



Stormwater Curriculum

Grades K-2

Developed by the University of Tennessee, Knoxville. Funding for this project is provided by the U.S. Department of Agriculture Forest Service, Urban and Community Forestry Program.



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Curriculum Introduction

This module is designed to help students understand one powerful and important idea: water moves, and how we manage that movement matters.

Across grade levels, students will explore what happens to rain after it falls. They'll investigate where water goes on their campus, explore how soil and plants change its path, and learn through hands-on activities how engineered systems like the Gravel Tree Stormwater System (GTSS) or rain garden help reduce flooding and support healthy, balanced ecosystems.

This module uses your school's outdoor infrastructure as a living laboratory. Rather than learning about stormwater from diagrams, slides, and videos, students will observe, measure, analyze, and evaluate a real system in their own environment.

BIG IDEAS OF THE STORMWATER MODULE:

- Water is constantly moving through Earth's systems (aka the Water Cycle).
- Land surfaces influence infiltration, runoff, and erosion.
- Plants play a critical role in managing stormwater.
- Engineered systems can reduce human impact on the environment.
- Data helps us evaluate and improve environmental solutions.

LEARNING PROGRESSION

In Kindergarten through Grade 2, students will build a foundational understanding. They observe rainfall, explore wet and dry soil, use simple measuring tools, and connect water to plant needs. They learn that water doesn't disappear when it hits the earth – it soaks in, it flows, and it collects.

In Grades 3 through 5, students begin investigating patterns and cause-and-effect relationships. They collect multi-day data, graph changes in water levels, compare surfaces, and explain how stormwater systems reduce runoff. They are introduced to the idea that this is an engineered solution, and we have great power and responsibility to come up with solutions to the human impact on or natural resources.

In Grades 6 through 8, students investigate stormwater with more depth and complexity, taking on the role of environmental engineers. They measure system performance, calculate infiltration rates, define design criteria and constraints, evaluate effectiveness, and propose improvements supported by evidence.

Throughout all grades, students engage in authentic scientific practices:

- Asking questions
- Collecting and analyzing data
- Constructing explanations
- Using models
- Designing and evaluating solutions

WHY DOES THIS MATTER?

Stormwater management is not abstract, and it impacts all of us in our day-to-day lives. It affects flooding, erosion, water quality, green and gray infrastructure, and urban tree health. By studying a system on their own campus, students see that environmental science is local, practical, and connected to their daily lives.

This module also strengthens cross-disciplinary skills. Students practice measurement and data representation in math, evidence-based writing in ELA, and systems thinking in science and engineering.

WHAT TO EXPECT

This curriculum prioritizes outdoor, hands-on learning whenever possible. Students will measure real rainfall, observe real infiltration, and track real tree growth. Schools without physical access to a GTSS will use rain gardens or visible infrastructure to conduct equivalent investigations.

Teachers should expect movement, observation, and discussion. Many lessons are designed to be revisited seasonally and annually, allowing students to build longitudinal understanding over time.

STANDARDS ALIGNMENT

This module is vertically aligned for K-8 and meets Tennessee State Standards in:

- Earth and Environmental Science
- Engineering Design
- Measurement and Data
- Speaking and Listening
- Informational and Explanatory Writing

Each activity identifies specific grade-level standards addressed.

INSTRUCTIONAL APPROACH

This module follows a progression of increasing rigor:

- K-2: Observe and describe
- 3-5: Investigate and explain
- 6-8: Evaluate and redesign

The physical system remains constant, but the cognitive demand should evolve each year. The stormwater management systems that they started off observing in K-2 and investigating in 3-5 become systems that they build and redesign in 6-8.

Repeating the same activities with accumulating depth season-over-season or year-over-year provides students with repetition that deepens their understanding without feeling boring, gives them the opportunity to observe how their own understanding of the subject matter changes and grows over time and provides consistent through-lines across their entire elementary/middle school educational experience.

ASSESSMENT

Assessments are embedded within activities and include:

- Student observation records
- Data tables and graphs
- Written explanations
- Engineering proposals
- Class discussions

Teachers may use provided Performance Indicators or adapt assessments to fit classroom needs.

