

## DFW Earth Day 2026



### Lesson Plan Information

**Name:** Watershed Detectives

**Grades:** 4-8

**Topic:** Students will step into the role of watershed detectives, challenged to uncover the source of pollution in a local creek. Working in small groups, they will analyze water samples using simple test kits to measure pH, nitrates and phosphates. Each test result provides an important clue – helping students narrow down the possible source of contamination. By comparing their findings to healthy water-quality ranges, students will piece together a chemical footprint and determine which of the following activities are responsible for polluting the creek: agriculture (fertilizer runoff), construction work (concrete washout), or vehicle washing (soap discharge from a car wash). Through discussion and evidence-based reasoning, students will present their conclusions and learn how common human activities can impact water quality, watershed health and the environment downstream.

**Time:** 30-60 mins.

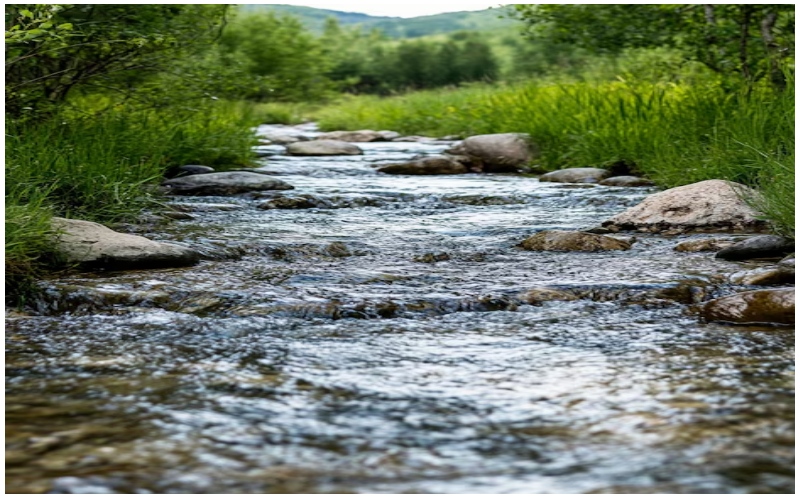
## DFW Earth Day 2026

### Introduction: Why Protecting Watersheds Matter

Freshwater is one of Earth's most valuable resources, yet only a tiny fraction of the planet's water is fresh and safe to use. Even though water covers most of the Earth, nearly all of it is just salty ocean water that people, plants and animals can't drink. The small amount of freshwater available is essential for life.

People rely on freshwater to drink, cook, clean, grow food, and stay healthy. Wildlife in creeks, rivers and lakes also needs clean water to survive. When freshwater becomes polluted, it can make people sick, harm animals and make it harder for plants to grow. Because water moves through an entire watershed, pollution in one spot can cause problems downstream.

Protecting our freshwater and watersheds helps safeguard our communities, wildlife and ecosystems. By keeping Earth's bodies of water clean, we ensure there is safe water for people, animals and plants today for generations to come.



## DFW Earth Day 2026

### Key Terms:

**Runoff** – The portion of precipitation (rainfall or snowmelt) that does not infiltrate into the ground, evaporate or get intercepted by vegetation. Instead, it flows over land surfaces or through drainage systems into streams, lakes or storm sewers.

**Illicit Discharge** – Any discharge to a storm drain's system or receiving water that is not composed entirely of stormwater -- except for specifically allowable non-stormwater discharges.

**Stormwater** – Water generated by precipitation (rainfall or snowmelt) that flows over land surfaces or through drainage systems instead of infiltrating into the ground.

**Pollution** – The introduction of contaminants into the environment that cause harm or degrade water quality, ecosystems or human health.

**Pollutant** – Any substance introduced into stormwater that degrades water quality or harms aquatic life, ecosystems or human health.

**Chemical Indicator** – A measurable chemical parameter used to assess water quality and indicate the presence, concentration or impact of pollutants in a waterbody.

**Concrete Washout** – Wastewater and residual material generated from the cleaning of concrete trucks, chutes, pumps, tools or equipment that contains cement, sand, gravel and highly alkaline water.

### Materials:

Kit will include:

- Watershed Detective evidence folders
- Phosphate test strips
- pH test strips
- Nitrate test strips
- Sample bottles
- Phosphate, pH and nitrate solution
- Pipettes

## DFW Earth Day 2026

- Gloves

### Procedure:

#### Prepare water samples before starting the kit with students:

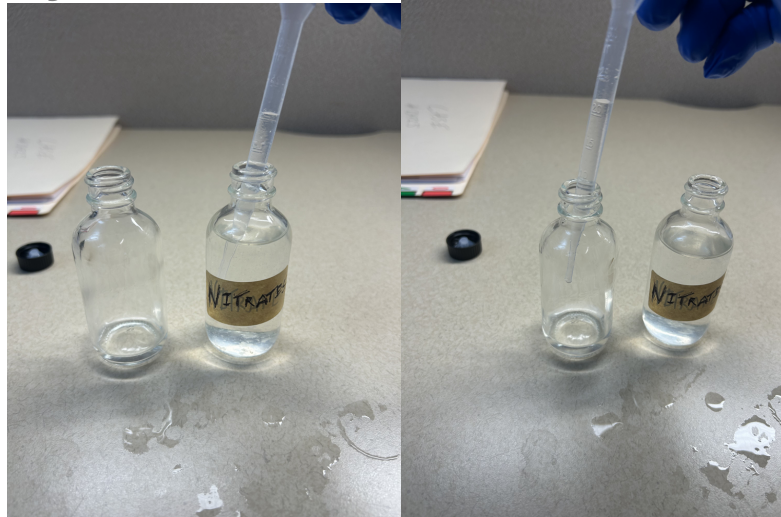
Before class begins:

