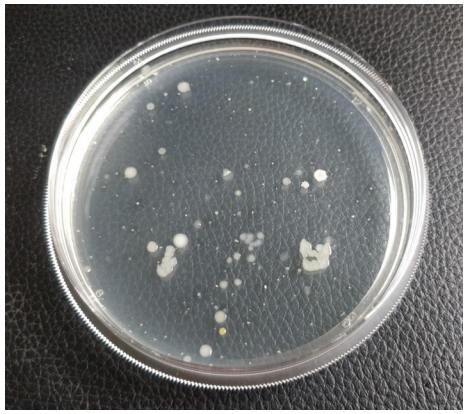






# Watershed Science: Growing Bacteria

## SPONSORED BY THE DRY COMAL AND COMAL RIVER WATERSHED PROTECTION PLAN

Visit **www.nbtexas.org/wpp**

Funded in part by EPA and TCEQ

SPRINGS. RIVERS. WATERSHED. OUR RESPONSIBILITY
NEW BRAUNFELS WATERSHED MANAGEMENT

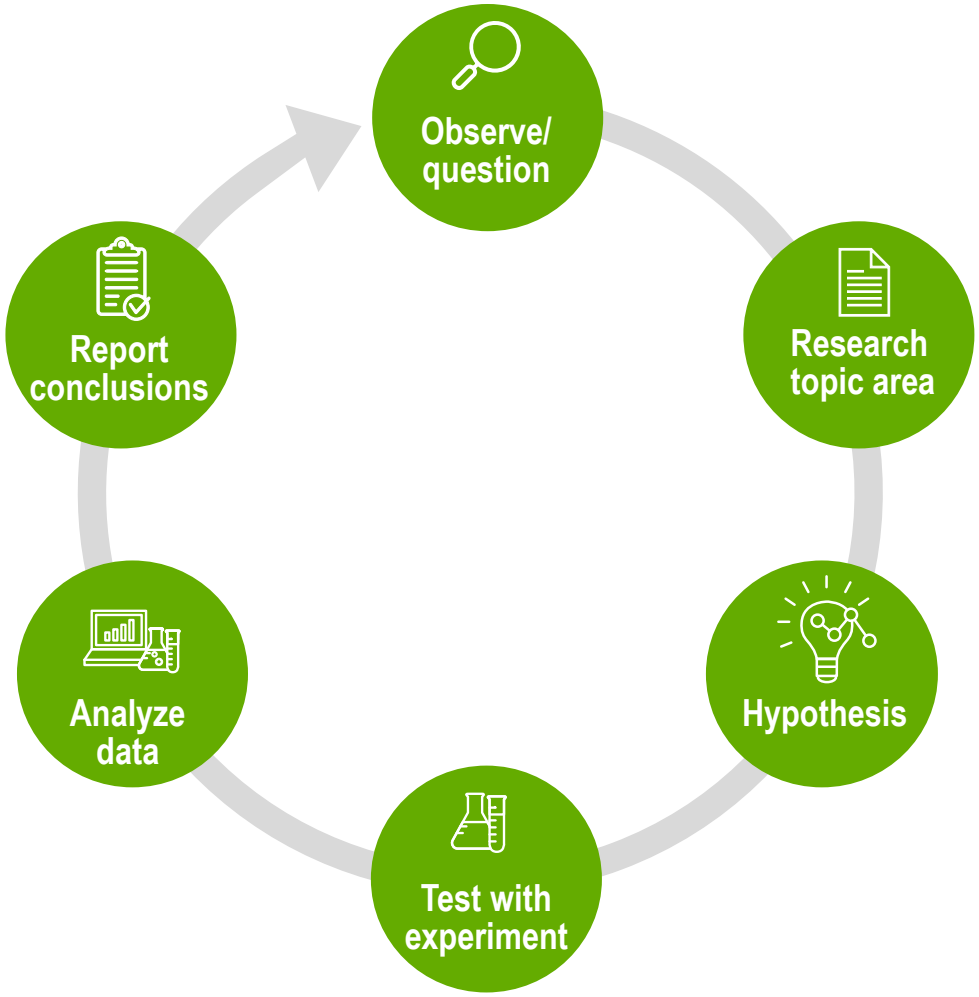
TEXAS PARKS & WILDLIFE

City of New Braunfels

EPA United States Environmental Protection Agency

GBRA Guadalupe-Blanco River Authority

# The Scientific Method





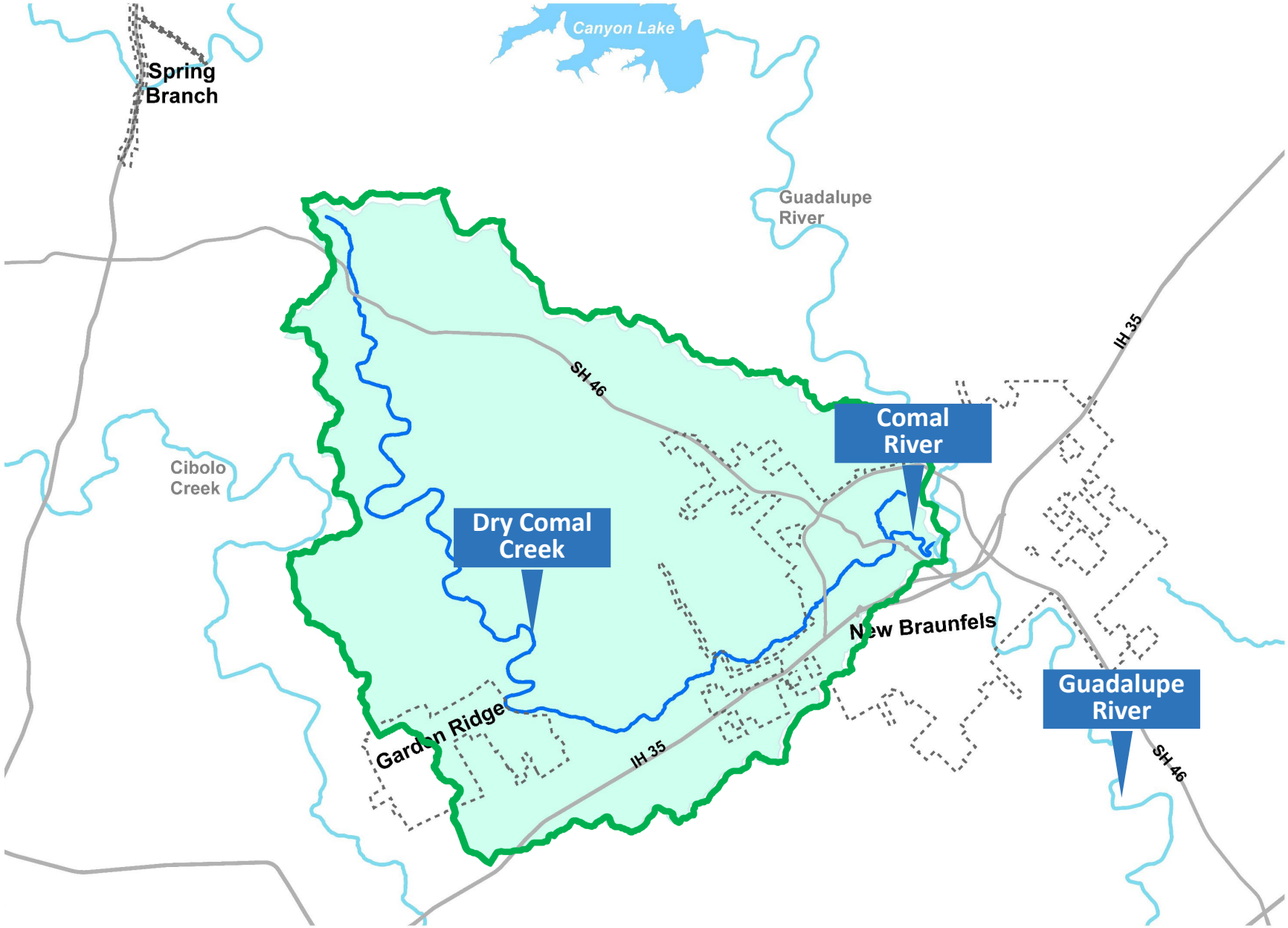
Step

1

# MAKE OBSERVATIONS

# Dry Comal Creek and Comal River Watershed

- The area of land that drains into the Dry Comal Creek and Comal River