TEACHER PREPARATION

Before beginning the module, teachers should:

- Locate the GTSS or rain garden on campus (or the proposed site, if not built yet)
- Identify safe observation boundaries
- Familiarize themselves with the rain gauge and observation well (if present)
- Review measurement tools needed for their grade band
- Prepare communications to parents about required clothing for days where you and your students will be exploring the rainy, muddy, outdoors environment

Lessons can be implemented after rainfall events or during dry periods to compare conditions.

FLEXIBILITY

Activities are designed to be adaptable based on:

- Access to infrastructure and resources
- Weather conditions
- Available time
- Student readiness

Scripts are provided in places to help guide instruction, but they are recommendations only. Teachers are encouraged to use their own words and alter language to fit their own voice.

Indoor extensions are provided when weather or safety limits outdoor access. Although we encourage students to experience the rain first-hand, please keep in mind that the presence of lightning during a rainstorm constitutes a real danger and in case of a thunderstorm, lessons should be moved under shelter or indoors for student and instructor safety.



K-2 Activities

K-2 Section Introduction

Welcome to the K-2 Stormwater Section!

In the primary grades, students are beginning to build a foundational understanding of the essential concepts of stormwater: rain falls, water moves, and plants need water to grow.

This section introduces young learners to stormwater through direct observation, simple measurement, drawing, discussion, and hands-on outdoor experiences. The focus is on noticing, describing, and making sense of what happens when it rains at their own school.

Teachers will guide noticing and questioning. The goal is not technical mastery, but nurturing curiosity and clear thinking:

- What did you see?
- Where did the water go?
- How does this help the tree?

By the end of Grade 2, students should be able to explain in simple terms that stormwater systems help slow down rain, soak it into the ground, and support plant growth. This early foundation prepares students to move into deeper investigation and data analysis in Grades 3-5.

LEARNING/ACTIVITY PROGRESSION

From Rain to Root: Learn about why rain is so important (it helps plants grow!)

Rain Watchers: Start noticing the weather and rainfall

Where Does the Water Go?: Start noticing where the rain goes after it falls

Meet our Stormwater System: See an example of a Stormwater Management System

Engineering Clean Water: Experiment with how different materials filter stormwater

Flood Prevention Engineering: Design a Stormwater Management System based on experiences throughout the year

From Rain to Root

Introductions

TEACHER INTRODUCTION

In East Tennessee, rain is a regular part of life. Knoxville receives abundant rainfall throughout the year, and our region's rivers, forests, and farmland depend on it. From the Tennessee River to neighborhood creeks and schoolyard rain gardens, water shapes our landscape and supports plant life across the region.

This activity connects students directly to that local reality. In our area, when it rains, water soaks into soil, flows downhill, or collects in low places. Trees and plants rely on that water to grow strong roots and leaves. Stormwater systems, like the Gravel Tree Stormwater System (GTSS) or rain gardens, are designed to help rainwater soak into the ground where plants can use it.

"From Rain to Root" helps students see the invisible process happening beneath their feet. By observing seeds germinate, students model what happens outdoors after a rainstorm. They begin to understand that rainfall is not just weather, it is the starting point of plant growth and ecosystem health.

This activity intentionally builds toward later stormwater investigations. Students connect rainfall to soil moisture, soil moisture to plant growth, and plant growth to larger systems. In East Tennessee, where heavy rains can cause flooding but also sustain forests and agriculture, this connection is especially relevant.

Encourage students to think locally:

- Where does rain go at our school?
- How do our trees stay alive during dry weeks?
- What happens after a big Tennessee thunderstorm?

This lesson lays the biological foundation for understanding stormwater management in later grades.

KINDERGARTEN INTRODUCTION

In Knoxville and all across East Tennessee, it rains a lot. Sometimes we have sunny days, and sometimes we have big rainstorms with thunder and lightning. When it rains, the water falls on the ground. Some of it makes puddles. Some of it soaks into the soil.

Plants need that rainwater to grow.

Today, we are going to see what happens when a tiny seed gets water. A seed may look small and dry, but inside it is alive. When it gets water, it can begin to change. It can sprout roots and grow into a plant.

