Watershed Workshops

Andrews Institute of Mathematics &
Science Education

Texas Christian University

College of Education

Kelly Feille, PhD

Jenesta Nettles, PhD

TCU

COLLEGE OF
EDUCATION

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Table of Contents

Watershed Rescue

Grades 5-7

Students will engage in inquiry practices to understand test results from local watershed systems, how humans and nature influence these results. Students will act as citizen scientists as they develop rescue plans for the local watershed. Pre-requisite: Watch Your Watershed

Summary of Curriculum

Day	Suggested Timing	Topic	Activities
1	**8:30**	Check In	Students pick seats Write names on journals Begin decorating Title page
	8:45	Introductions	Two truths and a lie at tables Go around room and tell name and one truth/lie while group guesses whether it is true or not Instructor(s) will also do 2 truths and a lie for whole group
	9:15	Pre-Data	mATSI Pre-Concept map
	10:00	Intro NOS	Introduce three water samples, what could we find out about these water samples? Scientific process intro and setup for water testing.
	12:00	Dismiss	
2	**8:30**	Check In	TOC Updates
	8:45	Chemistry of water quality	Students share resarch in jigsaw PPT of water tests
	9:00	Intro Watershed	Mapping of trinity river watershed Students glue maps in to journals with detailed titles
	9:15	Meet the creek	Students walk to creek to collect qualitative data and make observations
	10:00	Substrate Investigate	Test different kinds of substrate using shoe box models.
	10:45	Present findings	What did we learn about runoff vs. absorption?
	11:00	Dismiss	
3	**8:30**	Check In	TOC Updates
	8:45	What is a rain garden?	Introduce students to rain gardens and how they help water quality. Have students suggest answers to questions
	9:15	Scale model drawing	Design student rain gardens with white paper.
	10:15	Gallery Walk	Students make suggestions for improvement on rain gardens
	11:00	Re-work scale drawings	Edit/revise scale drawings. Put final version on large sticky pad

Day	Suggested Timing	Topic	Activities
	11:15	Concept Map	Brainstorm with students 5 topics to add to concept map for them all to write about
	12:00	Dismiss	
4	**8:30**	Check In	TOC Updates
	8:45	Begin Building rain gardens	Using provided materials, students will begin to build their rain gardens like their scale models.
	11:00	Water testing	Students test water samples through their rain gardens. Each group will have samples from different sources, determine which rain garden model is the most beneficial. Must justify with data and research
	12:00	Dismiss	
5	**8:30**	Check In	TOC Updates
	8:45	Post Data	mATSI
	9:15	Concept Map	Brainstorm with students 5 topics to add to concept map for them all to write about
	10:00	Finish water testing	Complete water testing and decide how to present data to parents and faculty
	11:00	Presentation Fair	Present data and rain gardens to parents and faculty
	12:00	Dismiss	

*mATSI and Concept Map is used for data to investigate student perceptions of science and content understanding.

Table of Contents

Day 1: Nature of Science & Water Testing

Day	Suggested Timing	Topic	Activities
1	**8:30**	Check In	Students pick seats Write names on journals Begin decorating Title page
	8:45	Introductions	
	9:15	Pre-Data*	mATSI Pre-Concept map
	10:00	Intro NOS	Introduce three water samples, what could we find out about these water samples? Scientific process intro and setup for water testing.
	12:00	Dismiss	

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Intro to NOS

Before beginning this lesson, be sure you have supplies required for testing pH, temperature, turbidity, Nitrate, Phosphate, Dissolved Oxygen, and Coliform Bacteria as well as safety materials such as goggles and gloves. This lesson also requires three separate water samples. We suggest samples of rain water, tap water, and dirty fish tank water. These water samples will be used multiple times throughout the week, so we suggest 2-3 liters per sample if possible (fish tank water can be manufactured by placing a dirty fish tank filter in tap water for 2-3 days).

Unless stated otherwise, students are always working in groups of 3-4

Objective: Through small group and class discussions, students will identify and use observations and inferences presented in a 3-picture scenario. Class discussion will direct students to a basic understanding of the Nature of Science and rules of scientific investigation which they will use to conduct a scientific investigation.

Engage: Ask students to discuss with their table groups, "What are some ways we learn about the world around us?" Give students plenty of time to discuss and be sure to listen in. As conversation slows, call on some table groups to share what was discussed. Prompt students with the second question, "How do you know if something is true or not?" Try to avoid leading students or giving students appropriate responses. Use this time to prompt their thinking and gauge the understanding of science they are bringing to the lesson.

Explore: Show students *Slide 5* and ask the question, "What can you say about this picture?" Have students write in their journal at least three things they can say about the picture. (Students will likely write down observations and inferences both, do not correct or lead them

here.) Reveal the definitions of OBSERVATION and INFERENCE and take time to give students one or two examples of each that are NOT about the Tracks in the Snow image. Ask students to volunteer to share OBSERVATIONS they recorded in their list of three. As students share, use class discussion to clarify whether the statement is an observation and based on data collected using the senses. Follow similar procedures to have students share INFERENCES they recorded. Finally, have students mark their three statements with an O for observation or I for inference. Check for understanding by looking at journals while they work.

Reveal *Slide 6* and have students write down two observations and two inferences based on the additional data. Use either table or large group discussion to share out and ensure students are correctly distinguishing between observations and inferences. Follow a similar procedure for *Slide 7*. At this point, the group may feel comfortable sharing verbally rather than recording their observations and inferences. Use the final slide to verify student understanding.

Explain: Using *Slide 8*, guide students through a discussion of questions science can and cannot answer as well as the "rules" of doing science. Use the discussion to have students explain their understanding of scientific procedures (beginning with making observations and defining a scientific question, forming a hypothesis, identifying necessary materials and procedures, collecting and organizing data, forming a conclusion, and communicating results). Be sure to address and respond to any misconceptions. Conclude with a discussion that highlights the need for fair tests in science as well as the importance of carefully recording data in an organized way.

Elaborate: Use *Slides 9-16* to review the types of water quality tests. If students have not taken Watch Your Watershed, this will be more of a quick introduction. Do not expect mastery from students, just refresh or introduce. Guide students to create a Water Testing section of their journal. They may want to create a section title page. Slides 17-19 display information and the procedures for testing temperature, pH, and turbidity. Either have students record these steps in their journals or have pre-printed instruction sheets for them to record in their journal. Be sure to review and demonstrate the procedures with students before moving to next steps.

Now that students understand the three primary tests, they will also become experts in Nitrate and Phosphate testing. Students will use test information sheets or instruction books to create a page in their journal for each test, refer to *Slide 20* for instructions (see Materials and Resources for more information). *Groups now* may *be different than the teams you have*

had students in prior to this point. Use this opportunity to create heterogeneous groups that will ensure success and inclusion of all students.

Once students have recorded and can verbally describe the procedures for their expert group test and have created a data table to record temperature, pH, turbidity and their expert test results (see Materials and Resources for a template), allow them to begin practicing each test with your three water samples. Be sure to carefully monitor groups as they move through the procedures.

Evaluate: As groups complete their water quality testing, have them begin to record their data on a class data table (see Materials and Resources for template). This should be posted in the room for reference throughout the week. Have students begin to try to form conclusions about the three water samples.

Ask students to complete research at home to learn about the effects of temperature, pH, nitrates, and phosphates on water quality.

Day 2: Qualities of Watersheds

Day	Suggested Timing	Topic	Activities
2	**8:30**	Check In	TOC Updates
	8:45	Chemistry of water quality	Students share resarch in jigsaw PPT of water tests
	9:00	Intro Watershed	Mapping of trinity river watershed Students glue maps in to journals with detailed titles
	9:15	Meet the creek	Students walk to creek to collect qualitative data and make observations
	10:00	Substrate Investigate	Test different kinds of substrate using shoe box models.
	10:45	Present findings	What did we learn about runoff vs. absorption?
	11:00	Dismiss	

Prior to this day's lesson, locate and map the local creek, stream, river or pond you plan to access. Students will need printed copies of maps of the local watershed to refer to. Be sure to visit the area prior to the lesson to identify safe access points to the waterfront.

Begin by having students discuss in small groups what they learned from their research. Use *Slides 9-16* to guide and help with discussion.

What is a Watershed

Objective: Using videos, discussion, and lecture students will have a basic understanding of what constitutes a watershed and using maps will identify components of their local watershed.

Display *Slide 25* and have students brainstorm in small groups what they think a watershed is. Give them some time to talk and then ask groups to share out ideas. Ask groups to come up with one or two YES or NO questions about a watershed (such as: *Is a watershed a place that you store water?*) and record them on their journal page. At this point, do not offer the definition of a watershed, simply allow students to generate ideas and questions.

Show the video linked on *Slide 26*. When the video concludes, ask students to define a watershed using their own words and what they learned in the video. Go through their YES or NO questions they recorded and have them write the answer. While displaying *Slide 27*, have students record a definition of watershed in their journal. They may come up with their own or use the more formal definition provided.

Slide 28 asks students to think about why a watershed is important and discuss ways we use and abuse our watershed. Using a discussion technique that gets students talking to someone new (such as stand up, hand up, pair up), have students brainstorm answers to those three questions. Once students are back in their seats, have them share some of the responses they came up with or heard. Then let them view the video linked on *Slide 29*. Lead a discussion that reviews any misconceptions or new information revealed in the video.

Walk students through the mapping of their local watershed using *Slides 30-36* (*Slides 31*-36) will need to be replaced with maps of your local watershed). Assess students' map-reading abilities and geographical awareness by having them locate where they are on the maps as they move from national to very local. Provide students with color copies of maps of the local watershed to glue into their journal.