# Dry Comal Creek and Comal River Watershed

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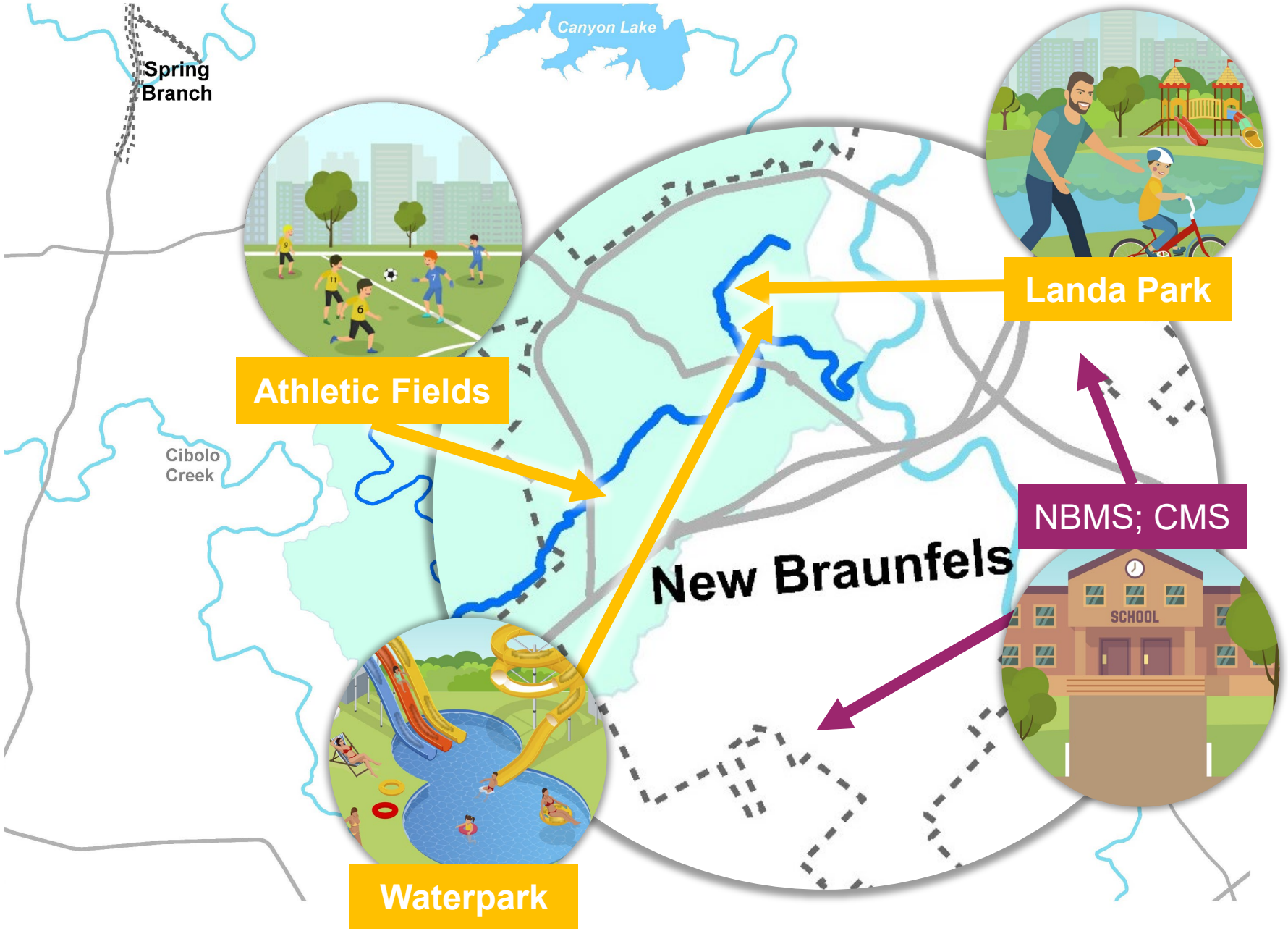
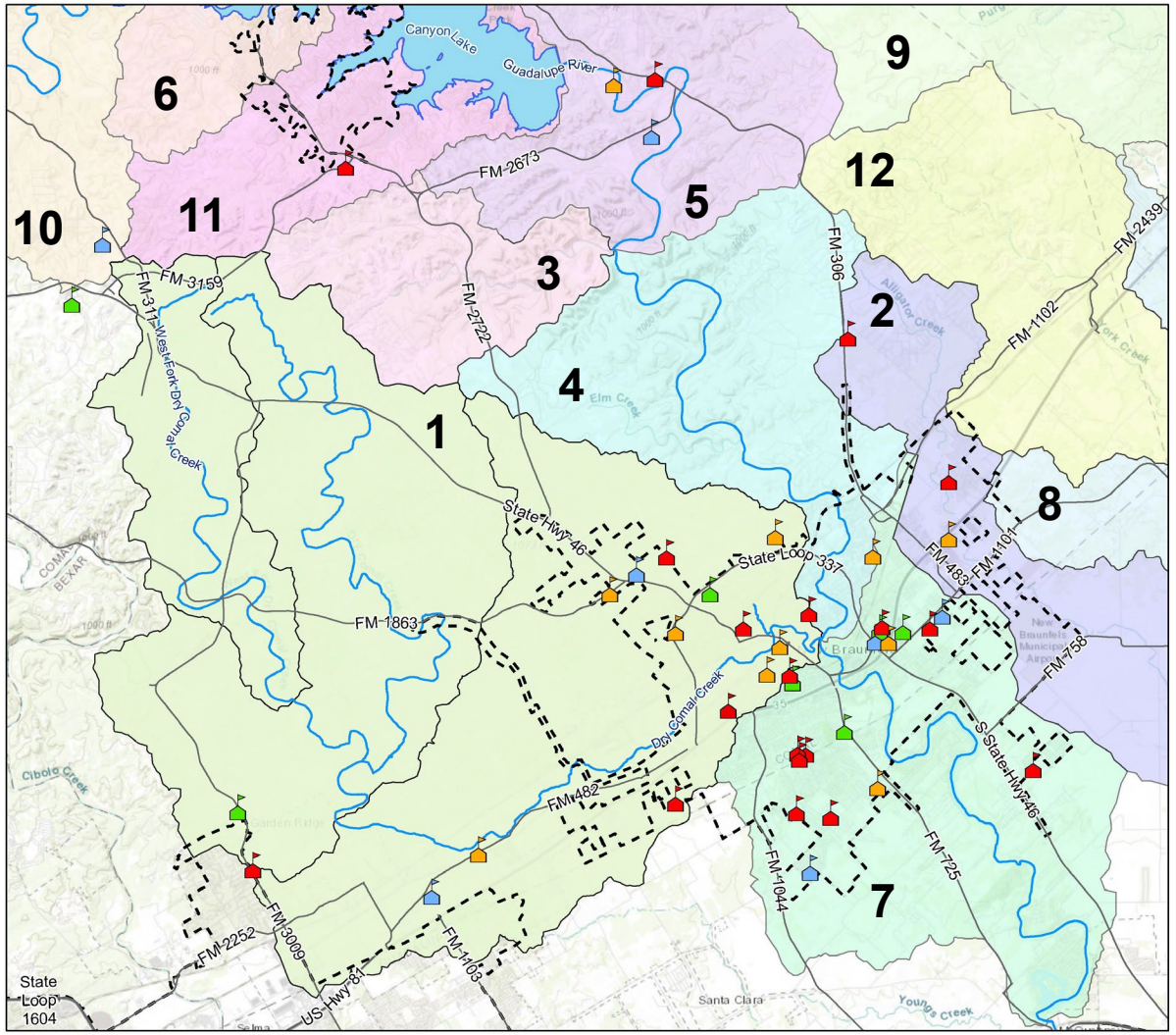


# Activity

# LOCATE YOUR SCHOOL AND HOME




- Streets
- City Boundaries
- Lakes
- Rivers

**Schools**

- Elementary School
- High School
- Middle School
- Private School

**Existing Watersheds**

| | |
|---|---|
| 1 | Dry Comal Creek and Comal River |
| 2 | Alligator Creek |
| 3 | Bear Creek |
| 4 | Elm Creek-Guadalupe River |
| 5 | Jacobs Creek-Guadalupe River |
| 6 | Jentsch Creek-Canyon Lake |
| 7 | Long Creek-Guadalupe River |
| 8 | Middle York Creek |
| 9 | Purgatory Creek-San Marcos River |
| 10 | Rebecca Creek-Canyon Lake |
| 11 | Tom Creek-Canyon Lake |
| 12 | Upper York Creek |

# Water Quality Challenges in our Watershed

2010

Dry Comal Creek listed as impaired

2016

Comal River listed as impaired

- Based upon standards for contact recreation
- Due to elevated bacteria concentrations

*Reference: Texas Integrated Report of Surface Water Quality (303(d) list)*

# Activity
# VISUALIZATION

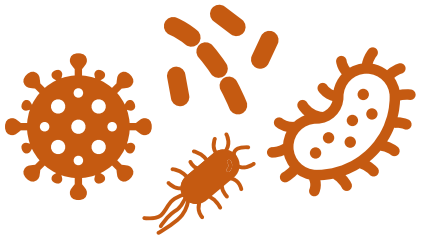
What have you observed throughout the Comal River and Dry Comal Creek Watershed?