Just like the trees outside our school use rainwater to grow, our seed will use water to begin growing. We are going to watch carefully and see what changes from rain to root.

Grades: K-2

Time: 30-45 minutes for planting, 5-10 minutes daily for observation over 1-2 weeks

Lesson: Investigate how water helps seeds germinate and observe changes in plant growth over time.

GRADE 1 INTRODUCTION

Last year in Kindergarten, you planted a seed and watched it grow. You noticed when it sprouted and saw how water helped it change. You learned that seeds need water to grow.

This year, we are going to go a little deeper.

Here in East Tennessee, rain helps our forests, gardens, and farms grow. When rain falls in Knoxville, some water flows across sidewalks and streets, and some water soaks into the soil. The water that soaks in helps trees and plants grow strong roots.

Seeds need water to begin growing. Without water, a seed stays dry and does not change. When water reaches the seed, it begins to sprout.

This year, we are going to act more like scientists. We will not only observe what happens, we will also describe the parts of the plant that grow. We will look for roots, stems, and leaves. We may measure how tall the plant grows or how long the roots become.

As we watch our seeds grow, think about the rain outside. Rain falls on the soil. The soil holds water. The roots take in water. That is how plants grow in our community.

This year, you are building on what you already know and learning more about how each plant part helps it survive.

We are following the journey from rain to root, and beyond!

GRADE 2 INTRODUCTION

In Kindergarten and First Grade, you planted seeds and observed how water helped them grow. You saw roots appear, stems grow taller, and leaves begin to form. You learned that plants need water to survive. This year, we are going to investigate growth in a more careful and detailed way.

Knoxville and the surrounding East Tennessee region receive steady rainfall throughout the year. That rainfall supports forests, crops, and the trees on our campus. When rain falls, it can either run off pavement or soak into soil. When it soaks into soil, plant roots can absorb it.

Plants depend on water and light to grow. Water absorbed by roots travels up the stem and supports leaf growth. Without enough water, plants cannot stay healthy.

In this investigation, we will measure how plants grow over time. We will record data, compare measurements from different days, and look for patterns. We may even compare plants that receive different amounts of water.

Last year, you focused on observing change. This year, you will measure, record, and explain why those changes happen.

As you observe your seed, think about what happens outside after a rainstorm in East Tennessee. Rain soaks into the soil. Roots absorb the water. Trees grow stronger.

We are studying how rain becomes growth, and how scientists use evidence to understand that process.

Crosscutting Concepts & Connections

- Cause and effect (water leads to growth)
- Systems (plants need water to survive)
- Engineering (using tools to observe and measure change)
- Math (measurement, comparison, data recording)
- Communication (describing changes over time)

TN Academic Standards

KINDERGARTEN	GRADE 1	GRADE 2
K.ESS3	1.LS1-2	2.LS2
K.ETS1-2	1.ETS2	2.ESS1
K.MD.A.1-2	1.MD.A.1-2	2.ETS2
K.RI.KID.1-2	1.RI.KID.1-2	2.NBT.B.5-7
K.RI.CS.4, 6	1.RI.CS.4	2.MD.A.1-4
K.RI.IKI.8	1.RI.IKI.7-8	2.MD.D.10
K.RI.RRTC.10	1.RI.RRTC.10	2.RI.KID.1
K.SL.CC.1-3	1.SL.CC.1-3	2.RI.KID.3
K.SL.PKI.4-6	1.SL.PKI.4-6	2.RI.CS.4, 6
K.W.TTP.1-3	1.W.TTP.1-3	2.RI.CS.6
K.W.PDW.4-5	1.W.PDW.4-5	2.RI.IKI.7-8
K.W.RBPK.8	1.W.RBPK.8	2.RI.RRTC.10
K.W.RW.10	1.W.RW.10	2.SL.CC.1-3
		2.SL.PKI.4-6
		2.W.TTP.2-3
		2.W.PDW.4-5
		2.W.RBPK.8
		2.W.RW.10

Disciplinary Core Idea Progression

- Kindergarten: Living things have needs, and plants need water to grow. Students observe differences between living and non-living things and use tools to make and record what they notice.
- Grade 1: Plants have distinct structures (roots, stems, leaves) that each serve a function, including taking in water. Students conduct simple experiments to show how plants depend on water, minerals, and light to grow.
- Grade 2: Living organisms grow and change over time in response to their environment. Students observe plants across multiple data points, use tools to measure growth, and begin identifying patterns in how water availability affects plant health.