Meet the Creek

Objective: Students will determine appropriate data to collect at the creek (stream, pond, or river access) and conduct initial observations, sketches, and mapping.

Display *Slide 37* and ask students what they can learn, as citizen scientists, about Frog Creek (*Slide 37* will need to be replaced to reflect your local water access point). Use this time to discuss with students the roles of citizen scientists (see Materials and Resources for additional information). Use questioning to guide students to appropriate questions, such as bank quality, water quality, evidence of wildlife, plant growth, pollution evidence, etc.

Guide students as they set up a 2-page journal spread to collect their initial observations and data of Frog Creek (you may use the template found in Materials and Resources). Once journals are ready, walk students to your water access point and allow them to collect their initial observations and create their map or sketch of the area. *Please remind students of safety rules and be sure they are prepared for the outdoor elements (have water, sunscreen, bug spray etc). Encourage students to work in their teams for safety and thorough data collection.*

Because the focus of this workshop is on designing ways to improve the quality of water runoff, draw students' attention to the ways in which water enters your water site. Is there a storm drain that draws water from the streets? Is there a park or green space near by where fertilizers might be applied? Is there a parking lot or driveways where pollutants from cars may be washed into the water site after a rain?

Once you have returned to the classroom, have groups share their observations. Consider recording these on a large piece of paper or white board to refer to later.

Substrate Investigate

Materials required for each group to conduct this investigation include large (1000mL) beaker, large funnel, several coffee filters, three substrate samples (sand, gravel, and soil mix), and water. For a thorough understanding, each group should investigate all three substrate types.

Objective: Students will use three substrate samples (sand, gravel, and soil mix) to investigate the question, "How does the type of substrate effect water runoff and water turbidity?"

Prior to beginning this investigation, create student groups that include one member from each expert test group.

Pose the scientific question to the students, "How does the type of substrate effect water runoff and water turbidity?" After introducing them to the three substrate samples (sand, gravel, and soil mix) and available materials, ask them to design an investigation to answer the scientific question. Use *Slides 38-39* as you guide them through the process. Groups will need to decide what type of data they feel is important to collect and how they would like to collect their data (Use scaffolding questions to guide students to an understanding that they will need to measure the amount of water retained/moved through the system as well as the before and after turbidity of the water sample).

Before students proceed with the investigation, ensure they have created a journal entry where they have identified their question, formed a hypothesis, described their procedures, and have a way to record data in an organized manner.

As students conclude their investigation, encourage them to create a conclusion statement to share at the beginning of the next day.

Day 3: Rain Garden Introduction

Day	Suggested Timing	Topic	Activities
3	**8:30**	Check In	TOC Updates
	8:45	What is a rain garden?	Introduce students to rain gardens and how they help water quality. Have students suggest answers to questions
	9:15	Scale model drawing	Design student rain gardens with graph paper.
	10:15	Gallery Walk	Students make suggestions for improvement on rain gardens
	11:00	Re-work scale drawings	Edit/revise scale drawings. Put final version on large sticky pad
	11:15	Concept Map*	Brainstorm with students 5 topics to add to concept map for them all to write about
	12:00	Dismiss	

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Designing a Rain Garden

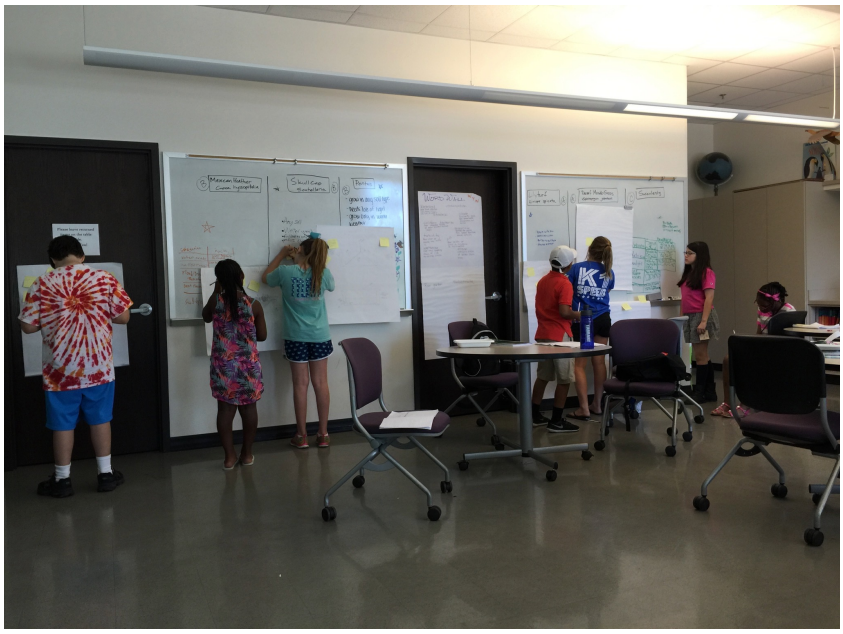
Students will need 2-3 pieces of graph paper as well as one large poster sized paper (preferably graphed as well) to create their scale drawings. In addition, each student will need one plastic shoebox with a 0.5cm hole drilled at the bottom of one end, 3-5 cups of substrate (they will choose which type(s) to include), and 2-3 rain garden friendly plants. A list of Texas Rain Garden plants can be found in Materials and Resources. Searching your local Agriculture Extension office will guide you to appropriate plants for your location. We have found that many of these plants are difficult to acquire. Therefore, we rely on plants have a variety of wetness requirements (i.e. succulents, grasses, ferns, semi-aquatic plants, etc). Just be sure to provide students with a description of the plant and its requirements so they may make informed choices as they plan their rain garden and discuss limitations of models to avoid misconceptions.

Engage: Pose the question, "Where does the rain go?" Ask students to brainstorm with their group before sharing out for class discussion. You may consider using the first minute or so of the YouTube video linked on *Slide 43* to help with student understanding of the impact of development on rainwater runoff. Use *Slides 44-47* to introduce students to the concept of a Rain Garden and the purpose of rain garden planning.

Explore: In the next page of their journals, have students make some notes and sketches individually of what they will consider as they plan their rain garden. Allow them to examine the available plant samples, review their substrate investigation data, and measure the shoeboxes as they think. After several minutes of planning, have students design a scale model of their rain garden on a poster sized sheet of graph paper (Encourage students to draw lightly with pencil, as they will make changes to their drawings in the coming activities).

Students may require a mini-lesson on scale and how to convert their life-sized shoebox to a smaller or larger drawing. Use *Slide 48* to guide them.

Explain: Have students display their scale models around the room. Students will conduct a gallery walk to visit 5-6 scale drawings. Using sticky notes, students will leave their compliments and questions on the scale drawings they visit. Remind students to be kind and constructive as they visit each scale drawing. The goal is to have helpful comments that will improve the rain garden models in the end. Use a large group discussion to have students point out ideas that they saw and would think about incorporating into their own rain garden.



Once students have collected the comments and questions from their scale drawings, they will re-work their drawing until they are satisfied.

Day 4: Building a Rain Garden Model

Day	Suggested Timing	Topic	Activities
4	**8:30**	Check In	TOC Updates
	8:45	Begin Building rain gardens	Using provided materials, students will begin to build their rain gardens like their scale models.
	11:00	Water testing	Students test water samples through their rain gardens. Each group will have samples from different sources, determine which rain garden model is the most beneficial. Must justify with data and research
	12:00	Dismiss	

Elaborate: Using their scale drawings as a reference, students will use supplied materials (shoe box, substrate samples, available plants) to construct their rain garden models. If students change their model from their drawn design, remind them to make notes about their changes justifying choices.

Once models are complete, groups will design an investigation to determine how their rain garden system impacts the quality of water as it moves through the system. Students will need to start with a scientific question, determine appropriate data, and design their procedure before beginning the investigation. (This is an appropriate time to differentiate student learning. Groups may test as many or as few signifiers of water quality as they choose. Groups with younger students may only choose to look at turbidity and/or pH while groups who work quicker or have more elaborate questions may also investigate changes to nitrate and phosphate levels in water

that moves through their rain garden system). *Slide 52* can be used to help guide students through the process.