Step

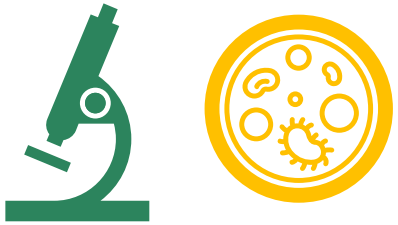
2

# RESEARCH TOPIC AREA

# What is *E. coli*?



Escherichia coli (*E. coli*) is a bacterium found in the intestines of warm-blooded animals. Although most strains of *E. coli* are harmless, some can make you sick. It can also contaminate or be found in food items.

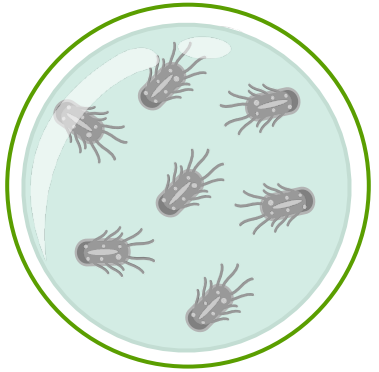


*E. coli* can be collected, grown and measured easily, making them and ideal indicator species – that is, they indicate the potential presence of harmful bacteria and viruses!

# The State Monitors *E. coli* in Texas Waterbodies

*E. Coli* is measured in units of: **colony forming units** (CFUs) **per 100 mL of water.**

Levels of *E. coli* have been slowly rising in the Dry Comal Creek and Comal River



# The Watershed Partnership began to investigate

- Watershed Protection Plan published in 2018:
  - **Phase 1:** Quantification of bacteria loads in the Dry Comal Creek and Comal River and identification of sources of bacteria pollution
  - **Phase 2:** Development of best management practices to reduce bacteria loads in the watershed

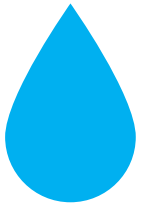

The mission of the Watershed Partnership is:

- **Protect the Watershed**
- Outline how we can **mitigate bacteria levels** and **enhance water quality**
- **Engage the community**

# Phase 1: Bacteria Source Testing (BST)

- Each bacterium has a ‘fingerprint’ that allows us to identify it
- BST can tell us where the *E. coli* in our water comes from

**Take a sample of water from the water body**



**Get the ‘fingerprints’ of the bacteria in it and send to Texas A&M University Lab**

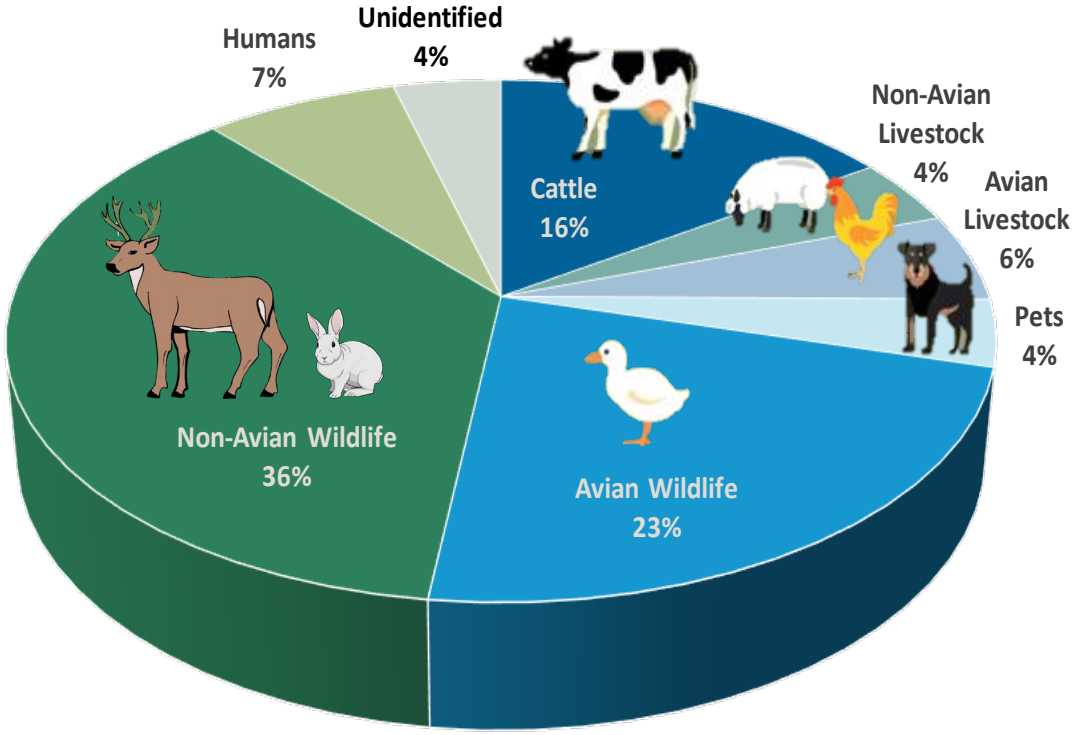
**Cross-check with the Texas *E. coli* BST Library**