Learning Objectives

Students will be able to:

- Observe and describe changes in a seed over time
- Explain that plants need water to grow.
- Use simple tools to observe and measure growth.
- Record observations using drawings and/or numbers.
- Compare plant growth under different watering conditions (optional extension).



Materials

1. Bean or pea seeds
(recommended for fast germination)
2. Clear plastic cups or plastic bags
3. Paper towels or potting soil
4. Water spray bottles or small watering cans
5. Rulers for Grades 1-2
6. Observation recording sheets or journals

Vocabulary

KINDERGARTEN	GRADE 1	GRADE 2
seed	soak	germinate
soak	root	infiltration
root	absorb	nutrient
sprout	stem	runoff

Activity Introduction

1. Show students a dry seed.
2. Ask:
 - a. Kindergarten:
 - “What do you notice about this seed?”
 - “Do you think this seed is alive?”
 - “What will happen to this seed if we do nothing?”
 - “What do you think it needs to grow?”
 - b. Grade 1-2:
 - “What do you think is happening inside this seed right now, even if you can’t see it?”
 - “What would need to happen for this seed to become a plant?”
 - “What tools might we use to track those changes?”
3. Explain in simple terms:
 - a. Kindergarten:
 - “Seeds need water to begin growing. When a seed gets water, it can start to change.”
 - b. Grade 1:
 - “You already know that seeds need water to begin growing. This year, we’re going to look more carefully at what happens next. Once a seed sprouts, different parts of the plant each have a job. Roots grow down to take in water. The stem carries that water up. The leaves use it to make food. We’re going to watch those parts appear and describe what each one does.”
 - c. Grade 2:
 - “You’ve seen seeds sprout before. This year, we’re going to measure what happens, not just watch it. We’ll record how plants change day by day, look for patterns in our data, and start asking why. Why does a plant in wet soil grow faster? Why do roots grow down instead of up? We’re going to think like scientists: observe carefully, record what we find, and use evidence to explain it.”



Observation & Discussion

1. Students examine seeds before planting.
2. Ask:
 - a. K: About the texture, color, and size of the seed
 - b. 1-2: About what they predict will happen at each stage:
 - i. Where do you think the root will come from?
 - ii. Which direction do you think it will grow?
 - iii. How can we measure it once it appears?
3. Discuss predictions:
 - a. What do you think will happen after we add water?
 - b. How long do you think it will take to see changes?
 - c. What changes will we see?
 - d. Grades 1-2:
 - i. How will we measure the changes?
 - ii. What would we need to measure to know which one grew better?
 - iii. What would count as fair evidence?

Activity Instructions

1. Planting
 - a. Place a damp paper towel inside a cup or bag, or fill a cup with soil.
 - b. Place the seed inside.
 - c. Add water lightly so it is moist but not soaked.
 - d. Place in a location with light.
2. Daily Observations
 - a. Observe seeds each day for changes. Use a magnifying glass or ruler when appropriate. Add water when paper towel or soil is dry.
 - b. Ask:
 - i. "What do you notice today?"
 - ii. "Did anything change?"
 - iii. "What do you think you will notice tomorrow?"
3. Recording
 - a. K:
 - i. Using the magnifying glass to make observations, draw the seed on Day 1 and again after sprouting.
 - ii. Use words like same, bigger, different.
 - b. 1-2:
 - i. Measure root length (if using clear cup or bag) and/or plant height (if using soil) using a ruler or non-standard units.
 - ii. Record measurements over several days (Day 1 of data recording should be the day you first see roots sprout, usually between 4-6 days after first 'planting').
 - iii. Create a simple chart or graph of growth.