You will receive one box containing five kits – designed to divide your class into five small groups for this activity. The box also includes five sample bottles. Please label the bottles one through five and prepare the water samples by adding the appropriate buffer to each bottle as instructed. Use the provided pipette and wear gloves while preparing the samples.

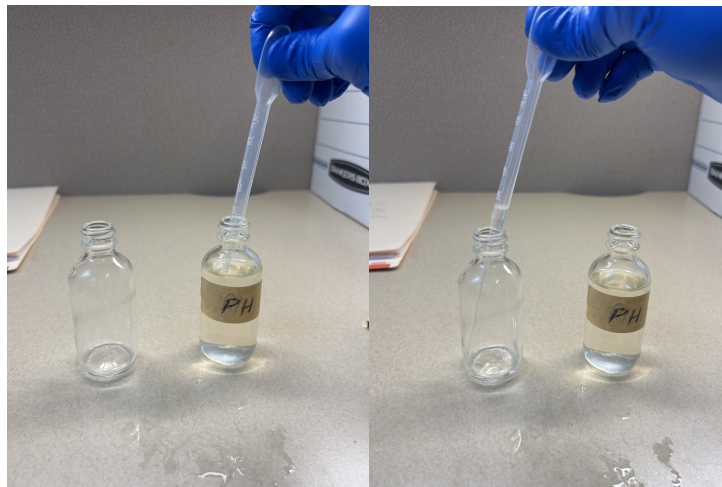
First sample: This sample will leave the students to conclude that the farmer is the culprit. Using the provided pipette Take 6 mL of the Phosphate buffer provided and 6 mL of the nitrate buffer provided and place in sample. Then fill the rest of the sample with normal tap water. Shake to mix.



## DFW Earth Day 2026



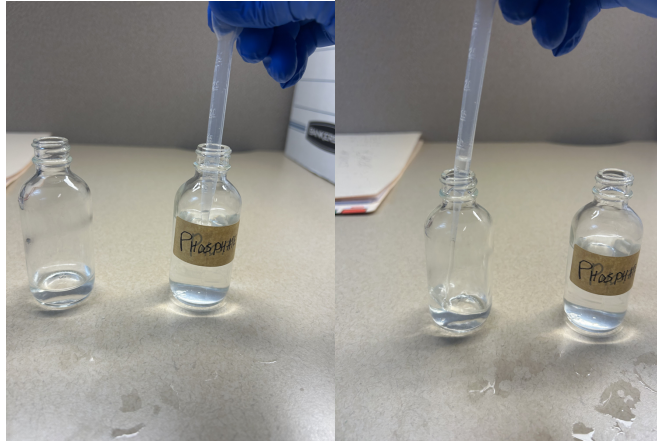
Second sample: This sample will leave the students to conclude that the construction worker is the culprit. Using the provided pipette, take another 6 mL of the provided pH buffer and put into the second sample. Then fill the rest of the sample with tap water. Shake to mix.



Third sample: This sample will leave the students to conclude that the car wash attendant is the culprit. Using the provided pipette, take another 6 mL of the

## DFW Earth Day 2026

phosphate buffer and place into the third sample. Then fill the rest of the sample with tap water. Shake to mix.



Fourth and fifth samples: Play around with these. You can put in all three buffer solutions, none or repeat the other samples. It's up to you.

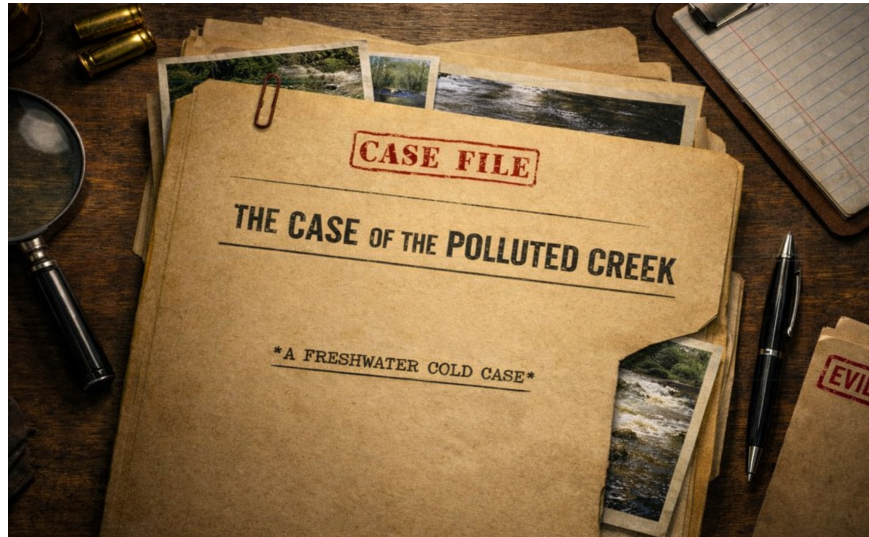
Place each prepared sample into a separate evidence bag along with one funnel and five pairs of gloves. To set up the activity stations, place one evidence bag, one testing bag and one case file on each of five desks to form five student groups. **Please note: the phosphate test students will have to share the tube.**

Pull up slideshow link and show opening slide on projector.