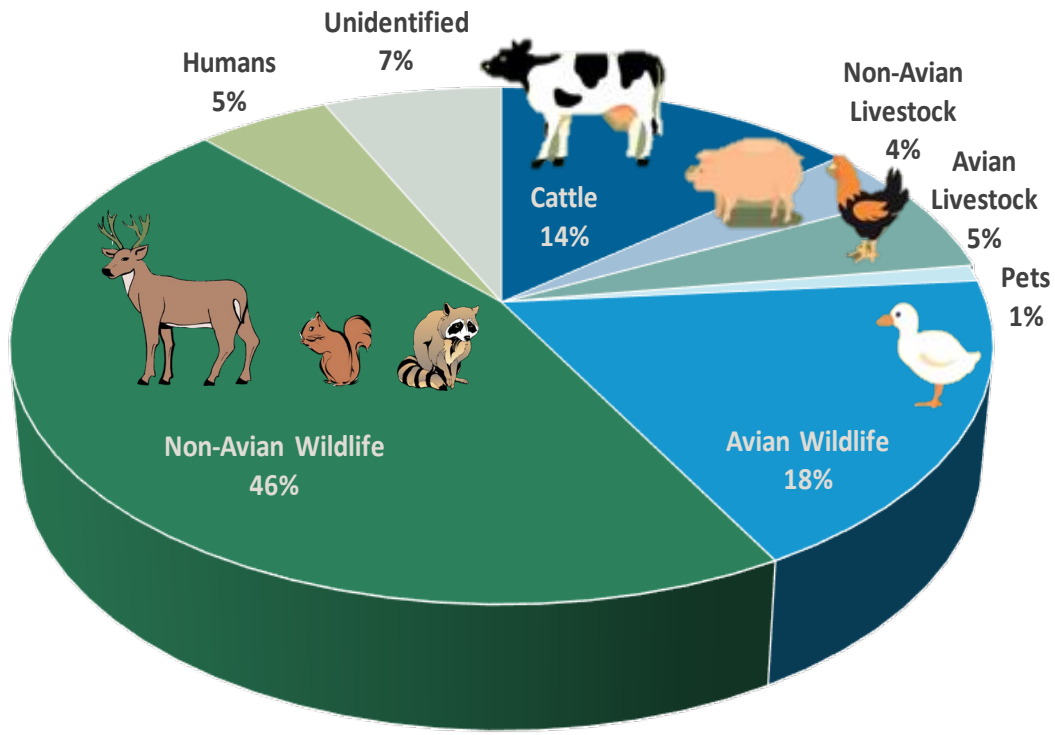
**Learn the source of the *E. coli***

# Analysis showed most bacteria in our watershed were from wildlife!

## Comal River (2013 & 2016)

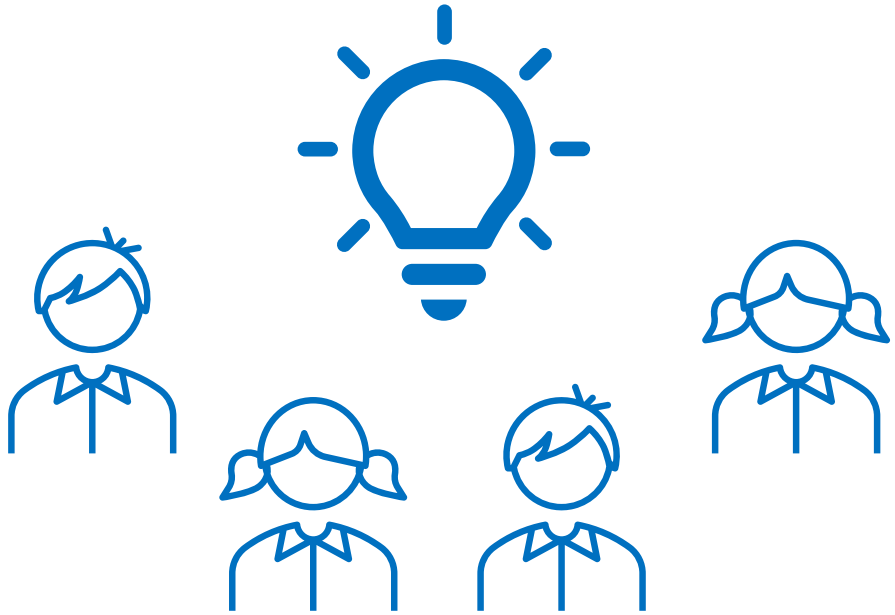



## Dry Comal Creek (2013 & 2016)



# What is Nonpoint Source Pollution?

# Activity
# BRAINSTORMING



How can I help keep our watershed healthy and clean?

# How do bacteria get into our water?

# How do bacteria get into our water?


Step
3

# HYPOTHESIS

# Exercise
# HYPOTHESIS

## Flip to Page 7 of your workbook and answer the following questions:

1. Do you think there are bacteria in natural water bodies, like rivers and ponds?
2. Are bacteria visible in natural water bodies? Why yes or no?
3. Do you think there can there be bacteria in clear water?
4. If you do think there is bacteria in natural water bodies -- do you think that two samples collected in the same water body would have identical bacteria? Do you think two samples collected on different days would have identical bacteria?