Sharing and Speaking

- a. Ask students:
 - i. What changed about their seed? What helped it grow?
 - iii. What would happen if it didn't get water, or got more or less water?
- iv. Encourage use of vocabulary.



Performance Indicators

- Student participates in planting and observation.
- Student can identify that water helps seeds grow.
- Student can describe at least one change observed.
- Grades 1-2: Student measures and records growth appropriately.
- Grades 1-2: Student can explain cause and effect (water leads to growth).



Extensions & Variations

- Compare one seed with water and one without water.
- Compare different amounts of water.
- Compare different types of liquids.
 - Does soda help the seed grow as much as water? (Watch carefully for mold with sugary liquids.)
 - Does muddy water work as well as the same amount of clear water?
- Transplant seedlings outdoors and discuss a seed's requirements for growth after germination (sunlight (photosynthesis), water, nutrients from soil).
 - Measure growth regularly after transplanting and connect to rainfall data (See **Rain Watchers** activity.)
- Write about how water travels from rain to soil to plant growth (see Reading Exercises for reading and writing exercises).



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Conclusion

Over the past several days, students have watched something remarkable happen. A small, dry seed received water and began to change. Roots grew downward into the soil, and stems and leaves began to grow upward. Through careful observation and measurement, students saw that water helps plants grow.

This investigation shows how rain supports plant life. When it rains in East Tennessee, some of that water soaks into the ground. Plant roots absorb this water, just like the seeds did in our classroom experiment. The rain that falls on our school helps trees, gardens, and forests grow strong and healthy.

But where does that rain come from, and how much rain do we actually get?

In our next activity, students will become **Rain Watchers**. They will begin measuring real rainfall using a rain gauge and recording how much rain falls over time. By collecting rainfall data, students will connect what they observed in their seeds to what happens outside in the natural environment.

As students track rainfall from day to day, they will begin answering new questions:

How much rain did we get today?
Was it more or less than yesterday?
How might that rain help plants grow?

The water that helped our seeds sprout started as rain. In the next activity, students will follow the journey of that rain from the sky to the ground.

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Rain Watchers

Introductions

TEACHER INTRODUCTION

Rain is an important part of life in East Tennessee. Knoxville receives frequent rainfall throughout the year, and that rain affects many things students see in their daily environment. On any given rainy day, students will see puddles on the playground, flowing gutters, wet soil, and water moving through stormwater systems. Because rain varies from day to day, measuring it helps scientists and communities understand weather patterns and prepare for changing conditions.

In this activity, students become local weather observers. By measuring rainfall on their own campus, they begin collecting real environmental data about the weather in Knoxville. This activity helps students see that weather science, or meteorology, is not just something that happens in distant place. Meteorology can be observed and studied right where they live.

The expectations for this activity increase gradually across the K–2 grade band.

Kindergarten students focus on noticing and describing rainfall. They learn that a rain gauge is a tool used to measure rain and practice comparing simple amounts such as “a little,” “a lot,” or “none.” Their observations are primarily recorded through drawings and discussion.

Grade 1 students begin connecting observations to simple measurements. They identify the closest marked line on the rain gauge and start recording rainfall amounts with teacher support. They also begin comparing rainfall between different days.

Grade 2 students work more independently with the rain gauge. They read measurement markings, record rainfall data, and help create simple graphs that show how rainfall changes over time. They begin identifying patterns in the data and discussing what those patterns might mean.

Because Knoxville receives rain throughout the year, students will likely see differences in rainfall during this investigation. Some days may have no rain, while others may follow a thunderstorm or steady drizzle. These observations help students begin understanding how weather changes over time. This routine prepares students for later stormwater investigations, where they will connect rainfall measurements to puddles, water movement, and the stormwater systems on their campus.

Grades: K-2

Time: 15-20 minutes daily routine, 30-45 minutes for initial setup

Lesson: Use simple rain gauges to observe, measure, and record rainfall over time.



KINDERGARTEN INTRODUCTION

In Knoxville and across East Tennessee, it rains often. Sometimes the rain is light and gentle. Sometimes we have big thunderstorms with thunder and lightning.

When rain falls, it lands on our playground, sidewalks, trees, and soil.