Begin presentation

## DFW Earth Day 2026

### Introduction



Alright detectives, listen up – no talking or guessing just yet. What you’re seeing is a real situation, something that happens every day in communities just like ours. A local creek has changed: the water looks different and fish and insects are struggling. No one knows exactly when it started. There were no witnesses, no alarms and no obvious signs of what happened. All we have left is the evidence – the water itself.

Today, you are not students, you are environmental detectives. Your job is to analyze water samples, figure out what chemistry is telling you and solve the mystery of what happened to this creek. By the end of this investigation, you should be able to answer three questions:

- **Why freshwater is so important?**
- **How easily it can be polluted?**
- **What people can do to protect it?**

This isn’t just a game. Creeks like this exist all over the country right now. So, detectives, let’s open the case.

## DFW Earth Day 2026

### The Problem: Understanding the Creek



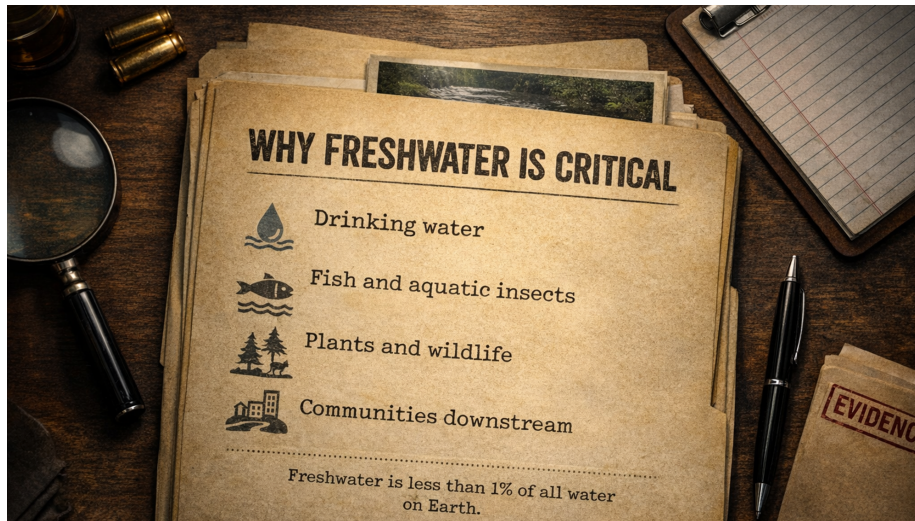
Here's what we know so far: this creek flows through areas where people live and work farms, construction sites and businesses. It used to support fish, insects and plants, but recently, something has changed. The water chemistry is off, and life in the creek is struggling. There were no witnesses, no warning signs – just gradual damage.

That tells us something important: whatever happened didn't seem dangerous at first. And that's how most freshwater pollution works – slowly, quietly and often unnoticed.

Before we can solve this case, we need to understand why this creek matters at all. Because if this water doesn't matter, then neither does what happened to it."

## DFW Earth Day 2026

### Why Freshwater Matters



This creek matters because it is part of a much larger system. Freshwater isn't just what we see in rivers and lakes – it's the water we drink, the water plants and animals rely on and the water that flows through communities downstream. When a creek like this is healthy, it supports fish, insects and plants that keep the ecosystem in balance. Those small organisms are critical because they form the base of the food web, and when they disappear, everything above them is affected.

Freshwater is also limited. Less than 1% of all the water on Earth is available for people and wildlife to use. Once it becomes polluted, it can be very difficult, costly and sometimes impossible to restore. **Pollution** doesn't stay in one place – what enters this creek can travel downstream, affecting other waterways, wildlife and communities far away. That's why even small changes in water quality matter – and why understanding what happened to this creek is so important.

## DFW Earth Day 2026

### How Pollution Happens



Freshwater pollution usually doesn't come from one big event. It happens through many small actions that add up over time. When it rains, water flows over the land instead of soaking in, picking up chemicals, dirt, and other substances along the way, and carrying them into nearby creeks and streams. Once these pollutants enter the water, they don't stay in one place. They travel downstream and spread the impact far beyond where they started.

Many sources of **pollution** come from everyday activities. Farming, construction or washing cars might seem harmless on their own, but together, they can seriously change water quality. That's why freshwater pollution is often hard to notice at first: the damage builds slowly, and by the time it's obvious, the creek is already in trouble. Learning how **pollution** enters the water is the first step toward preventing it.