Step

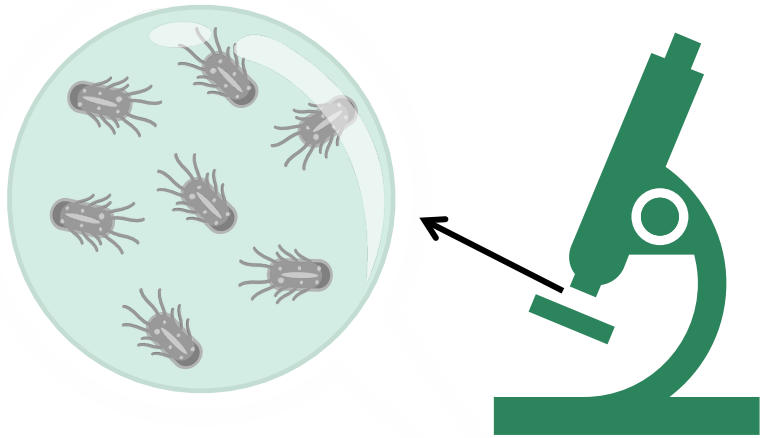
4

# TEST WITH EXPERIMENT

# How is *E. coli* measured?

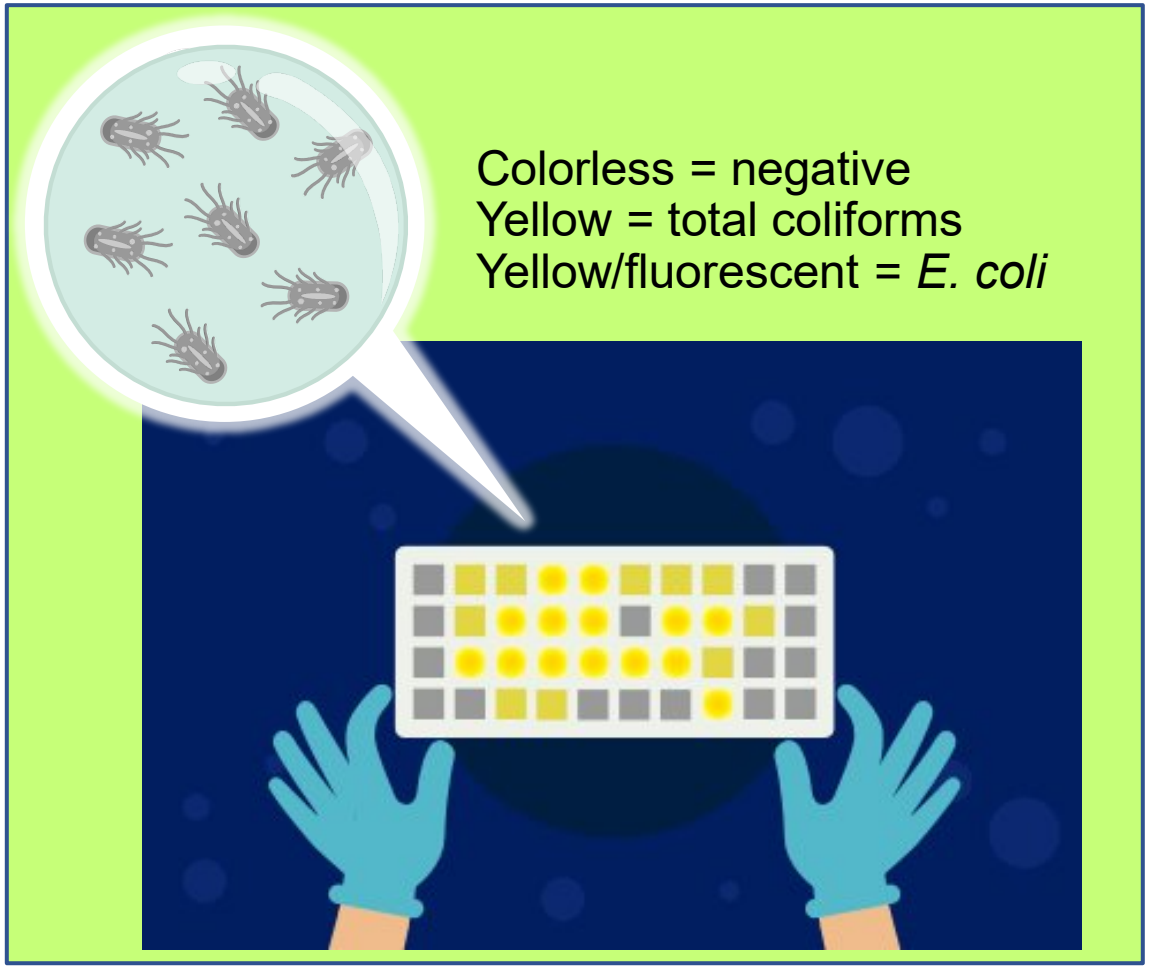
- **Plate Method:**
  - Dilute the sample (meaning, add water)
  - Culture the sample by placing the sample on an agar plate
  - Calculate the bacteria in the sample by multiplying the **dilution factor** with the **number of colonies** on the plate.

**Culturing bacteria** means to grow it in a controlled medium. Agar is a jelly-like substance often used as a culture medium.