Today we are going to start watching the rain in our own schoolyard.

This tool is called a rain gauge. Scientists use rain gauges to see how much rain falls from the sky.

Each day we will look at the rain gauge outside our school and see what happened.

- Did it rain today?
- Was there a little rain or a lot?
- Is there more water than yesterday?

Our job is to look carefully, talk about what we see, and draw what the rain gauge shows.

We are becoming Rain Watchers!

GRADE 1 INTRODUCTION

In East Tennessee, rain is an important part of our weather. Rain helps fill rivers like the Tennessee River and helps plants and trees grow.

Last year in Kindergarten, you learned that scientists can watch the weather and notice when it rains.

This year we will begin measuring the rain more carefully.

Scientists use a tool called a rain gauge to measure rainfall. Do you recognize this tool from last year? When rain falls, the water collects inside the rain gauge so we can see how much rain has fallen. We will place our rain gauge outside at school in Knoxville. Each day we will check it and record what we see.

Now we will begin using the lines on the rain gauge to help us describe the amount of rain. We will also compare rainfall from one day to another.

We will ask questions like:

- Was there more rain today or yesterday?
- Did it rain a little or a lot this week?
- What do we notice about Knoxville's weather?

By the end of the week, we will have our own record of how much rain fell at our school.

GRADE 2 INTRODUCTION

Knoxville and the surrounding East Tennessee region receive rain throughout the year. Some storms bring heavy rain, while other days may have only a small amount. Scientists measure rainfall to understand these patterns.

In earlier grades, you learned that scientists observe weather and use tools to help measure it.

Now we are going to collect real rainfall data from our school.

A rain gauge measures how much rain falls during a storm. By reading the markings on the rain gauge and recording the amount each day, we can keep track of rainfall in Knoxville over time. You might remember this from last year!

During this activity, we will measure rainfall, record the amount, and add the data to a class chart. At the end of the week, we will compare the measurements and look for patterns in our local weather.

We will ask questions such as:

- Which day had the most rain?
- Which day had the least rain?
- Did we notice any patterns during the week?

By collecting rainfall data from our own schoolyard, we are doing the same kind of work that weather scientists, or meteorologists, do when they study weather patterns in East Tennessee.



Crosscutting Concepts & Connections

- Engineering (using tools to collect data)
- Environmental observation
- Math (measurement, comparison, graphing)
- Patterns over time
- Communication (describing observations and trends)

Disciplinary Core Idea Progression

- Kindergarten: Weather can be observed and recorded using tools. Students gather weather data including precipitation using instruments like a rain gauge, and use simple graphs to describe patterns over time.
- Grade 1: Observations become measurements. Students use the markings on a rain gauge to record rainfall amounts, compare measurements across days, and begin noticing that weather follows patterns over time. Using tools carefully and recording what they find are the central scientific practices.
- Grade 2: Repeated measurement reveals patterns. Students record daily rainfall, create graphs, and use data to describe how precipitation varies across a week. They connect those patterns to Earth's cyclical processes.

TN Academic Standards

KINDERGARTEN	GRADE 1	GRADE 2
K.ESS2-3	1.ETS2	2.ESS2
K.ETS1-2	1.OA.A.2	2.ETS2
K.CC.A.1-3	1.OA.B.4	2.OA.B.2
K.CC.B.5	1.OA.C.5-6	2.NBT.A.3
K.MD.A.1	1.MD.A.2	2.NBT.B.5
K.RI.KID.1-2	1.MD.C.5	2.MD.D.10
K.RI.CS.4	1.RI.KID.1-2	2.RI.KID.1
K.RI.CS.6	1.RI.CS.4	2.RI.KID.3
K.RI.IKI.8	1.RI.IKI.7-8	2.RI.CS.4
K.RI.RRTC.10	1.RI.RRTC.10	2.RI.CS.6
K.SL.CC.1-3	1.SL.CC.1-3	2.RI.IKI.7-8
K.SL.PKI.4-6	1.SL.PKI.4-6	2.RI.RRTC.10
K.W.TTP.1-3	1.W.TTP.1-3	2.SL.CC.1-3
K.W.PDW.4-5	1.W.PDW.4-5	2.SL.PKI.4-6
K.W.RBPK.8	1.W.RBPK.8	2.W.TTP.2-3
K.W.RW.10	1.W.RW.10	2.W.PDW.4-5
		2.W.RBPK.8
		2.W.RW.10