Day 5: Gathering Data & Communicating Results

Day	Suggested Timing	Topic	Activities
5	**8:30**	Check In	TOC Updates
	8:45	Post Data*	mATSI
	9:15	Concept Map*	Brainstorm with students 5 topics to add to concept map for them all to write about
	10:00	Finish water testing	Complete water testing and decide how to present data to parents and faculty
	11:00	Presentation Fair	Present data and rain gardens to parents and faculty
	12:00	Dismiss	

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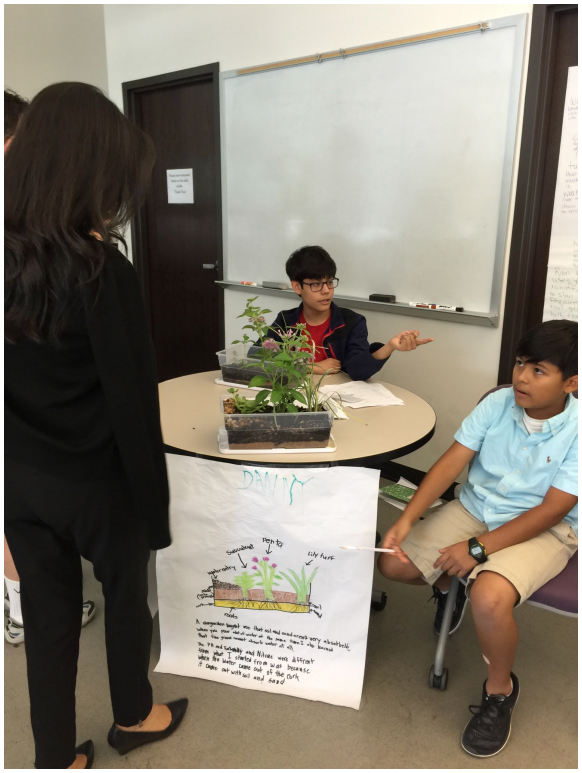
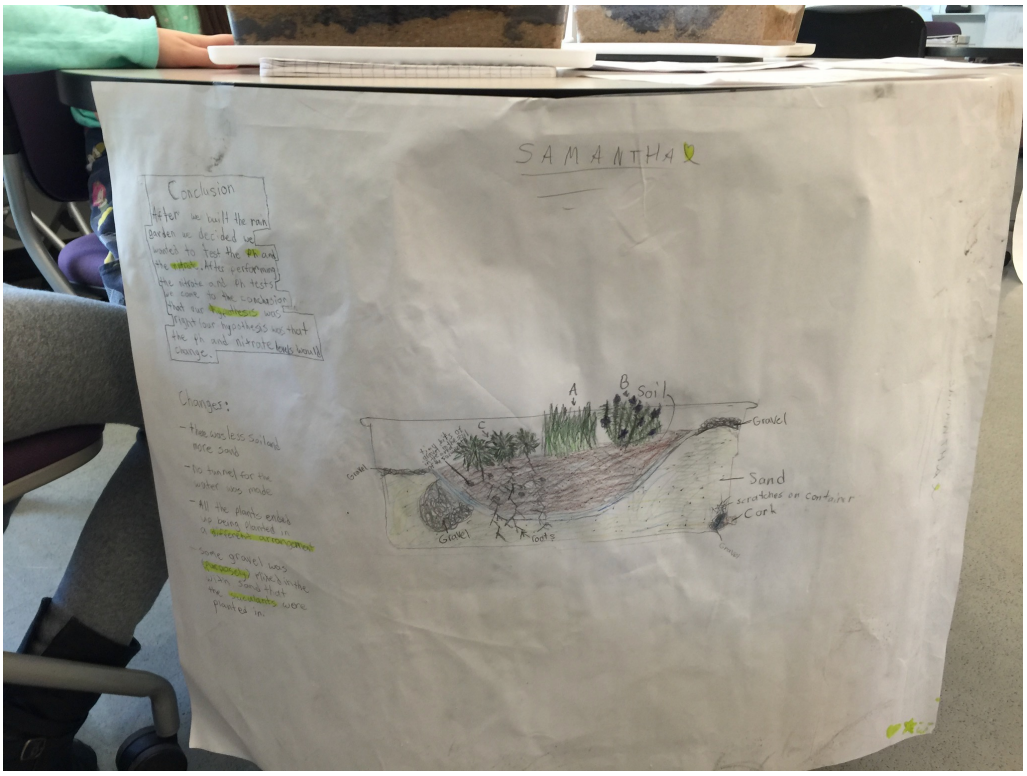
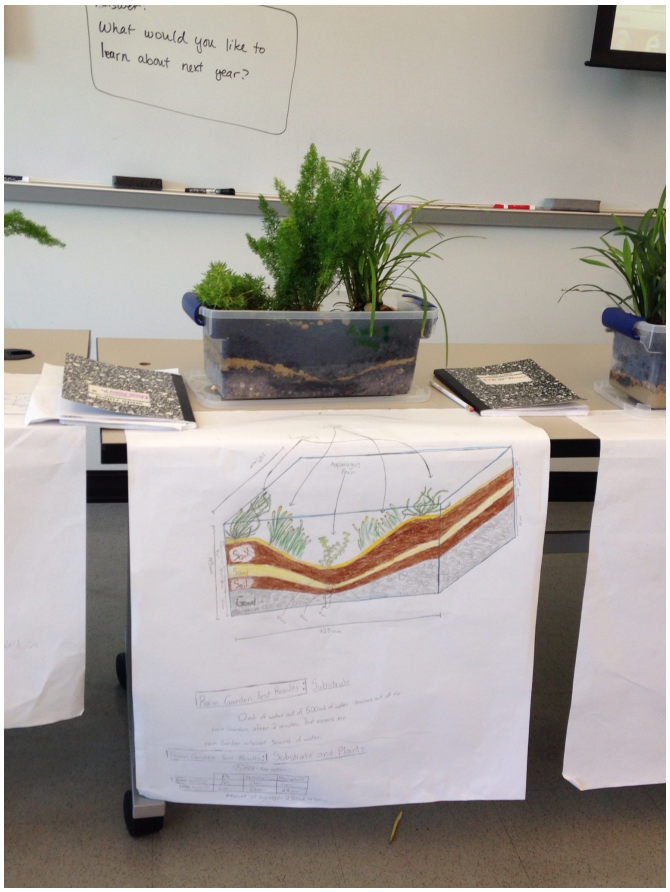
Evaluate: At the conclusion of the investigation, students will prepare for the research presentation fair. Each student should color and label their final diagram of their rain garden. They should include the type of substrate, depth of substrate throughout the model, and the type of plants included in their rain garden. They may decide how they would like to share the procedures and results of their group's investigation (See Materials and Resources for examples).




SAMANTHA
Conclusion
Changes:
A
B
Soil
Gravel
Sand
Cork
Gravel
Roots


What would you like to learn about next year?

Date:
Time

Location
Temperature or Weather

About Frog Creek

Observations

What do I see?

What do I hear?

What do I smell?

Map

Materials & Resources

Watershed Rescue

Water Quality Testing Kit: http://www.lamotte.com/en/education/water-monitoring/5848.html or http://www.lamotte.com/en/education/water-monitoring/3-5886.html

Defining Citizen Science: http://www.birds.cornell.edu/citscitoolkit

Plastic Shoe Boxes (1 per student): http://a.co/43FQcrQ

Texas Rain Garden Plants: http://rainwaterharvesting.tamu.edu/files/2011/05/Rain-Garden-Plant-List-11-02-09.pdf

Data Table Template

Test	Group 1			Group 2			Group 3			Group 4		
Sample	A	B	C	A	B	C	A	B	C	A	B	C
Temp												
pH												
Turbidity												
Nitrate												
Phosphate												

Presentation Slides

WATERSHED RESCUE

- Welcome! We are glad you are here.
- Please begin creating a Title Page on the first page of your journal.
  - The title of our workshop is "Watch Your Watershed"
  - You may design your title page any way you would like, but make sure it has:
    - A Title
    - Your Name

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INTRODUCTIONS

INTRODUCTIONS

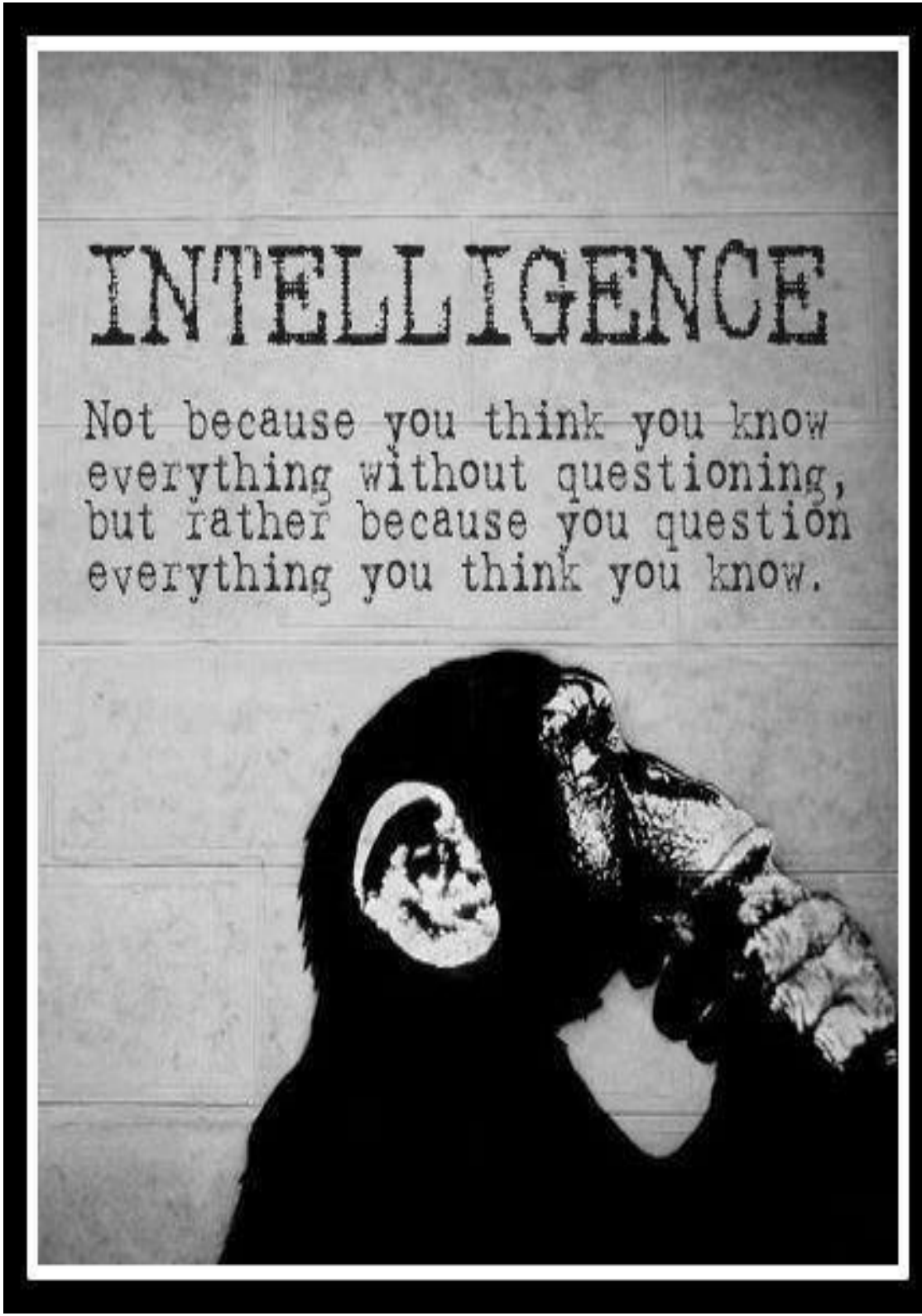
- On your notecard, write down:
  - TWO things about you that are TRUE
  - ONE thing about you that is a LIE
  - Do not tell anyone in your group!

