
- ☐ Soap bubbles
- ☐ Mercury
- ☐ Oxygen
- ☐ Excessive algal growth
- ☐ Fats, oils, and grease

7. What concerns do you have about local water quality?

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8. Have you ever toured the wastewater treatment plant in San Jose?

- ○ Yes
- ○ No
- ○ No, but would like to

9. Check all that apply: I _____ in Cupertino

- ☐ live
- ☐ work
- ☐ attend school
- ☐ None of the above, I am a Cupertino visitor

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➢ Action Activity | *Storm Drain Spotters*

Review this list of major sources of water pollution via storm drains and discuss which ones you think apply to your school site. Brainstorm a solution for each pollution source you list.

Pollutant Pathways	Pollutant Sources
Urban Runoff: Rainfall, landscape irrigation, and street cleaning and other cleaning practices flush pollutants off paved surfaces such as streets, sidewalks, roofs, bridges, parking lots and buildings, mostly untreated, into storm drains, creeks and waterbodies such as San Francisco Bay	(1) Automobiles: crank case oil, tires, combustion byproducts and batteries (2) Household and garden chemicals (3) Sediments from new development, construction sites (4) Waste from commercial yards (5) Animal and human waste (6) Fertilizer or treated sewage (7) Trash, lawn clippings
Nonurban, Agricultural Runoff: Grazing, plowing, fertilizing, planting, and harvesting and rainfall and irrigation water flush pollutants from crop, pasture, park, range and forest lands through farm drains and rivers, leach pollutants from soils, untreated into waterbodies such as the Delta and San Francisco Bay	(1) Pesticides (2) Other agricultural chemicals, e.g., nutrients, salts (3) Animal wastes/confined animal facilities (4) Acid drainage from mine sites (5) Sediment from eroded soils
Rivers: Rivers act as conveyances of pollutants that originate from both point and nonpoint sources along their banks	(1) Nonurban: e.g., pesticides, agricultural chemicals, animal wastes, eroded sediment (2) Urban: e.g., sediment, household chemicals, auto-related pollutants, etc. (3) Other, e.g., industrial facilities
Atmospheric Fallout: Airborne pollutants reach the water through winds and precipitation	(1) Cars and trucks, especially diesels (2) Fossil fuels (automobiles, trucks, construction equipment) (3) Building materials and products (4) Windblown dust from roadways and construction (5) Other, e.g., manufacturing and industrial facilities, businesses[11]

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Pollutant Pathways	Pollutant Sources
Municipal Sewage Treatment Plants, Industrial Facilities: Wastewater treatment plant processes cannot remove all solvents, metals or chemicals from wastewater. Current treatment practices remove at minimum 85 percent of solids and biodegradable materials, along with 40-95 percent of solvents and metals. [12].	(1) Urban: improper use and disposal of household, lawn and garden products, pool and spa chemicals (2) Petroleum refining, manufacture of agricultural pesticides and fertilizers (3) Manufacturing, shipping, storage operations (4) Equipment, vehicle, building and surface cleaning (5) Building repair and maintenance practices
Illegal Dumping/ Illicit Connections: Improper discharges of pollutants to storm drains, catch basins and other conveyance facilities and improper permanent storm drain connections that allow sanitary wastewater to enter storm drains; untreated pollutants flow to creeks and waterbodies such as San Francisco Bay	(1) Non-storm water from industrial plants: industrial process water, building waste water (2) Improper use and disposal of household liquid and solid wastes, e.g., antifreeze, oil, paint, household cleaners, detergents, yard wastes (3) Floatable debris
Accidental Spills: Spills resulting from both residential and business practices, if not properly and immediately cleaned up, can result in pollutants flowing directly into storm drains, remaining on pavement and being washed by rains into a storm drain, or remaining in the soil to become a possible groundwater pollutant. Spills from vessels can also contribute pollutants to waterbodies	(1) Industrial/commercial and light industrial facility practices: materials storage, building repair and maintenance, cleaning, landscaping (2) Vehicle service practices: changing oil, fluids, engine cleaning, washing cars, body repair, painting (3) Urban: automobile repair, painting, house-cleaning, landscaping (4) Boating practices

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Pollutant Pathways	Pollutant Sources
Natural and Artificial Erosion and Sedimentation: Erosion is the washing away of soil by wind and water. When rain strikes bare soil, topsoil is dislodged and dirt and debris are carried into storm drains and creeks in stormwater runoff. The more that land is disturbed, the more its erodability increases and the more sediment can be transported. Sedimentation is the accumulation of soil and other particles washed into waterways from land.[13] Erosion of shorelines and streambanks contributes significant amounts of NPS pollution in surface waters	(1) Sediment from new development, construction sites (2) Excavation and grading, road building (3) Bare or poorly vegetated soils, steep, unstable slopes (4) Decomposing plant and animal wastes (5) Seepage of ground water, overland flow of surface water runoff[14]
Marine Vessel Discharges: When operating and maintaining boats significant amounts of solvent, paint, oil, and other pollutants potentially can seep into the ground water or be washed directly into surface water. Discharge of sewage and waste from boats can degrade water quality[15]	(1) Discharge of untreated waste: garbage, sewage, grey water, oil (2) Motors and refueling activities, ballast material (3) Paint pigment, antifouling paints, pesticides solvents, and wood preservatives (4) Boat cleaners
Landfill Seepage, Leakage From Waste Disposal Sites, Groundwater: Pollutants can enter waterbodies such as San Francisco Bay through landfill or waste disposal seepage, or leaching and through groundwater. Old, leaking disposal sites near the estuary may contribute toxic leachate	(1) Fertilizers and pesticides (2) Urban sources, e.g., motor oil, metals, paints, solvents (3) Hazardous and municipal solid waste (4) Other, e.g., industrial and manufacturing facilities, septic tanks (5) Floatable Debris (plastics, wood, cigarette butts, etc.)