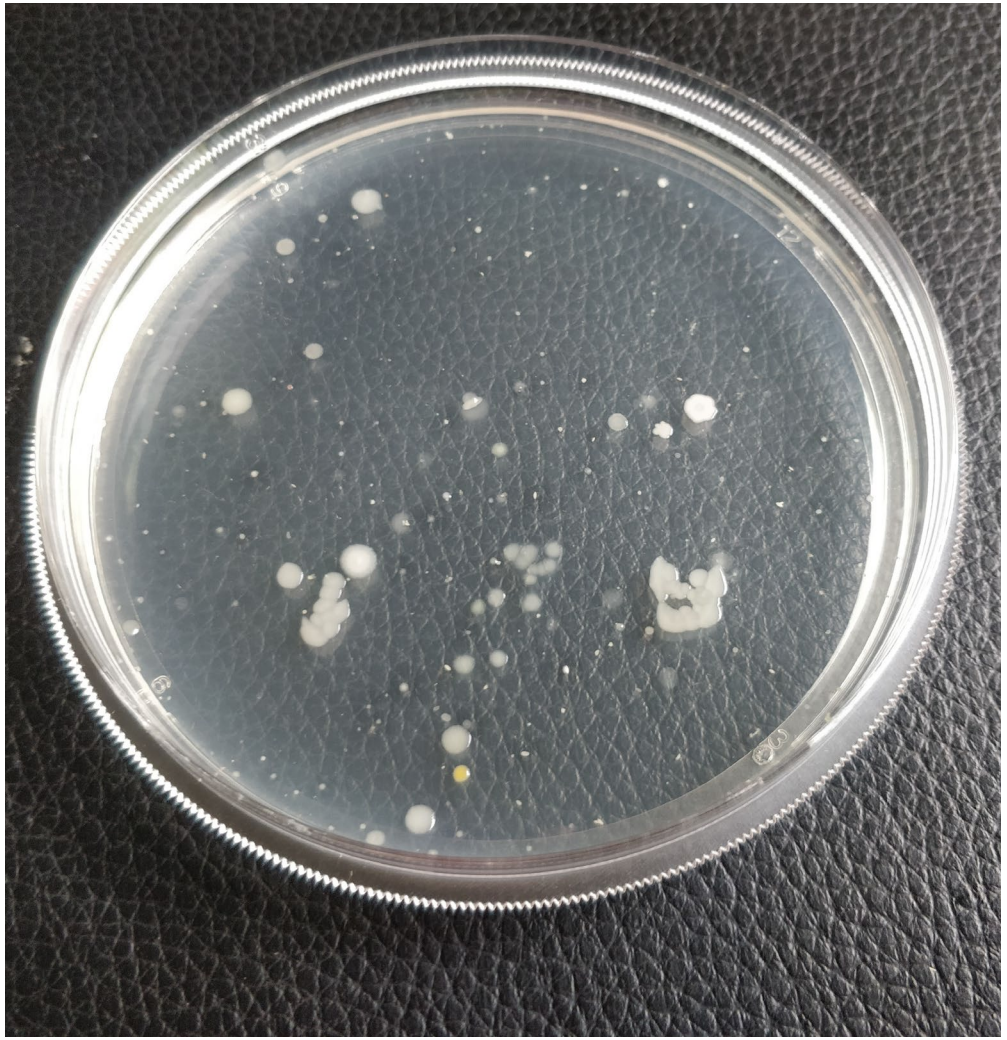


# How is *E. coli* measured?

- **Colorimeter Method**
  - A colorimeter can measure color or fluorescence in a sample
  - Due to a chemical reaction, samples with *E. coli* present will glow fluorescent yellow



# Exercise
# EXPERIMENT – GROWING BACTERIA




Step

5

# ANALYZE DATA

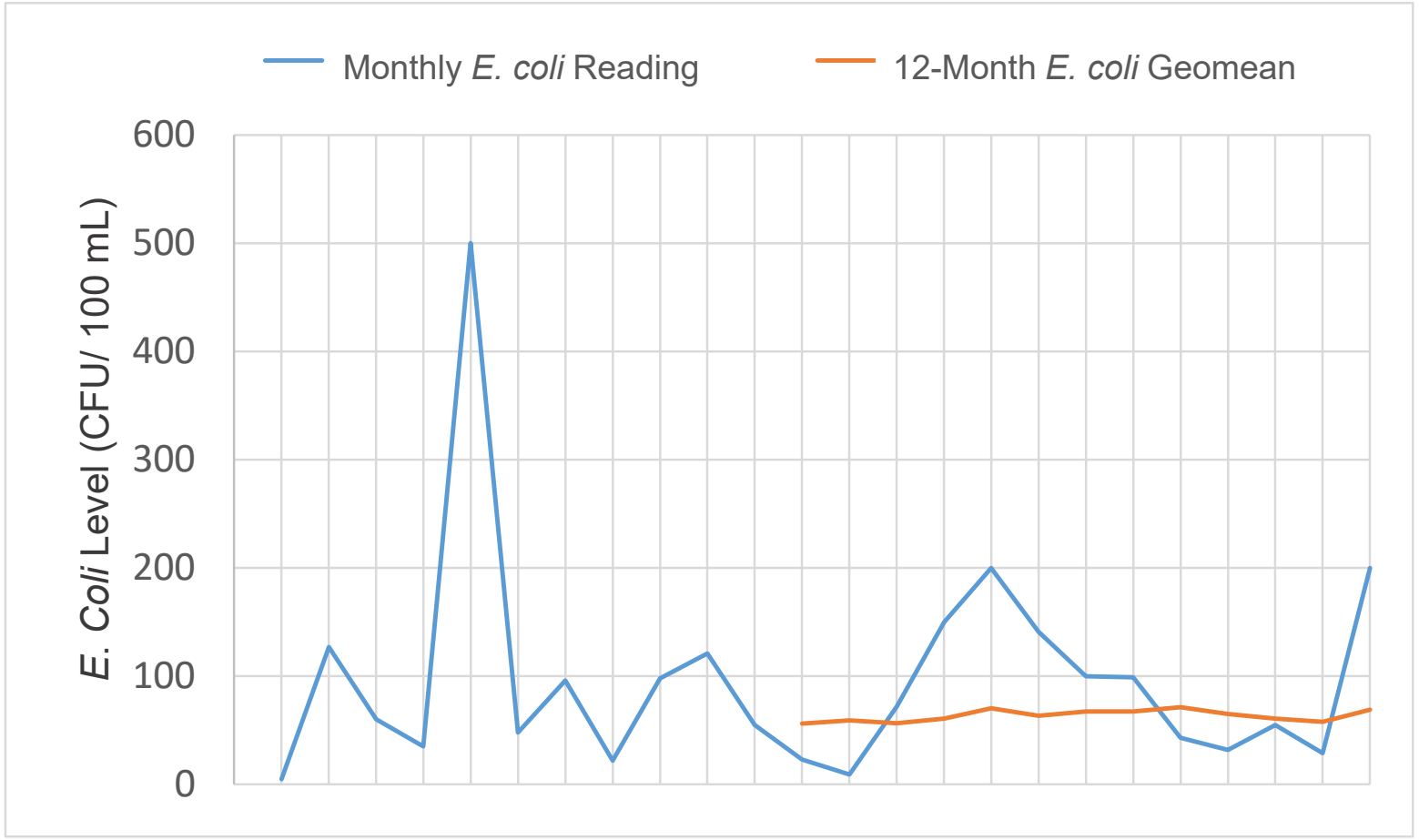
# What is a geomean?

**A geomean (or geometric mean)** is a different way to measure the average. You calculate it by multiplying the set of *n* numbers together and then taking the *n*th root of the product.