INTRODUCTIONS

- On your notecard, write down:
  - TWO things about you that are TRUE
  - ONE thing about you that is a LIE
  - Do not tell anyone in your group!
- Go around your table, tell everyone your name and read the statements from your card. Let your table mates guess which of your statements is a LIE.

Next page of journal

Title: Nature of Science



Talk with your table…

Talk with your table…

What are some ways we learn about the world around us?

Talk with your table…

What are some ways we learn about the world around us?

How do you know if something is true or not?

Talk with your table…

What are some ways we learn about the world around us?

How do you know if something is true or not?

Tracks in the Snow

Tracks in the Snow

- Write down 3 things you can say about this picture.

Tracks in the Snow

- Write down 3 things you can say about this picture.
- An OBSERVATION is based on what we can learn using our senses (something we see, hear, smell, touch, or taste).

Tracks in the Snow

- Write down 3 things you can say about this picture.
- An OBSERVATION is based on what we can learn using our senses (something we see, hear, smell, touch, or taste).
- An INFERENCE is a conclusion we make based on data collected or observations.

Tracks in the Snow

Tracks in the Snow

Tracks in the Snow

Tracks in the Snow

Tracks in the Snow

What do you know about doing science?

What do you know about doing science?

- What are some questions science cannot answer?

What do you know about doing science?

- What are some questions science cannot answer?
- What are some questions science can answer?

What do you know about doing science?

- What are some questions science cannot answer?
- What are some questions science can answer?
- What are the rules of doing science?

PH

- MEASURES THE ACTIVITY OF HYDROGEN IONS
- PH BELOW 7.0 = ACIDIC
- PH ABOVE 7.0 = BASIC
- PH OF 7.0 = NEUTRAL
- PH RANGE OF 6.5-8.2 IS IDEAL FOR MOST ORGANISMS

TEMPERATURE

- TEMPERATURE IS IMPORTANT TO WATER QUALITY
- AFFECTS THE AMOUNT OF DISSOLVED O_2, RATE OF PHOTOSYNTHESIS, AND ORGANISM SENSITIVITY TO POLLUTANTS

TURBIDITY

- MEASURES HOW CLEAR THE WATER IS
- TURBID WATER IS CAUSED BY ORGANIC AND INORGANIC MATERIALS AND MICROSCOPIC ORGANISMS
- MAY BE CAUSED BY EROSION, RUN-OFF, ALGAL BLOOMS, AND DISTURBANCES

BENTHIC MACROINVERTEBRATES

- IMMATURE AQUATIC STAGES OF INSECTS
  - BENTHIC = BOTTOM MACRO = SEEN WITH NAKED EYE INVERTEBRATE = ANIMAL THAT LACKS A BACKBONE
- LIVE ON SUBMERGED MATERIAL ON BOTTOM OF RIVER OR STREAM
- REQUIRE A SPECIAL ENVIRONMENT TO SURVIVE
- THEIR PRESENCE OR ABSENCE INDICATES THE HEALTH OF THE WATER

COLIFORM BACTERIA

- PRESENT IN HUMAN DIGESTIVE TRACT
- ABSENT IN UNPOLLUTED WATERS

DISSOLVED OXYGEN

- AQUATIC ANIMALS NEED DISSOLVED OXYGEN (O_2) TO LIVE!
- O_2 DISSOLVED IN WATER DIFFUSES SLOWLY AND IS MOVES IN THE WATER
- AQUATIC PLANTS, ALGAE, AN PHYTOPLANKTON PRODUCE ALGAE THROUGH PHOTOSYNTHESIS TOO

NITRATE

- NITROGEN (N) ACTS AS A FERTILIZER FOR AQUATIC PLANTS.
- HIGH N LEVELS CAUSE WATER QUALITY PROBLEMS FROM TOO MUCH PLANT AND ALGAE GROWTH
- N ENTERS THE WATER FROM ANIMAL WASTE, DECOMPOSITION, AND FERTILIZER RUN-OFF

PHOSPHATE

- PHOSPHORUS (P) ACTS AS A FERTILIZER FOR AQUATIC PLANTS
- HIGH P LEVELS CAUSE WATER QUALITY PROBLEMS THROUGH EXCESSIVE PLANT AND ALGAE GROWTH
- P OCCURS NATURALLY, BUT MOST COMES FROM DETERGENTS (SOAPS)

WATER TESTING

WATER TESTING

- Page title: Temperature

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- Page title: Temperature
- Measures how hot or cold the water is

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- Measures how hot or cold the water is
- Temperature affects the amount of dissolved oxygen, the rate of photosynthesis, and organism sensitivity to pollutants

WATER TESTING

- Page title: Temperature
- Measures how hot or cold the water is
- Temperature affects the amount of dissolved oxygen, the rate of photosynthesis, and organism sensitivity to pollutants
- Temperature procedures
  1. Wear protective gloves.
  2. Place the thermometer 4 inches below the surface (if possible) for one minute.
  3. Remove the thermometer from the water. Read the temperature and record the results as degrees Celsius
  4. Repeat the test approximately 10 meters upstream

WATER TESTING

WATER TESTING

- Page title: pH

WATER TESTING

- Page title: pH
- Measures the activity of hydrogen ions

WATER TESTING

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- Measures the activity of hydrogen ions
- pH below 7.0 is acidic. pH above 7.0 is basic. pH of 7.0 is neutral. A pH range of 6.5-8.2 is ideal for most organisms.

WATER TESTING

- Page title: pH
- Measures the activity of hydrogen ions
- pH below 7.0 is acidic. pH above 7.0 is basic. pH of 7.0 is neutral. A pH range of 6.5-8.2 is ideal for most organisms.
- pH procedures
  1. Wear protective gloves.
  2. Dip the pH test strip halfway into the water sample and leave it for 5 seconds
  3. Pull the test strip out of the water sample and compare it to the color guide on the container. Record the result.

WATER TESTING

WATER TESTING

- Page title: Turbidity

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- Measures how clear the water is

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- Turbid water is caused by organic and inorganic materials and microscopic organisms. May be caused by erosion, run-off, algal blooms, and disturbances.

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- Turbidity procedures
  1. Fill the turbidity tube with 25mL of water

WATER TESTING

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- Turbidity procedures
  1. Fill the turbidity tube with 25mL of water
  2. Place the base of the tube on the outline on the Turbidity Chart

WATER TESTING

- Page title: Turbidity
- Measures how clear the water is
- Turbid water is caused by organic and inorganic materials and microscopic organisms. May be caused by erosion, run-off, algal blooms, and disturbances.
- Turbidity procedures
  1. Fill the turbidity tube with 25mL of water
  2. Place the base of the tube on the outline on the Turbidity Chart
  3. Look down through the sample water at the Secchi disk icon under the tube

WATER TESTING

- Page title: Turbidity
- Measures how clear the water is
- Turbid water is caused by organic and inorganic materials and microscopic organisms. May be caused by erosion, run-off, algal blooms, and disturbances.
- Turbidity procedures
  1. Fill the turbidity tube with 25mL of water
  2. Place the base of the tube on the outline on the Turbidity Chart
  3. Look down through the sample water at the Secchi disk icon under the tube
  4. Compare the appearance of the Secchi disk icon under the tube to the gray Secchi disks on the either side of the tube to determine the turbidity in JTU (Jackson Turbidity Units).

WATER TESTING

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- Your group is responsible for becoming experts in phosphate and nitrate, testing.

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- With your group, read about the tests to learn:
  - What does it test for?
  - What do the results mean?
  - What are the procedures of the test?

WATER TESTING

- Your group is responsible for becoming experts in phosphate and nitrate, testing.
- With your group, read about the tests to learn:
  - What does it test for?
  - What do the results mean?
  - What are the procedures of the test?
- In your journal, create a page for each test that includes the answers to those three questions. Make sure to give it a title!

SHARE WHAT YOU LEARNED

Test	Group 1			Group 2			Group 3			Group 4		
Sample	A	B	C	A	B	C	A	B	C	A	B	C
Temp												
pH												
Turbidity												
Nitrate												
Phosphate												

FOR TOMORROW

- Next blank page title: Notes on Water Quality
- What can you learn about:
  - pH
  - Temperature
  - Turbidity
  - Phosphates
  - Nitrates

  And their effects on water quality?