## DFW Earth Day 2026

### The Map



This map shows a section of the creek and the areas around it. Upstream, the creek passes a construction site, a farm and a car wash. Each of these places has **stormwater** drains or outfalls that connect directly to the creek. As water flows downstream, it carries anything that enters it along the way – pollutants don't stay near their source; they travel with the current.

Further downstream, the creek flows through a community, and near the end of this section, is a school. This shows how water quality can affect the places where people live, learn and play. **Pollution** that enters the creek upstream doesn't disappear. It moves through the system and can impact everything downstream. Right now, we don't know which location caused the problem. All we know is that the creek connects them all, and the only way to solve the case is to carefully examine the evidence found in the water itself.

## DFW Earth Day 2026

### Introducing the Suspects



This board shows the three individuals who were working near the creek before the water quality changed. Each suspect is associated with a different activity that could affect freshwater if something from their site entered the creek. None of these activities are illegal. They are common, everyday jobs that communities rely on. The question is not whether these activities happen but whether something from one of these locations entered the creek and altered the water chemistry.

Each suspect has provided a statement about what they do and how their work could impact the environment. Your job is to listen carefully and compare their statements to the evidence found in the water samples. Remember: good detectives make decisions based on data, not assumptions.

#### **The Farmer**

“I run a farm upstream from the creek. We use fertilizer to help crops grow because plants need nutrients to survive. We follow application guidelines and only fertilize when conditions are right. Fertilizer is meant to stay on the fields, not in the creek.”

*(Hint: nutrients, runoff conditions)*

## DFW Earth Day 2026

### The Construction Worker

“I work on a construction site near the creek. Concrete is used all the time for roads and buildings. When we’re done pouring, equipment has to be cleaned out. Concrete is mostly rock and water. It hardens quickly, and once it does, it doesn’t go anywhere. I don’t see how I could have affected the creek.”

*(Hint: washout water, chemistry changes, pH)*

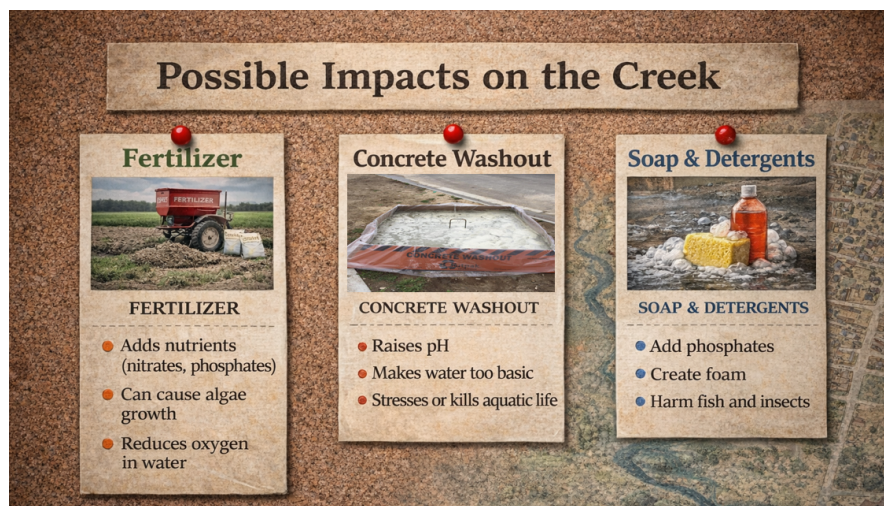
### The Car Wash Attendant

“I work at a car wash close to the creek. We use soaps and detergents to clean vehicles. Everything goes down the drains like it’s supposed to. The water looks dirty but it’s just soap and dirt from cars. It all gets washed away.”

*(Hint: detergents, foaming, nutrients)*

Now that you’ve heard from each suspect, it’s time to stop listening to stories and start looking at the evidence. The water samples will show which chemical clues match what happened in the creek.

### Understanding the Chemistry



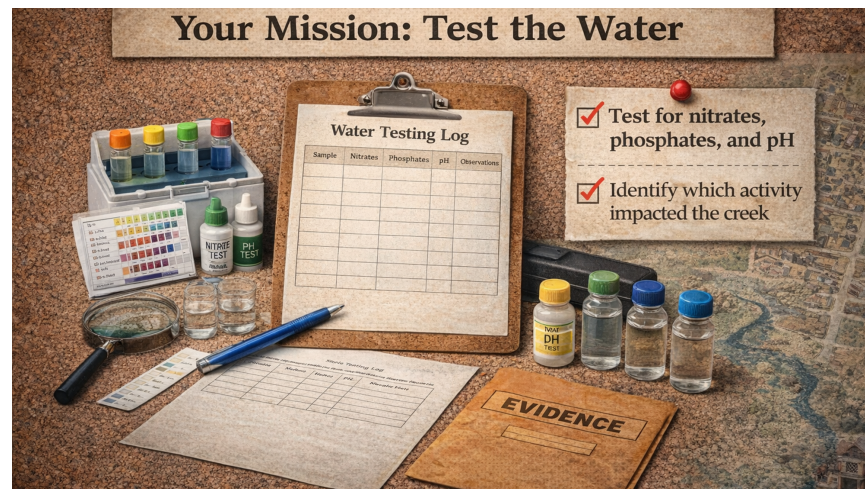
This slide explains how each type of activity could affect the creek if something enters the water. Fertilizer contains nutrients like nitrates and phosphates.

