

# COSEE WEST

## INTEGRATED COORDINATED SCIENCE UNIT CHALLENGES student handbook

student handbook



## UNIT 3: chemistry storm drain water testing



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Los Angeles is world famous for its beautiful beaches. After a rain, however, our beaches can be dirty and dangerous—even closed—because rain water washes trash and other pollution off our streets into storm drains, and down to the sea. Trash and poisons that run into the ocean from Los Angeles storm drains can make people sick. It can do the same to the plants and animals that live in the ocean or on our beaches. Before we can stop storm drain water pollution, we have to know which pollutants are getting into this water, and where these pollutants come from. The first place to look is up stream—at the water that flows into our storm drains.

## THE CENTRAL QUESTION OF UNIT 3 IS:

**How can you use your knowledge of chemistry to test the safety of the water that flows off our campus and our streets, and into the ocean?**

Your challenge in this unit is to write a “report card” for the water that enters the storm drains around your school. Working in a student research group, you will draw a map of where the storm drain inlets are. You will test the water flowing into one of the inlets on your school campus, and write a report.

With your group, you will create and present a “Report Card” style report that rates the chemical health of water entering the inlet you are studying. Your group’s presentation will include a grade of “A,” “B,” “C,” “D,” or “F” for this water. You will include descriptions of the chemical tests you used to determine that grade. You will also make recommendations for improving the “health” of the water entering storm drains near our school.

### 1. YOU AND YOUR RESEARCH GROUP WILL RECORD THE CONCENTRATIONS OF THESE ELEMENTS:

- Oxygen
- Nitrogen
- Phosphorous
- Chlorine
- Copper
- Iron

### 2. YOU WILL RECORD:

- the water temperature
- how salty the water is (salinity)
- how clear it is (turbidity)
- the acidity (pH) of the water.

### 3. YOU WILL USE A CHEMICAL REACTION TO TEST WATER FOR THE PRESENCE OF BACTERIA.

Your group may choose to present their report as a three-panel poster, a PowerPoint presentation, a video, or some other way approved by your teacher. You may also help your teacher plan how to grade these presentations.

To prepare for the Unit 3 Challenge, you are going to do many of the activities described in chapters 7 and 8 of your ICS textbook.

There may be some additional assignments—so you can learn about storm drain water and the Pacific Ocean that this water flows into.

### Storm Drain System

The Los Angeles storm drain system is a 1,500 mile long network of underground pipes and tunnels. These pipes and tunnels carry rain water from our streets into concrete lined flood control channels that empty into the Los Angeles River, the Dominguez Channel, and Ballona Creek. The Los Angeles River and the Dominguez Channel flow to the ocean at Long Beach. Ballona Creek flows into the ocean at Marina Del Rey. Even when it is not raining, there is often water running off lawns and driveways, down the streets, into storm drains, and out to the ocean.

Storm drain water is not cleaned before it enters the ocean. The water that runs through our storm drain system carries all the trash and poisons that people throw or dump on our sidewalks and streets. The trash include paper, plastic bags, and cigarette butts. The poisons include motor oil leaked from cars, trucks, and buses, rubber from tires copper and other metals from brakes, paints, lawn fertilizers, and insect poisons. Disease causing viruses and bacteria come from food scraps and food wrappers, used baby diapers, and dog and cat poop.

When street catch basins are clogged, storm drain water floods streets. Traffic is slowed, and pollutants in the water expose neighborhoods to trash, poisons, and disease causing bacteria and viruses.

### It's Important to Test Storm Drain Water for Oxygen, Nitrogen, and Phosphorous:

Water that flows through Los Angeles storm drains does not go to a sewage treatment plant like wastewater (from sinks, baths, and toilets) does. Most of it either flows through the wetlands of Ballona Creek to Santa Monica Bay—or it runs down the Los Angeles River and straight out to the San Pedro Bay at Long Beach.