DAY 2

Date	Title	Page
	Nature of Science	
	Temperature	
	pH	
	Turbidity	
	Nitrate	
	Phosphate	
	Notes about water quality	

NOTES ON WATER QUALITY

- What can you learn about:
  - pH
  - Temperature
  - Turbidity
  - Phosphates
  - Nitrates

  And their effects on water quality?

NEXT PAGE TITLE:
WHAT IS A WATERSHED?

A watershed is…

https://www.youtube.com/watch?v=QOrVotzBNto&feature=youtu.be

A watershed is…

- IT'S THE AREA OF LAND THAT CATCHES RAIN AND SNOW AND DRAINS OR SEEPS INTO A MARSH, STREAM, RIVER, LAKE OR GROUNDWATER.

WHY IS A WATERSHED IMPORTANT?

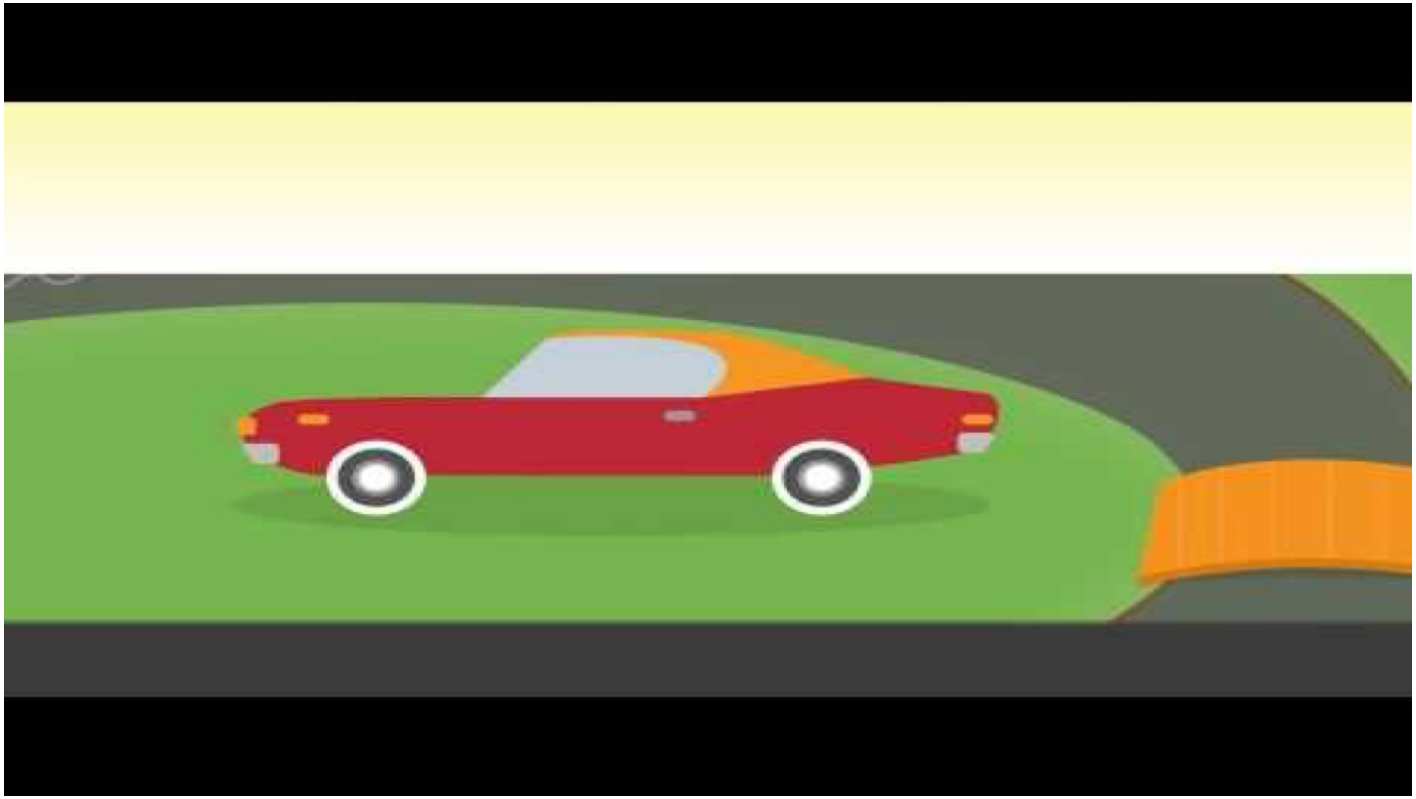
WHY IS A WATERSHED IMPORTANT?

- How do we use our watershed?

WHY IS A WATERSHED IMPORTANT?

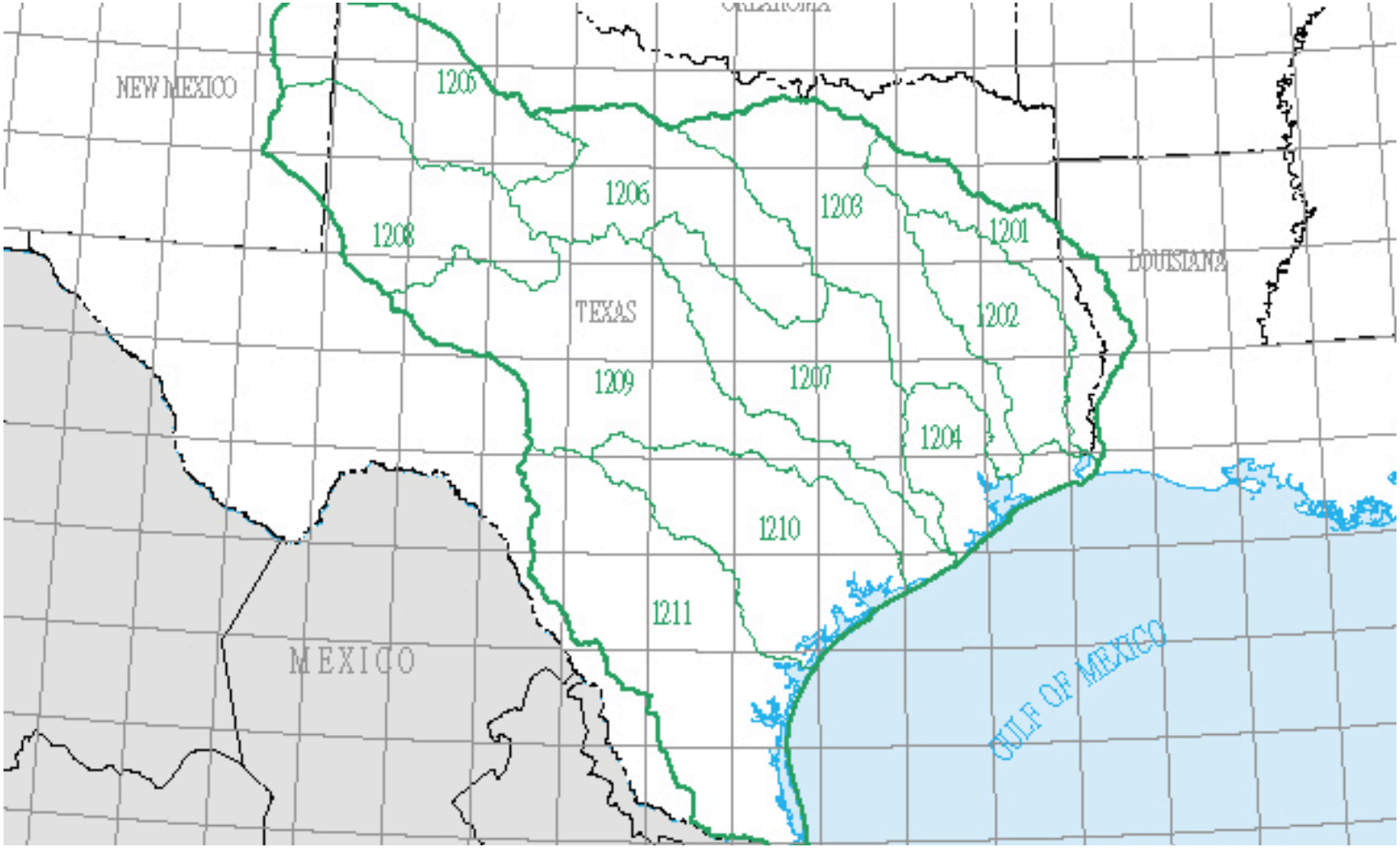
- How do we use our watershed?
- How do we abuse our watershed?

WHY IS A WATERSHED IMPORTANT?