## DFW Earth Day 2026

Small amounts are normal, but too much can cause algae to grow quickly, using up oxygen that fish and insects need to survive. Concrete washout water is very basic (high pH). If it enters the creek, it can raise the pH rapidly, stressing or killing aquatic life. Soaps and detergents often contain phosphates as well. When these enter freshwater, they can create foam and contribute to algae growth, harming water quality. Each source affects the water differently, and those differences are exactly what you will look for in your test results.

---

### Beginning the Investigation



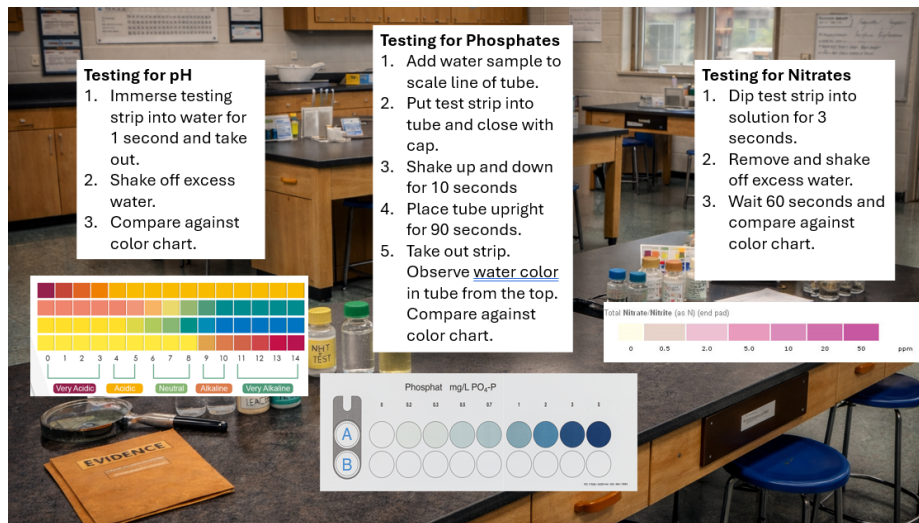
This is where your investigation begins. You will be testing water samples collected from the creek. These samples contain the evidence you need to figure out what affected the water. Your job is to test for **nitrates, phosphates and pH**. Remember to record your results carefully.

As you work, think back to what you learned about **fertilizer, concrete washout, soaps or detergents**. Look for patterns in your results that match one of these activities. Don't rush to a conclusion. One result alone is not enough to solve the case. The answer comes from considering all the evidence together. Once your tests are complete, you

## DFW Earth Day 2026

will use your findings to determine which activity most likely impacted the creek and explain your reasoning. This is how real environmental investigations are done.

### During Testing



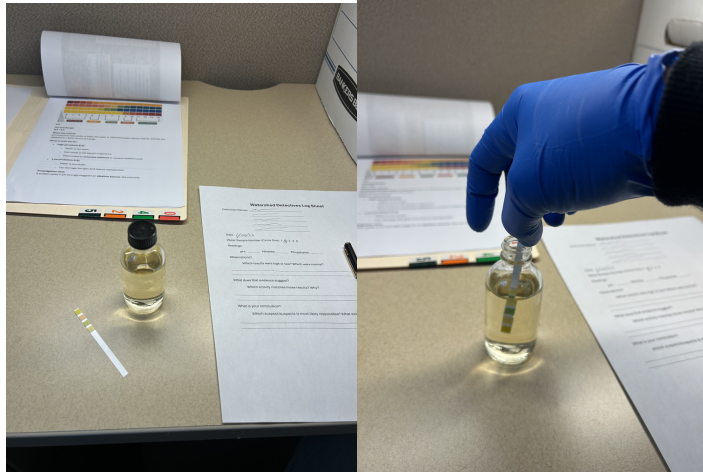
You are now in the testing phase of the investigation. On the screen are the instructions for testing each water quality parameter. Follow these instructions carefully and work together as a team. **Accuracy matters more than speed.** Record every result exactly as you see it, and do not change a result just because it doesn't match what you expected.

Each test gives you one piece of the puzzle. No single test tells the whole story. Your goal is to look at all the results together and decide what they mean. If something seems confusing or unexpected, that's normal. Real investigations rarely give perfect answers right away. Once testing is complete, be ready to explain which results stand out and how they connect to what you learned earlier about the possible pollution sources.

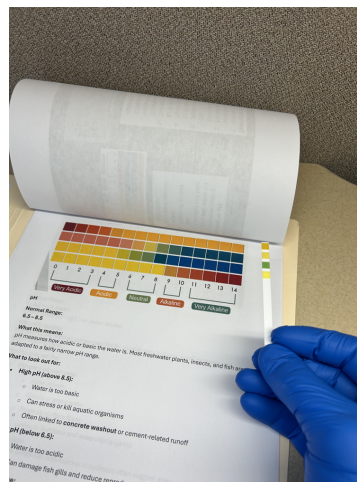
## DFW Earth Day 2026

Students will begin to test water samples.