Learning Objectives

Students will be able to:

- Identify a rain gauge as a tool used to measure rainfall
- Observe and describe the amount of rainfall
- Use simple measurement strategies appropriate to grade level
- Record rainfall data
- Compare rainfall amounts across multiple days

Materials

1. Simple rain gauges (commercial or clear plastic bottles with marked lines)
2. Permanent marker or tape for marking measurement lines
3. Clipboards (optional)
4. Student data sheets and/or class recording chart
 - a. Pencils or crayons
 - b. Rulers (Grades 1-2)

Vocabulary

KINDERGARTEN

rain gauge
measure
puddle
drop

GRADE 1

precipitation
rain gauge
measure
record

GRADE 2

watershed
infiltration
data
gravity

Activity Introduction

1. Show students the rain gauge.
2. Ask:
 - a. "What do you think this tool is used for?"
 - b. "How could this help us learn about rain?"
3. Explain in simple terms:
 - a. "This is called a rain gauge. It helps us see how much rain falls."
 - b. "When it rains, the water collects inside. We can look at the lines to measure how much rain we got."



Observation & Discussion

1. Place the rain gauge outside in an open area away from buildings or trees.
2. Choose a week in advance in which rain is predicted for some or all the week.
3. After rainfall, gather students to observe the gauge.
4. Ask:
 - a. "Where is the water level today?"
 - b. "Is it more or less than yesterday?"
 - c. "Is this a little rain or a lot of rain?"
 - d. 1-2: "How does this season impact the amount of rain we see?" "How much rain might we see in ___ season?"



Activity Instructions

1. Daily Rain Check (outside):
 - a. Students observe the rain gauge at eye level.
 - b. Identify where the water stops in relation to marked lines.
 - i. K: Identify as empty, a little, or a lot; compare with the previous day.
 - ii. 1-2: Identify the number or unit marking closest to the water line.
2. Recording Data (inside):
 - a. K:
 - i. Draw the rain gauge and shade to match the level observed.
 - ii. Teacher records numerical amount if desired.
 - b. 1-2:
 - i. Write the rainfall amount.
 - ii. Add the amount to a class chart.
 - iii. Create a simple bar graph or picture graph over time.
 - iv. Have students keep a daily writing log of observable precipitation changes.



3. Comparing Patterns:
 - a. At the end of the week, review the data.
 - b. Ask:
 - i. "Which day had the most rain?"
 - ii. "Which day had the least rain?"
 - iii. "Which day had no rain?"
 - iv. "Do you notice a pattern?"
 - v. "Did it rain after you left school?"

Sharing and Speaking:

- a. Invite students to explain what they observed.
- b. Encourage the use of vocabulary such as measure, amount, and compare.
- c. 1-2 students may recount how the class measured rainfall and what they learned.

Performance Indicators

- Student participates in observing and recording rainfall
- Student can identify the rain gauge as a measurement tool
- Student can describe rainfall amount
- 1-2: Student accurately reads and records measurement
- 1-2: Student can compare rainfall amounts using data

Extensions & Variations

- Compare rainfall amounts between two gauges placed in different locations.
- Connect rainfall amounts to puddle size observations. (See Where Does The Water Go? Activity)
- Track rainfall for a month and identify the rainiest day.
- Compare rainfall data to plant growth observations.
- Introduce simple prediction before rain (“Do you think we will get more or less rain than yesterday?”).
- Create a class weather journal including drawings and written explanations.
- Write about the experience that a bug, small animal, or bird might have when it’s raining.



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QR Code for Feedback Form

Conclusion

Over the course of this activity, students did something that is unusual in a school setting: they paid attention to the same thing, in the same place, every day for a week. That kind of sustained, repeated observation of a single subject is one of the most foundational habits in science. Weather scientists, hydrologists, and environmental engineers all depend on longitudinal data, or data collected over time (just like the data your students have now begun collecting).