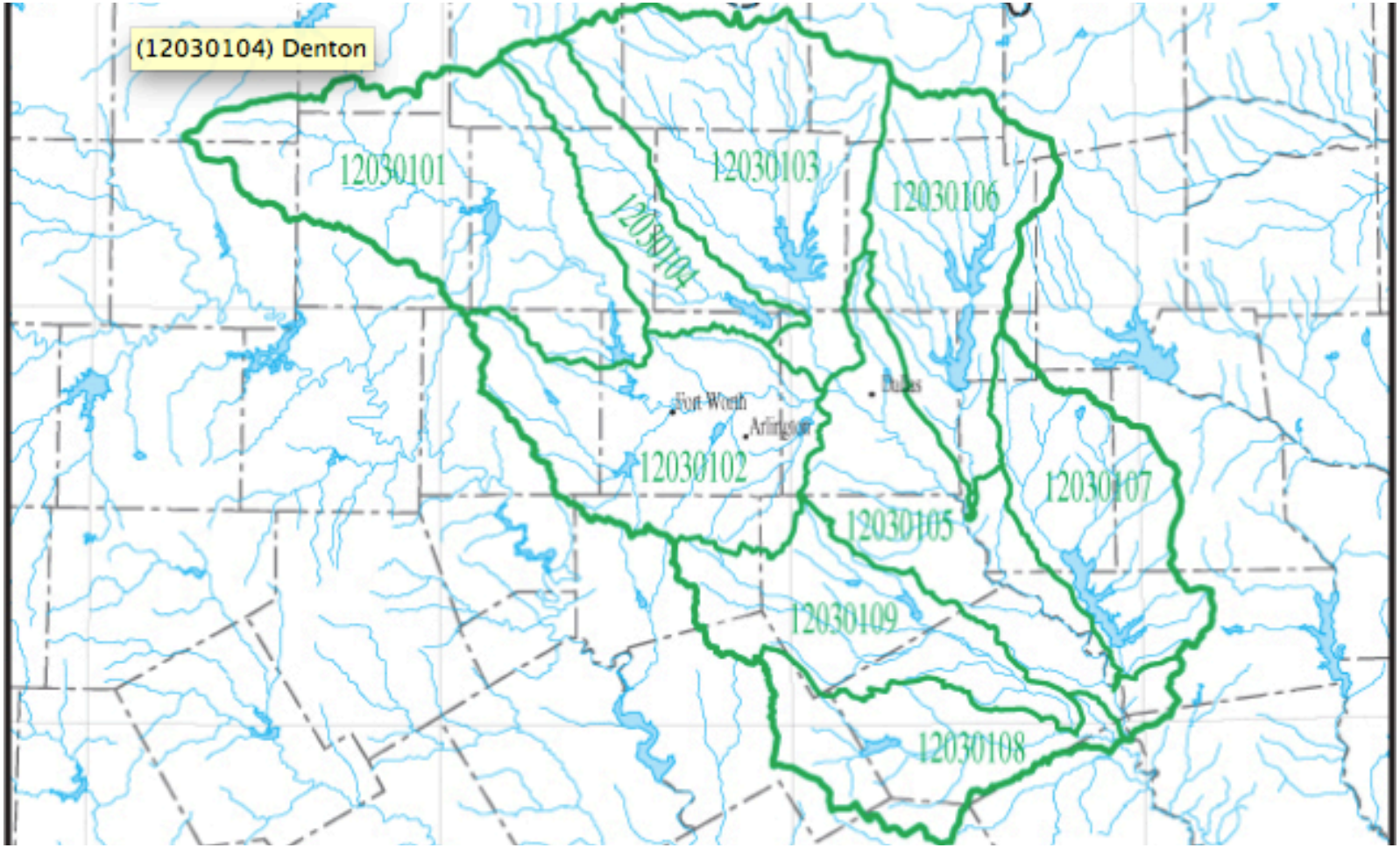
https://youtu.be/ZlyKhwagkI4

NATIONAL WATERSHED REGIONS

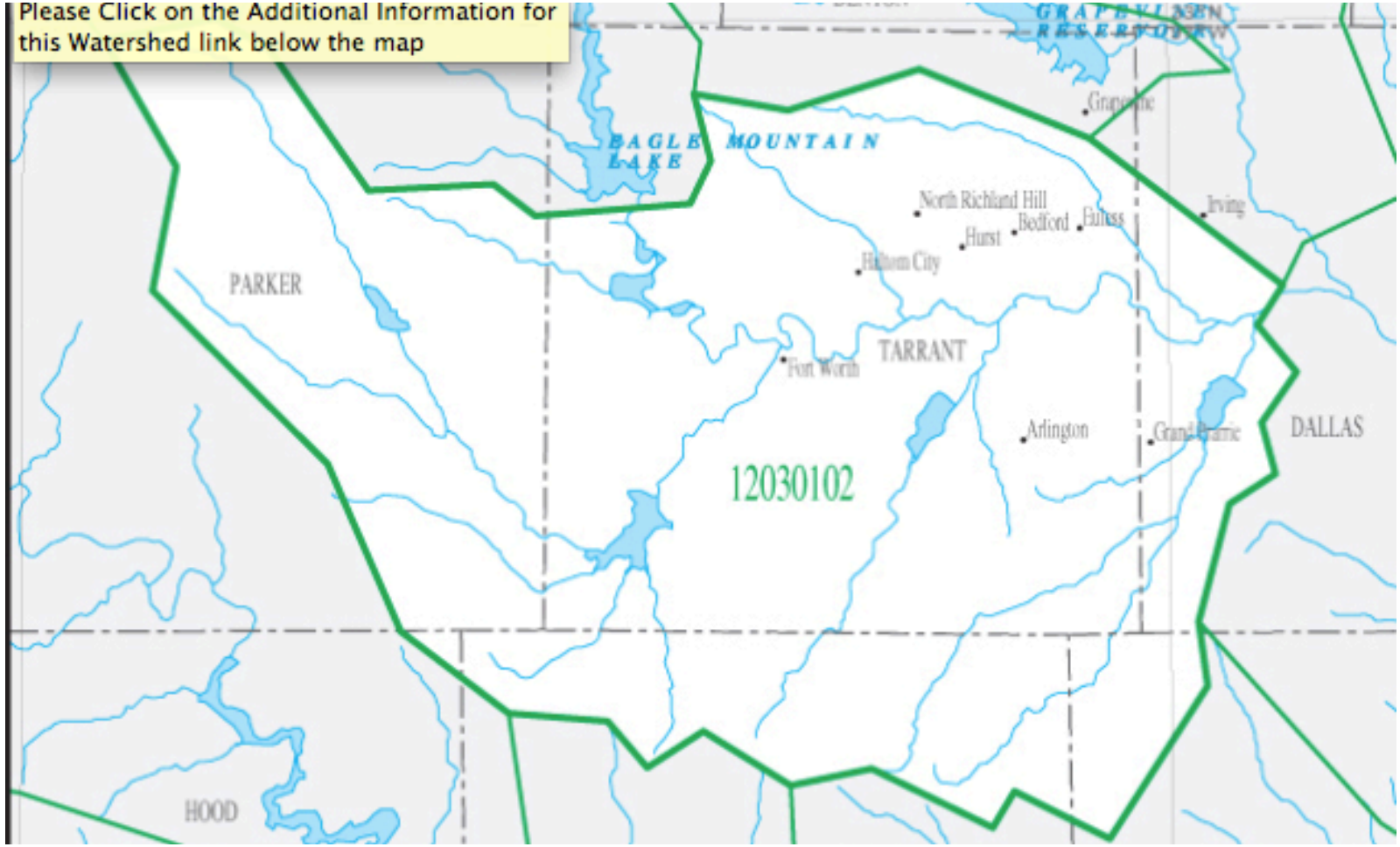


TEXAS GULF COAST

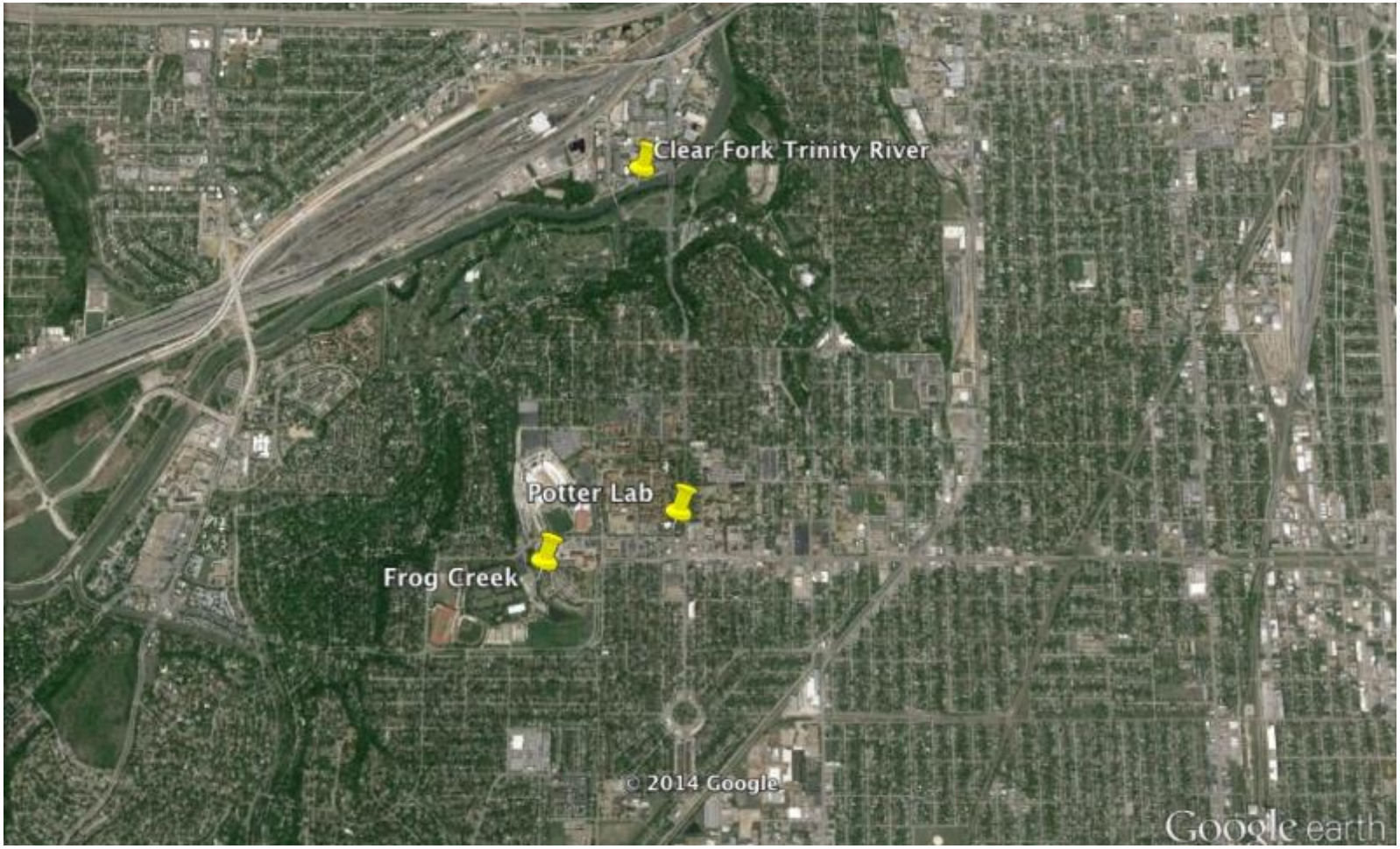
TRINITY RIVER WATERSHED



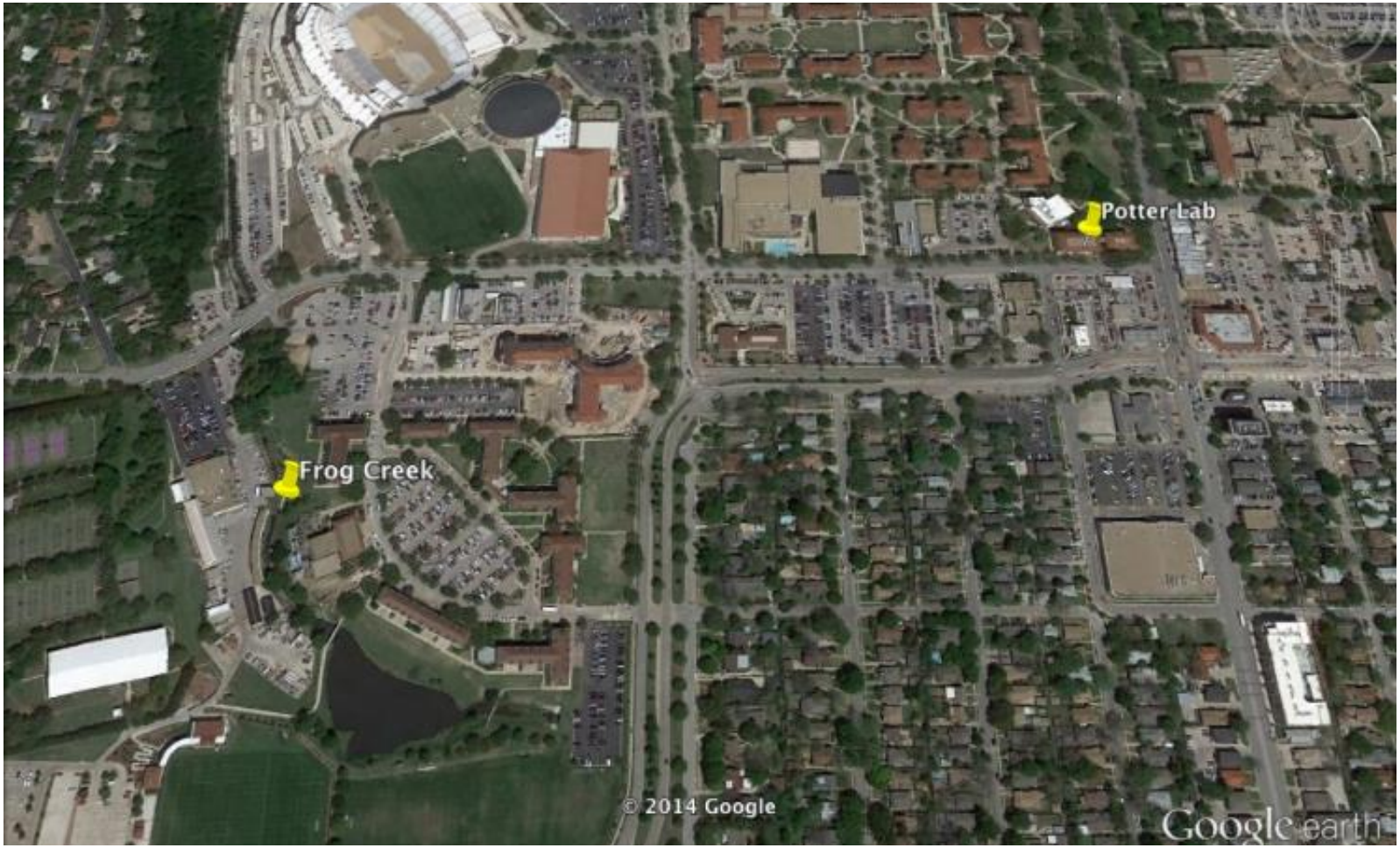
UPPER TRINITY



LOWER WEST FORK TRINITY RIVER



TCU AREA – FORT WORTH



SOUTH CAMPUS

Next Page Title: About Frog Creek

Next Page Title: About Frog Creek

- What can we, as citizen scientists, learn about Frog Creek?

Next Page Title: About Frog Creek

- What can we, as citizen scientists, learn about Frog Creek?
- Organize this page in your journal so that you have a place to record all of your observations about Frog Creek (You may want to use more than one page for this).