1. Fill out detective names, date and sample number 1-5 on log sheet.
2. Test pH
  - a. Take the four boxed colored test strips and dip them into the samples.



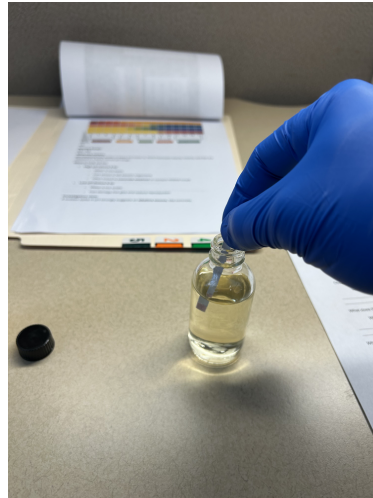
- b. After three seconds, take out strip and shake off excess water.
  - c. Compare pH level to provided chart and record matching value.



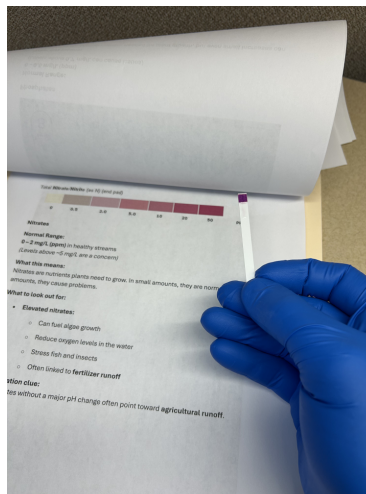
## DFW Earth Day 2026

### 3. Test for nitrates

- a. Take single box test strip and place in sample for three seconds.



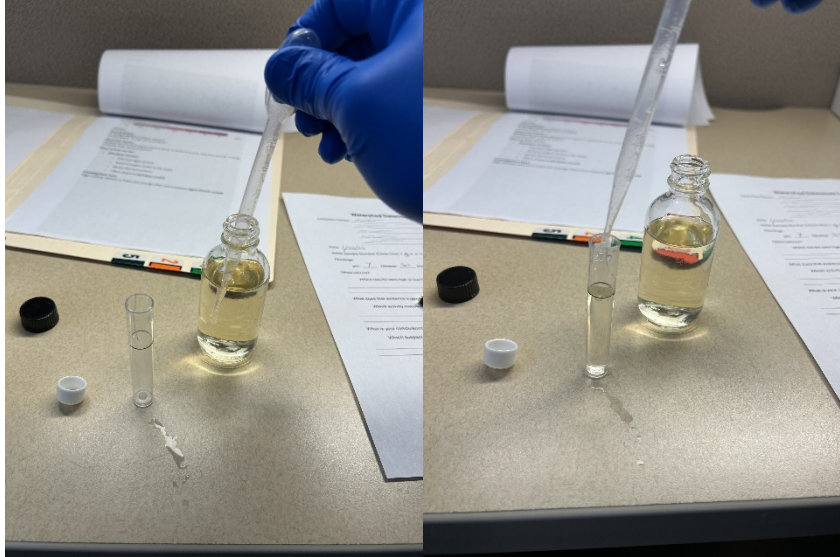
- b. Shake off excess water and compare it to provided chart. Record value.



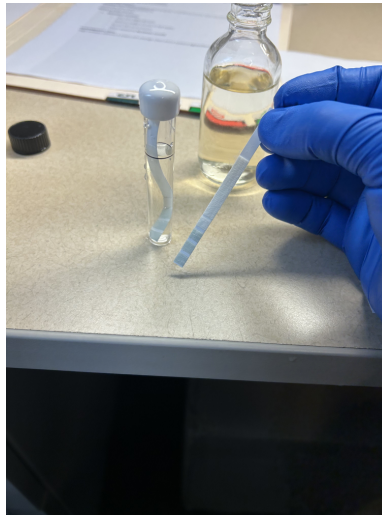
### 4. Test phosphates (groups will have to share tube so stagger the order in which groups do tests)

- a. Fill provided tube to line with sample using pipette.

## DFW Earth Day 2026

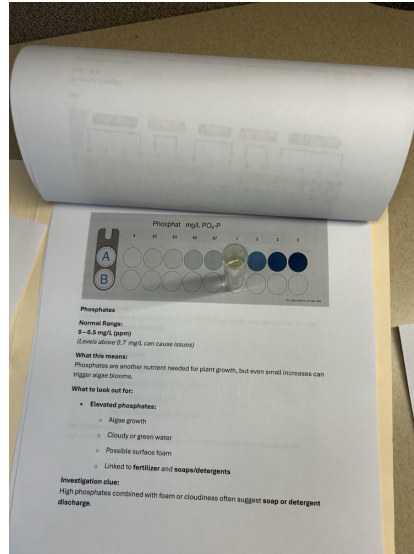


- b. Take final test strip and place in tube. Shake tube for 30 seconds.