Both Santa Monica Bay and San Pedro Bay are important for ocean life—including plants and algae, clams and crabs, birds, fish, seals and sea lions, dolphins, and whales. Both bays are important to the people of Los Angeles, too: for fishing, swimming, diving, surfing, boating, shipping, and other things.

Along Santa Monica Bay and San Pedro Bay, there are large clumps of a very long seaweed called Giant Brown Kelp. Giant Brown Kelp can grow to be 200 feet in length. It grows up from the sea floor in large masses called kelp forests. Kelp is very important for sea life. Big fish such as Sheepshead, Giant Sea Bass, Kelp Fish, and Garibaldi (the California State Fish) live in kelp forests. Because the open ocean is a dangerous place, many smaller fish such as Gobi live and hide in the kelp forests. Many fish eat kelp. So do sea urchins. Sea lions eat fish. Sea otters eat urchins.

Storm drain water can harm kelp forests, and all the animals that live there, in several ways. Storm drain water often contains large amounts of nitrogen and phosphorous—chemical elements that cause algae to grow quickly. When algae grow fast, they die fast—and sink to the ocean floor. Bacteria eat the dying kelp. Then, the bacteria reproduce very fast. Soon, there are so many bacteria, they use up all of the oxygen dissolved in the water. When this happens, fish can't get enough oxygen. Large numbers of fish die. If sea lions can't eat enough fish, they die. If sea urchins can't eat enough kelp, they die. If sea otters can't eat enough urchins, they die too.

## Nitrogen, Phosphorous, and Harmful Algal Blooms

Huge amounts of microscopic size algae called diatoms and dinoflagellates make up the base of the ocean food chain. Small fish such as anchovies and sardines, and shellfish such as clams and California mussels, eat these microscopic algae. Larger fish eat the anchovies and sardines. Sea lions and dolphins eat the larger fish. So do people.

Excess nitrogen and phosphorous in the ocean is one reason why algae sometimes grow very fast. Sometimes they grow so fast, they color the seawater a reddish brown. This is known as a Red Tide.

Most algae are great food, but some algae produce poisons such as Domoic Acid. When anchovies, mussels, and other small animals eat poisonous algae, and are themselves eaten, they pass these poisons up the food chain. Every year, hundreds of sea lions are poisoned and die because they eat fish contaminated this way. Poison from harmful algae cause memory loss and death in people, too.



## It's important to test the temperature of storm drain water.

Los Angeles ocean water is colder than the water around Australia, Hawaii, or Mexico. Cold water can hold more oxygen than warm water. The Giant Brown Kelp that live around here start to die when our water gets above 70 degrees Fahrenheit. Fish that live here prefer cold water, too. When it gets too warm, the way it does in an El Nino year, our native fish swim north.

## It's important to test the clarity (turbidity) of storm drain water.

When water is too turbid (cloudy), sunlight doesn't go down as deep. Photosynthesis slows down, and algae slow their growth or die. Steelhead trout and other types of fish die.

## It's important to test the pH (acidity) of storm drain water.

The pH scale goes from 1 to 14. A reading of pH 1 indicates the presence of a very strong acid. pH 14 indicates a very strong base. pH 7 is in the middle, neutral—neither acidic nor basic. Most animals that live in the ocean prefer a pH of 6.5-to-8.5.

## It's Important to Test Storm Drain Water for Coliform bacteria because:

Coliform bacteria are a kind of bacteria that are found naturally in soil and in the intestines of humans and other animals. They are not harmful, but they are easy to test for.

The kinds of bacteria, viruses, and one-celled organisms that do make people and other animals sick are more difficult to observe than coliform bacteria. However, many pathogens (things that cause disease) are found in the same places and conditions as coliform bacteria. So, coliform bacteria are good indicators for the presence of pathogens. If you find coliform bacteria in water, pathogens are probably there also.



## What does testing for bacteria have to do with chemistry?

Coliform bacteria, like most other living things, breathe in oxygen and breathe out carbon dioxide. When bubbles of carbon dioxide gas, produced by bacteria, react with water they create a weak acid called carbonic acid.