Next Page: How does the type of substrate effect water runoff and water turbidity?

Data to Collect

- Amount of water runoff
- Water Quality Measures of Turbidity

In your group, determine what data you will collect, how you will collect your data, and how you will record your data.

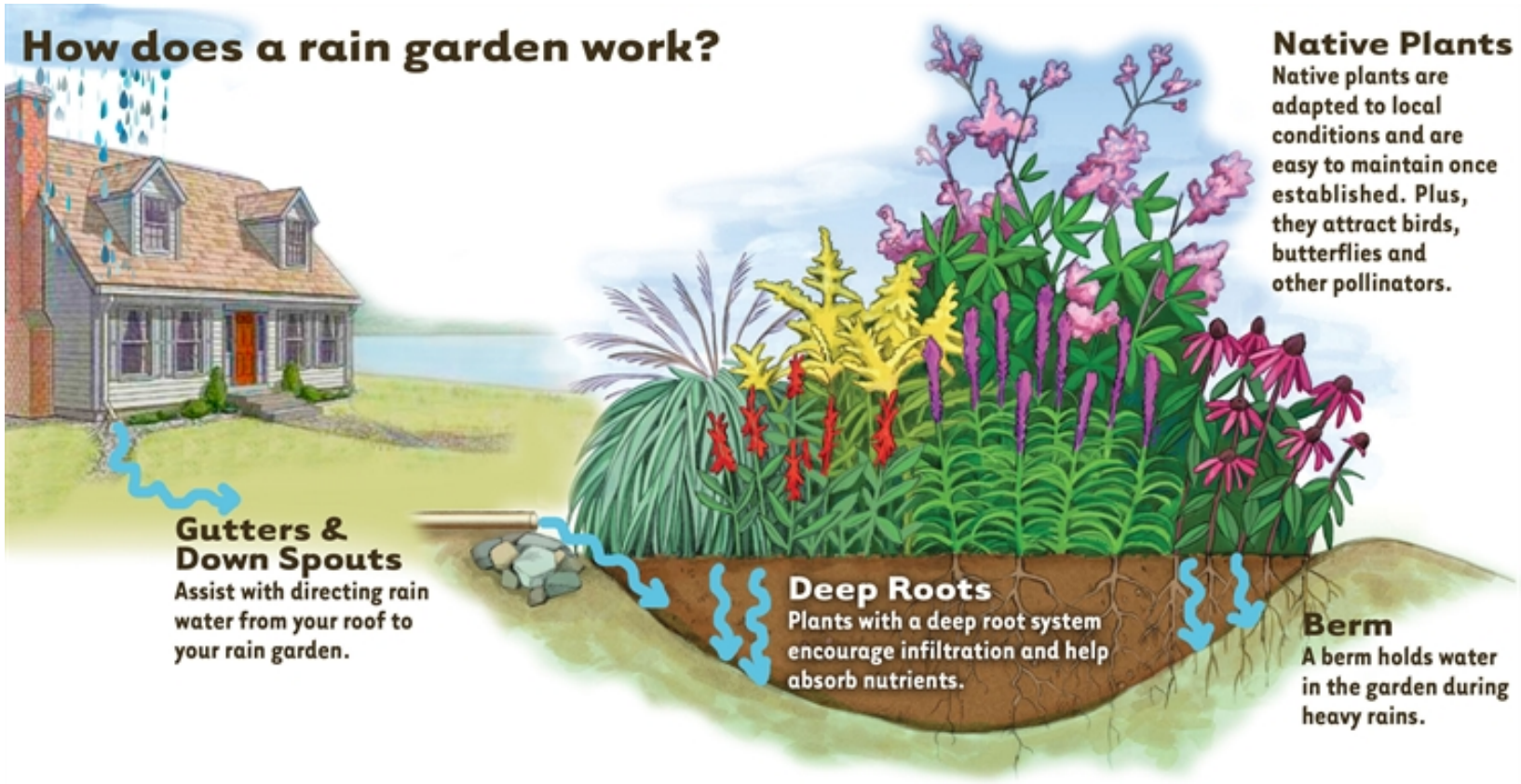
DAY 3

Date	Title	Page
	Nature of Science	
	Temperature	
	pH	
	Turbidity	
	Nitrate	
	Phosphate	
	Notes about water quality	
	What is a Watershed?	
	TCU Area Fort Worth Map	
	South Campus Map	
	About Frog Creek	
	Substrate Investigation	

SUBSTRATE INVESTIGATION

- What did your data teach you?