➢ Research Activity | *Fact or Fiction: Become Your Local Stormwater Expert*

1. A parasite common in cat feces has been linked to serious disease in sea otters.[4]
2. Dog feces are good fertilizer for the grass.
3. Preliminary studies have found Acetaminophen (Tylenol) in San Francisco Bay Water.[5]
4. Flushing medicines down the toilet are the best way for it to get treated by the wastewater treatment facility.
5. Mercury from one thermometer can contaminate up to 5, 000, 000 gallons of Bay water or six Olympic size swimming pools.[6]
6. San Francisco Bay fish are unsafe to eat because of high mercury and PCB concentrations.[7]
7. Copper causes salmon to lose their ability to find their spawning streams.[8]
8. During heavy rains, sewer pipes are often flooded by rainwater, increasing the change of sewage spills.[9]
9. Residents can get a city permit to pour grease down the drain.
10. A native plant garden uses less water, needs less fertilizer, and has less sediment runoff – all reasons why it helps reduce pollutants washing into the storm drain.

Answers: 1) true, 2) false, 3) true, 4) false, 5) true, 6) true, 7) true, 8) true, 9) false, 10) true.

[4] Save the Bay, accessed on 11/22/14 at http://www.savesfbay.org/pollution-facts.
[5] Save the Bay, accessed on 11/22/14 at http://www.savesfbay.org/pollution-facts.
[6] Save the Bay, accessed on 11/22/14 at http://www.savesfbay.org/pollution-facts.
[7] San Francisco Baykeeper, accessed on 11/18/14 at https://baykeeper.org/our-work/controlling-urban-storm-water-pollution.
[8] San Francisco Baykeeper, accessed on 11/18/14 at https://baykeeper.org/our-work/controlling-urban-storm-water-pollution.
[9] San Francisco Baykeeper, accessed on 11/18/14 at https://baykeeper.org/our-work/controlling-urban-storm-water-pollution.

Lesson 3: Stormwater Pollution Solutions

Awareness of how the storm drain system works and sources of pollution that affect waterways can help your school protect water quality. Below are some activities students can conduct to help educate their peers on preventing stormwater pollution.

➢ Action Activity | *Storm Drain Audit*

The following investigation will help you better understand how water flows through your campus. Based on your assessment, you and your classmates can implement initiatives to protect your storm drains from pollution!

It's time for some detective work. You can make a difference on your campus by ensuring that storm drains are kept clean from contamination.

Find the storm drains on your campus and record some observations about each drain. Take pictures of anything on or in the drains so you can better illustrate what is flowing into the drains. You'll want to note the location of the drains, if any liquids are running into them, if there is any debris or litter inside or nearby, or any potential sources of pollution nearby.

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#	Location (parking lot, quad, field, etc.)	Is there a "No Dumping" sign? Y/N	Litter on or near the drain? Y/N	Other potential pollution sources nearby? Y/N	Notes: Other observations?
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Use this information, plus your pictures, to alert your administration or custodial staff to potential sources of pollution that they may need to address, either for particular storm drains or for your campus as a whole.

➢ Action Activity | *Anti-litter Campaign*

Design an anti-litter campaign for your school and conduct outreach to your peers. Here are a few simple steps to get you started:

1. Decide your message. What do you want others to know about litter as a pollutant?
2. How will you get your message to your peers? What outreach materials do you need? Video? Posters?
3. Host a litter cleanup event. Make it a competition!
4. Form a green team that will continually monitor your school grounds for litter.
5. Analyze your findings. Study the litter you find during clean-up events. What are the most common items? Where do you find the most litter? How can you adjust your campaign to target these items and/or locations?

➢ Professional Development Activity | *Brainstorm Solutions for Storm Drains*

Now that you have assessed your campus storm drains, it's time to put on your thinking cap and brainstorm some solutions. Think of three ways you and your classmates can help prevent pollution from entering campus and community storm drains and polluting your water:

1. Are there school policies that need improvement?
2. Are there storm drain improvements that can be made?
3. Can you run a competition to reduce potential pollutants that can make their way to a storm drain?
4. What can you do to educate your family and community about polluting storm drains?

➢ Professional Development Activity | *Storm Drain Markers*

Your school may be eligible for free storm drain markers. (Cupertino schools can inquire with the City of Cupertino.) In collaboration with your custodial staff and district, work with administration to obtain the markers to label all storm drains with a "no dumping" message. This is a simple way to inform anyone who comes on your campus that the storm drains lead directly to a waterway.