Coliform test tablets contain food for bacteria. They also contain a gelling substance and an indicator chemical that colors the water red. When there is carbonic acid in the water, the indicator goes through a chemical reaction that changes the water color from red to yellow. Bubbles of carbon dioxide gas also cause the gel to float to the top of the test tube. You know there are bacteria in the water if the water turns yellow or the gel floats to the top of the test tube.



For Scoring Purposes Only

Book Number \_\_\_\_\_

Please print initials

### Group Storm Drain Presentation

Score 1: \_\_\_\_\_

Score 2: \_\_\_\_\_

Score 3: \_\_\_\_\_

### Student Summary Report

Score 1: \_\_\_\_\_

Score 2: \_\_\_\_\_

Score 3: \_\_\_\_\_



## ICS CHEMISTRY UNIT ASSESSMENT STORM DRAIN REPORT CARD

### Student Booklet

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Teacher \_\_\_\_\_

Grade: \_\_\_\_\_

School \_\_\_\_\_



# STORM DRAIN DATA SHEET



INLET SITE \_\_\_\_\_

Research Team Member Names

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

	1st Observation	2nd Observation	3rd Observation	4th Observation	5th Observation
DATE					
TIME					
Time since last rain					
Amount of last rain					
Trash at drain inlet					
Water Temperature					
Water Color					
Turbidity					
Odor ?					
Salinity					
Dissolved O2					
Nitrate					
Phosphate					
pH					
Bacteria (ppm)					

5.

# GRADING YOUR GROUP PRESENTATION

With help from your teacher, you will take part in deciding how your Storm Drain Water Report presentation will be graded. Think about what a good presentation will have.

**CRITERIA:** Your grade might be based on some or all of these criteria:

## Water Chemistry:

- A description of your study site, the tests your group performed, and a summary of your results.
- A grade of "A"-through-"F" for the storm drain water you studied, and an explanation of how your group decided this.
- Water chemistry data, including concentrations in parts per million (ppm) of oxygen, nitrogen, and phosphorous; temperatures, salinities, turbidities, acidities, and the presence or absence of bacteria
- Comparisons of this chemistry data to the same kinds of measurements for samples of STANDARD water that is considered "healthy" (tap water, distilled water, bottled water)
- Comparisons to the data other groups in your class got
- An explanation of why these data (oxygen, nitrogen, and phosphorous; temperatures, salinities, turbidities, and acidities) are important

## Presentation:

- Well planned and prepared for
- Clear, complete, and accurate
- Interesting and flows well
- Helpful and accurate visual aids (poster panels, PowerPoint slides, videos, etc.)
- Correct grammar and spelling
- Contribution by each group member

**POINTS:** You and your teacher may come up with other criteria to judge the project. Your teacher will tell you how much the whole storm drain water project is worth. You can suggest how much each part of the project (each criterion) is worth.



# COLLECTING STORM DRAIN WATER

You will be collecting water that runs off streets into storm drain inlets near your school or on the grounds of your campus.

If there are storm drain inlets on your school campus, it is probably safer to collect water from them than to collect from street curb inlets.

## SAFETY FIRST!

If you are collecting water from street curb inlets, keep your whole body on the sidewalk. Do not go into the street! Instead, use a small bucket attached to a pole to scoop up water or lower a collection bottle into the storm drain inlet on a string, on a stick, or on a pole. One student in each group should be responsible for letting the group know if a vehicle is approaching. Be especially careful not to get hit by a car or bus!

Wear gloves when you collect water. If you are where your feet might touch contaminated water, wear rubber boots too. Wear gloves and goggles when you do the water quality tests.

If the water is deep enough, you can collect samples in water bottles or beakers. If the water is not deep enough to do this, you can collect samples by laying a resealable plastic bag (Ziplock, baggie, or a special "whirl-pack") on the asphalt, opening the bag to collect water, and then resealing it.