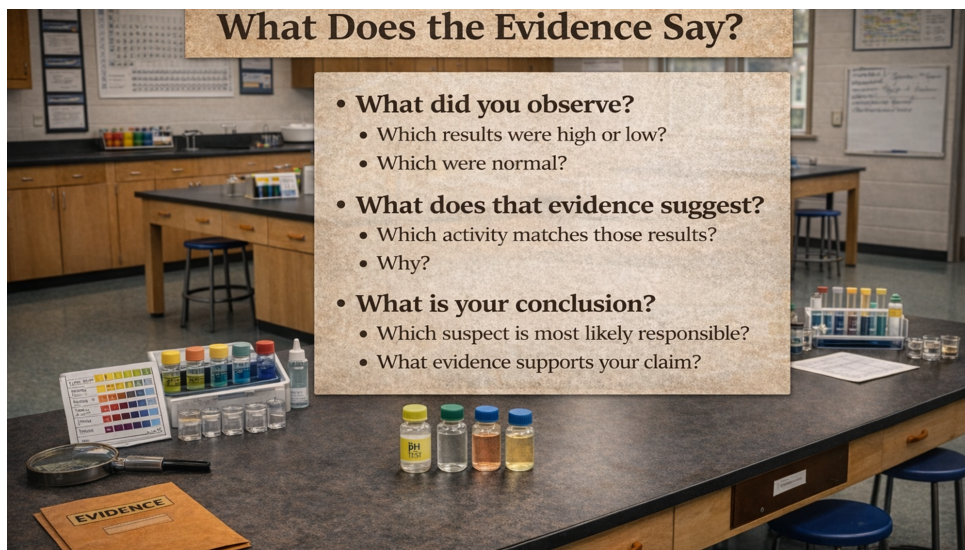


- c. Let tube rest for 90 seconds.  
d. Take out strip. Look down through top of tube in blank circles compared to chart. Record your value.

# DFW Earth Day 2026



## Analyzing the Evidence



Now that testing is complete, it's time to review the evidence. Start by looking only at your data. Describe what you observed without trying to explain it yet. Focus on which results stood out and which were within normal ranges.

## DFW Earth Day 2026

Next, connect your results to what you learned about how **fertilizer, concrete washout, soaps and detergents** affect water. Think about which activity best matches the patterns you observed.

Finally, come to a conclusion. Decide which activity most likely impacted the creek and be ready to explain your reasoning using evidence from your tests. Remember, there may be more than one reasonable conclusion – the important part is how well you support your claim with the data.

---

### Conclusion



You've now completed the investigation. Based on your test results, you identified which activity most closely matched the changes in the creek's water quality. What mattered most was not which suspect you chose but **how you used evidence to support your conclusion**.

In real environmental investigations, scientists often don't get one clear answer. They look for patterns, collect data and make the best conclusion they can with the information available. This case shows how easily freshwater can be affected by everyday activities, even when no one intends to cause harm. It also shows how

## DFW Earth Day 2026

connected water systems are: what happens upstream can impact communities, wildlife and people downstream.

Protecting freshwater means paying attention to how our actions affect the environment and taking steps to prevent **pollution** before it enters waterways. The case may be closed but the responsibility to protect water continues every day.

# DFW Earth Day 2026

## Watershed Detectives Log Sheet

Detectives Names: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

Water Sample Number (Circle One): 1 2 3 4 5

Readings:

pH: \_\_\_\_\_ Nitrates: \_\_\_\_\_ Phosphates: \_\_\_\_\_

Observations?

Which results were high or low? Which were normal?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What does that evidence suggest?

Which activity matches those results? Why?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

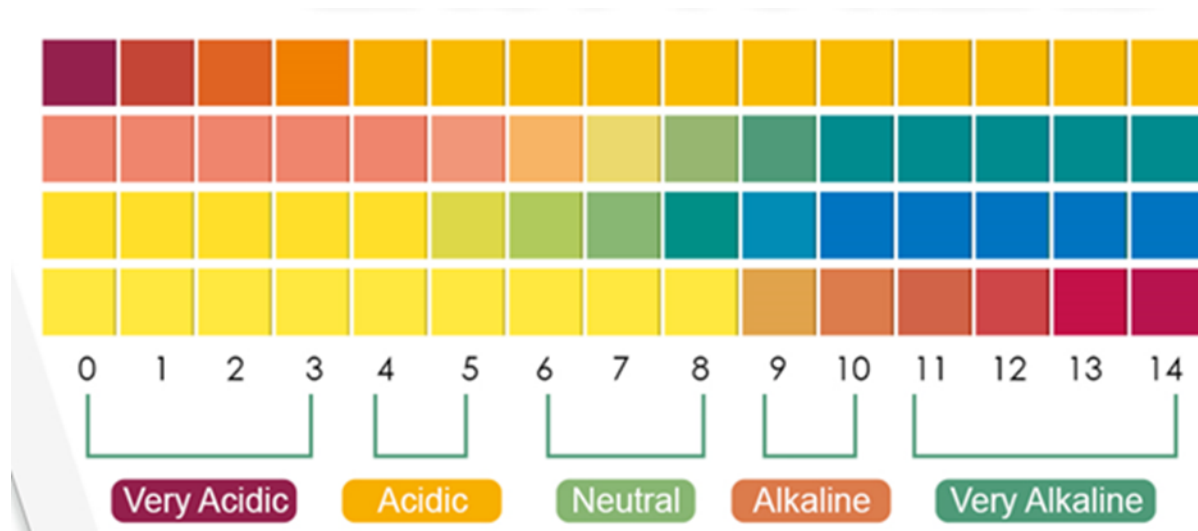
What is your conclusion?