- Geomean = geometric mean
- A **geomean** reduces the effect of a single data point on the calculated mean compared to an arithmetic mean (also known as an average)

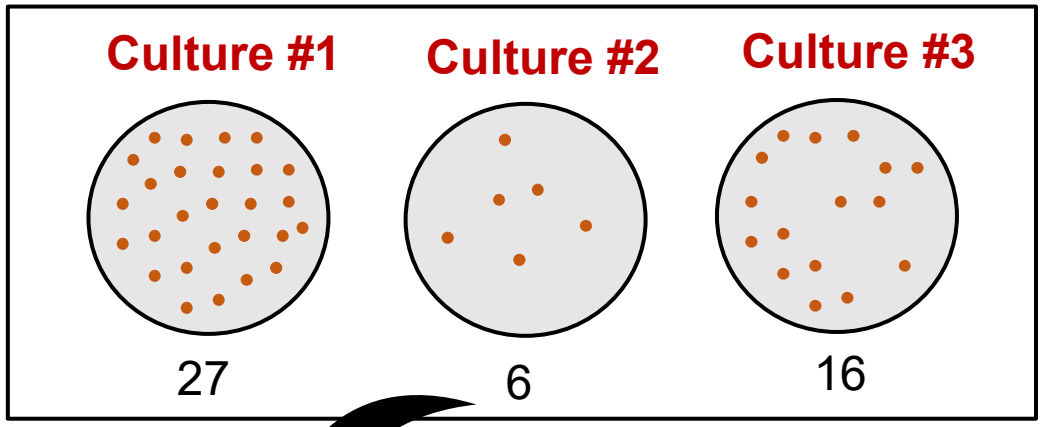
# Why do we use a geomean?

- Bacteria vary a lot in natural water systems
- Geomean dampens the effect of each specific data point



# How are *E. coli* data analyzed?

**Let's see an example…**




$$\sqrt[3]{27 \times 6 \times 16} = 14 \text{ CFU}$$

#1 #2 #3

# Exercise
# GEOMEAN

## Flip to Page 15 of your workbook and answer the following questions:

The following bacteria concentrations were found in five consecutive months.

| Month (2012) | February | March | April | May | June |
|---|---|---|---|---|---|
| *E. Coli* Concentration (CFU/100 mL) | 120 | 59 | 93 | 160 | 160 |

The 5-Month Average is: _____ CFU/100 mL.

The 5- Month Geomean is: _____ CFU/100 mL.

# Exercise
# GEOMEAN

## Flip to Page 16 of your workbook and answer the following questions:

Another measurement was made on the following month, with a bacteria concentration of 2900 CFU/mL. Now, the five most recent measurements are:

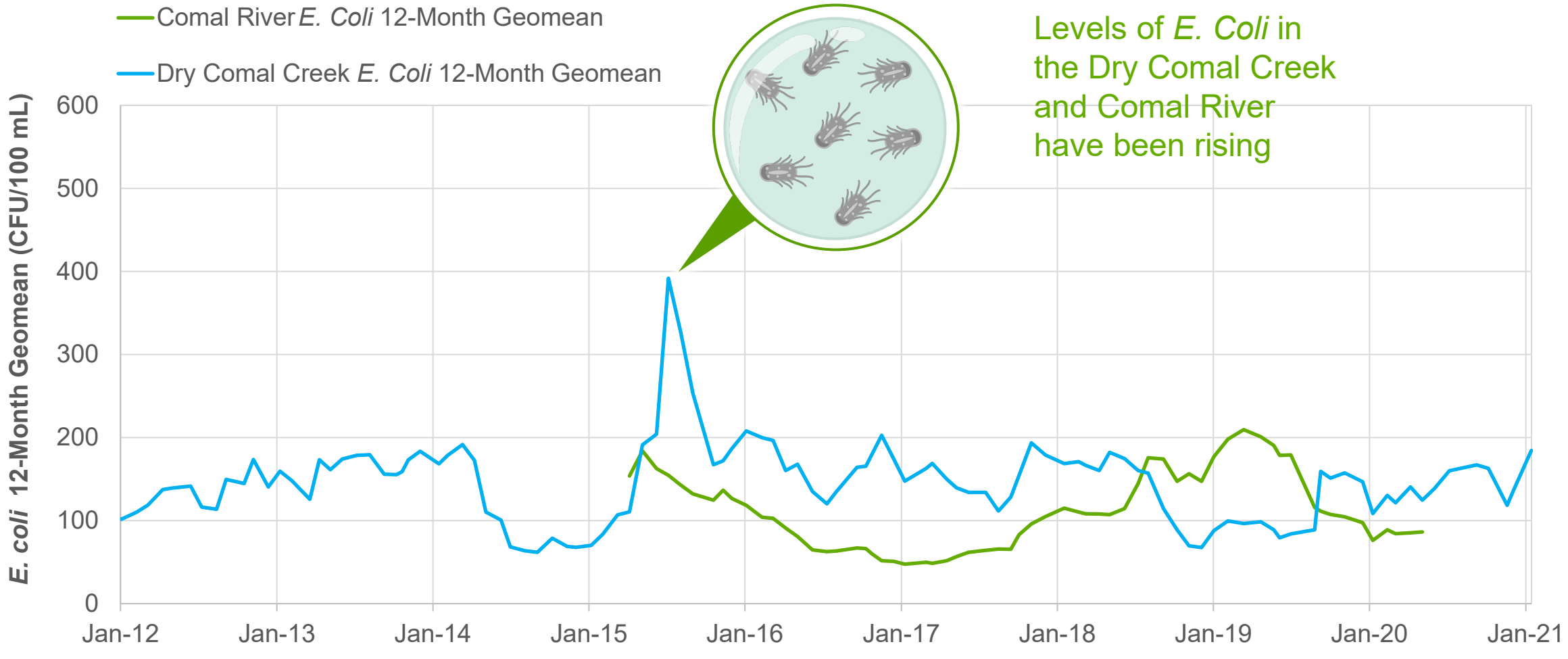
| **Month (2012)** | March | April | May | June | July |
|---|---|---|---|---|---|
| ***E. Coli* Concentration (CFU/100 mL)** | 59 | 93 | 160 | 160 | 2900 |

The new 5-Month Average is: _____ CFU/100 mL.

The new 5-Month Geomean is: _____ CFU/100 mL.

Which was more affected?

# The WPP Partnership Monitors a 12-Month *E. coli* Geomean




Levels of *E. Coli* in the Dry Comal Creek and Comal River have been rising


Step

6

# REPORT CONCLUSIONS

# Activity
# EXPERIMENT

## TIME TO START GROWING BACTERIA!

Flip to page 9 of your workbook to get started.