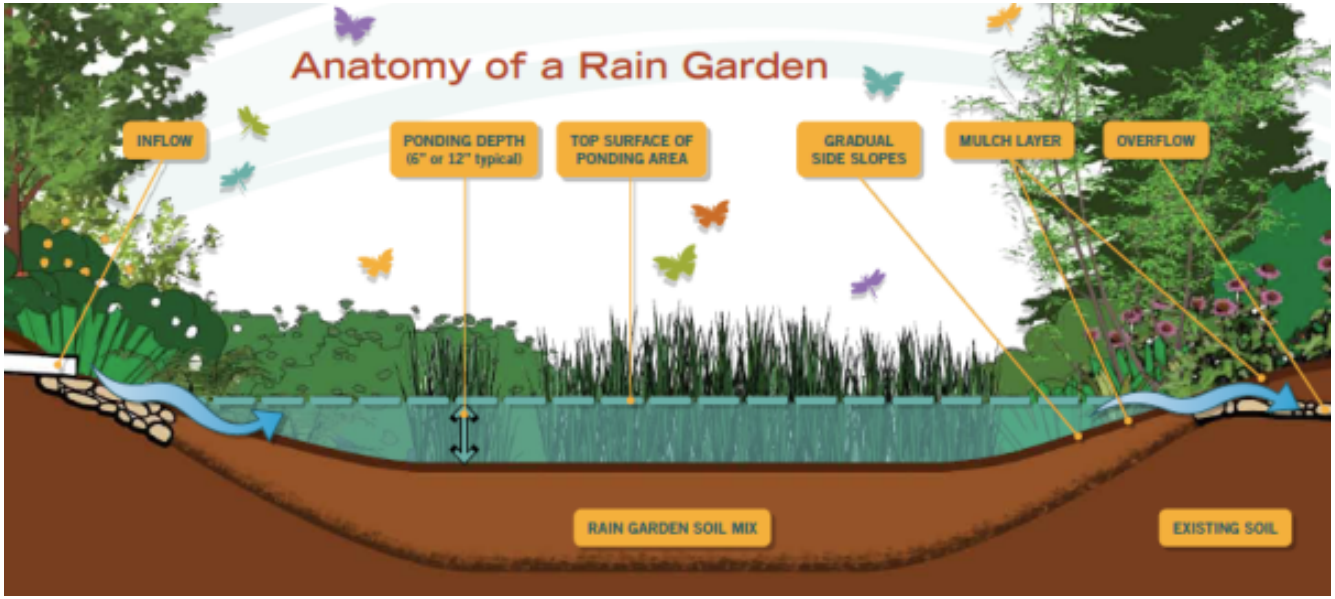
NEXT PAGE: WHAT IS A RAIN GARDEN?



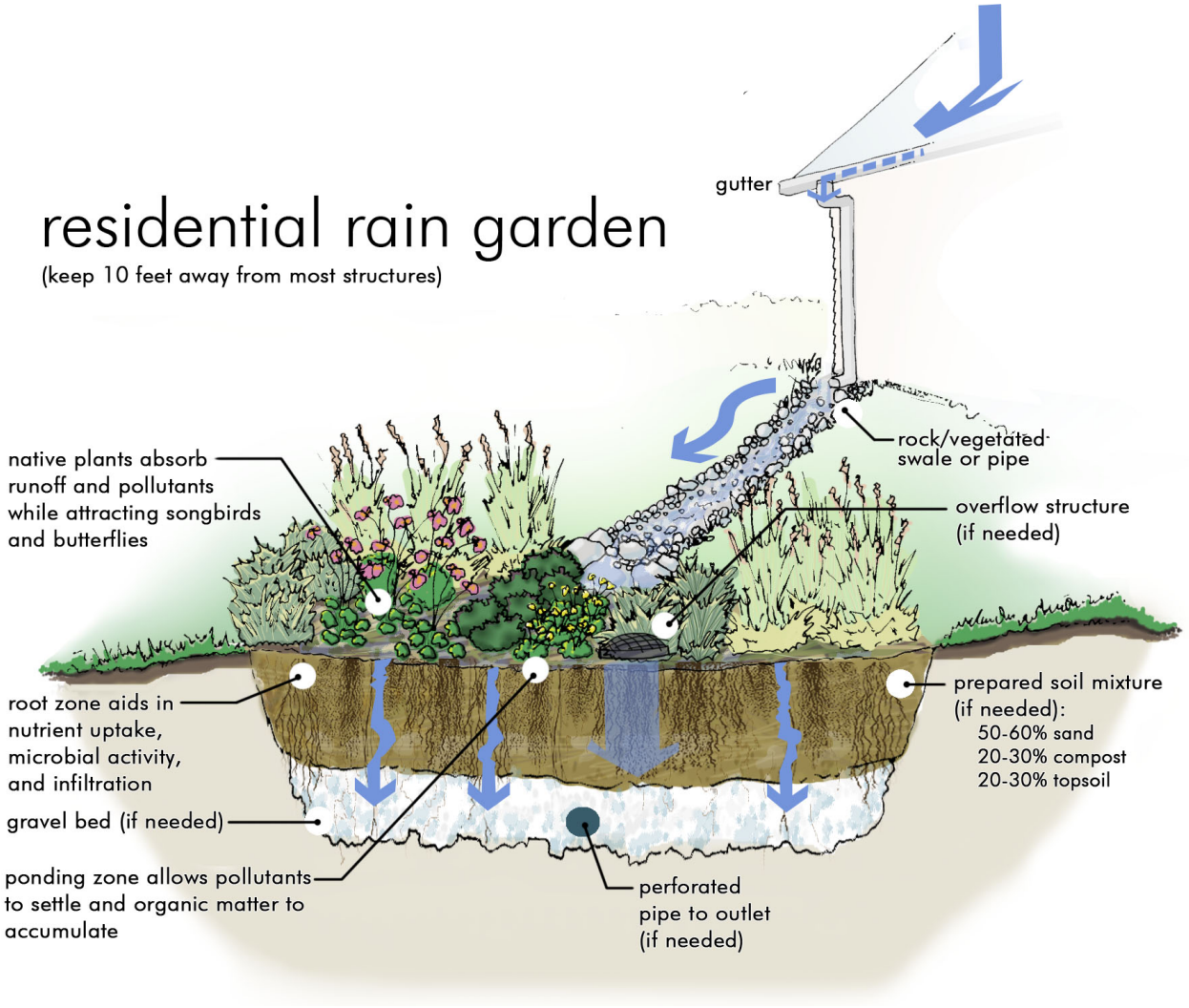
Where does the rain go?

https://youtu.be/LMq6FYiF1mo

WHAT IS A RAIN GARDEN?



WHAT IS A RAIN GARDEN?



WHAT IS A RAIN GARDEN?

- A rain garden is a garden which takes advantage of rainfall and stormwater runoff in its design and plant selection. Usually, it is a small garden which is designed to withstand the extremes of moisture and concentrations of nutrients, particularly Nitrogen and Phosphorus, that are found in stormwater runoff. Rain gardens are sited ideally close to the source of the runoff and serve to slow the stormwater as it travels downhill, giving the stormwater more time to infiltrate and less opportunity to gain momentum and erosive power.

- Rain gardens are designed to be drained within four hours after a 1” rain event. As a result, the plants selected for the bioretention cell need to be able to withstand both the extremes of flooding and drought. Plants on the upper edges of the garden are often xeric in their cultural requirement descriptions with plants lower in the garden being more adapted to floodplain conditions. Many riparian edge species are particularly well suited to the extreme environments of rain gardens.

NEXT PAGE: RAIN GARDEN DESIGN

- Make some notes for your Rain Garden Model.
  - What type of substrate mix do you plan to use?
  - What types of plants do you want to plant where?
  - How do you plan to build your model?
- When you have some ideas, you may begin your scale model drawing on graph paper.

GALLERY WALK

- Walk around and view the other scale drawings.
- If you have any questions, compliments, or suggestions, write them on a post-it note and place it on the drawing.
  - Be Kind. Be Constructive.
- Use the suggestions of your class-mates to improve your drawing.

DAY 4

Date	Title	Page
	What is a Watershed?	
	TCU Area Fort Worth Map	
	South Campus Map	
	About Frog Creek	
	Substrate Investigation	
	What is a Rain Garden?	
	Rain Garden Design	

RAIN GARDEN BUILD

- USING YOUR SCALE DRAWINGS AND THE SUPPLIED MATERIALS, BEGIN TO CONSTRUCT YOUR RAIN GARDEN MODEL.

NEXT PAGE: RAIN GARDEN EVALUATION

- In your group, determine what measures you would like to evaluate for your rain gardens.
  - Examples: Amount of absorption, Nitrate change, pH change, Phosphate change, Temperature change, etc.
- When you have decided, identify and record:
  - the question(s) you will investigate,
  - the procedures for your investigation,
  - what data you will collect and
  - how you will record & organize your data.

DAY 5

Date	Title	Page
	What is a Watershed?	
	TCU Area Fort Worth Map	
	South Campus Map	
	About Frog Creek	
	Substrate Investigation	
	What is a Rain Garden?	
	Rain Garden Design	
	Rain Garden Evaluation	

FINISHING UP

- Conclude your Rain Garden Evaluation.
- When you are done, decide how you want to present what you have learned to your parents and guests.