Which suspect/suspects is most likely responsible? What evidence supports your claim?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# DFW Earth Day 2026

## Parameter Cheat Sheet and Color Tests (for teacher + students)



### pH

#### Normal Range:

6.5 – 8.5

#### What this means:

pH measures how acidic or basic the water is. Most freshwater plants, insects and fish are adapted to a fairly narrow pH range.

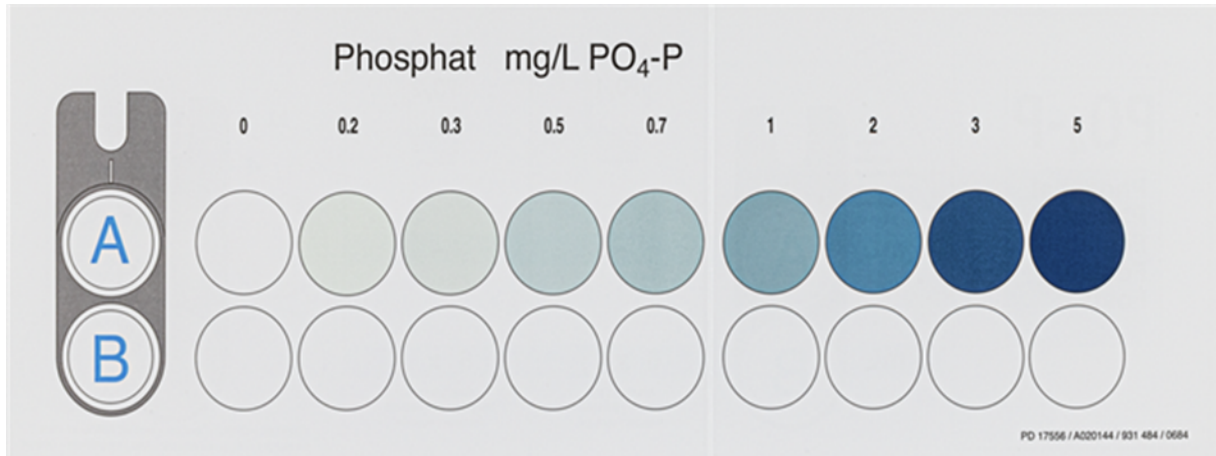
#### What to look out for:

- **High pH (above 8.5):**
  - Water is too basic
  - Can stress or kill aquatic organisms
  - Often linked to **concrete washout** or cement-related runoff
- **Low pH (below 6.5):**
  - Water is too acidic
  - Can damage fish gills and reduce reproduction

## DFW Earth Day 2026

### Investigation clue:

A sudden spike in pH strongly suggests an **alkaline source**, like concrete.



### Phosphates

#### Normal Range:

**0 – 0.5 mg/L (ppm)**

*(Levels above 0.7 mg/L can cause issues)*

#### What this means:

Phosphates are another nutrient needed for plant growth but even small increases can trigger algae blooms.

#### What to look out for:

- **Elevated phosphates:**
  - Algae growth
  - Cloudy or green water
  - Possible surface foam
  - Linked to **fertilizer** and **soaps/detergents**

#### Investigation clue:

High phosphates combined with foam or cloudiness often suggest **soap or detergent discharge**.

## DFW Earth Day 2026

Total Nitrate/Nitrite (as N) (end pad)



### Nitrates

#### Normal Range:

**0 – 2 mg/L (ppm)** in healthy streams  
*(Levels above ~5 mg/L are a concern)*

#### What this means:

Nitrates are nutrients plants need to grow. In small amounts, they are normal. In large amounts, they cause problems.

#### What to look out for:

- **Elevated nitrates:**
  - Can fuel algae growth
  - Reduce oxygen levels in the water
  - Stress fish and insects
  - Often linked to **fertilizer runoff**

#### Investigation clue:

High nitrates without a major pH change often point toward **agricultural runoff**.

---

---

# DFW Earth Day 2026

## Classroom Setup

### Group Structure

- Students work in **groups of five or fewer.**
- One kit per group; **five kits per class box.**

### Materials in Each Kit

- Nitrate test & Buffer



- Phosphate test & Buffer

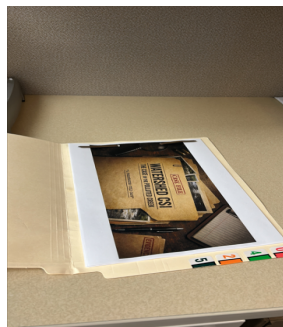


## DFW Earth Day 2026

- pH test & Buffer



- Case Files



- Evidence Vials (for water samples and for teacher buffers)