Take time to review the week’s data as a class before moving on. Which day had the most rain? Which had the least? Were there days with no rain at all? For Kindergarten, this review is primarily oral and visual, pointing to drawings and comparing levels. For Grades 1 and 2, students should be looking at their graphs and charts and using the language of comparison: more than, less than, the same as.

If weather permits, this is also a strong moment to go outside and look at the rain gauge together one final time. The ritual of that shared observation, the class gathered around a tool they have learned to read, reinforces that measurement is not an abstract classroom exercise. It is how we know things about the world.

One question worth bringing up to the students before the class transitions: “where did all that rain go?” Students have now measured how much water fell from the sky, but that water did not disappear. It landed somewhere: on pavement, on soil, on leaves, on the roof. Some of it soaked in. Some of it ran off. Some of it collected in low spots.

In **Where Does the Water Go?**, students will follow the rain after it falls. They will go outside and look for evidence of where water traveled, pooled, and disappeared, connecting the amounts they measured in the rain gauge to the patterns they can observe on the ground. The data they collected this week gives that investigation a new dimension. Students will not just see where water went, they will have a sense of how much water there was to go somewhere.

Where Does the Water Go?

Introductions

TEACHER INTRODUCTION

Rain is a constant presence in East Tennessee. Knoxville receives an average of around 47 inches of rainfall per year (more than Seattle or Chicago). Students in East Knoxville live and go to school in a landscape shaped by that rain: they cross creeks, notice puddles on the blacktop, watch water run along the curb on Magnolia Avenue in the humid heat after a summer storm. Most have never been asked to slow down and think carefully about where all that water actually goes.

This activity does exactly that. Rather than explaining the water cycle through diagrams, it asks students to go outside and observe it directly. Where do puddles form? Where doesn't water collect? Why does the grassy area dry faster than the sidewalk? These are not trivial questions, they are the foundation of hydrology.

Developmentally, students in K-2 are at a stage where concrete, observable experiences are the primary pathway to understanding. This outdoor observation activity is ideally suited to that learning mode. Teachers should resist the urge to over-explain; the most powerful learning here comes from students noticing, pointing, and wondering aloud.

A few things to prepare for:

- This activity works best conducted shortly after rainfall, when water movement and pooling are visible. Early morning after overnight rain is ideal.
- If rain has not occurred recently, watering cans can simulate the effect, though real rainfall creates more authentic observations.
- Direct students to touch the ground (with supervision). The difference between wet grass, damp soil, and dry pavement is something felt, not just seen.
- East Knoxville's streets and campus surfaces often have good visible runoff pathways. Draw students' attention to how water moves directionally (downhill, toward drains, away from buildings). This activity builds directly on Rain Watchers, where students measured how much rain fell. Now they begin asking what happens next.

Grades: K-2

Time: 30-45 minutes, can be split across 2 days (outdoor observation day 1, mapping/measurement day 2)

Lesson: Investigate where rainwater goes after it falls and observe how different surfaces affect water movement and collection.



KINDERGARTEN INTRODUCTION

After it rains, have you ever walked outside and looked around?

The ground is wet. There are puddles. Water is moving.

Where is all that water going?

Today, we are going outside to be water detectives. We are going to walk slowly and look very carefully at the ground after it rained.

We're going to look for puddles, for water sitting still or moving, and where the ground is dry or wet.

Here is something interesting: water does not go everywhere equally. It goes to some places more than others. That is because water follows the shape of the ground.

Our job today is to notice where the water goes, and where it does not.

GRADE 1 INTRODUCTION

Last year, you learned that rain falls and some of it soaks into the soil. Plants and trees use that water to grow.

But not all rain soaks in. Have you ever seen a big puddle after a storm? Have you noticed water running along the sidewalk? That water is moving somewhere, but where?

This year, we are going to go outside and investigate what happens to rainwater after it hits the ground.

Some water soaks into soft ground like grass or soil. Some water cannot soak in; it runs off hard surfaces like pavement and sidewalks and flows somewhere else.

Today we will look for puddles and wet areas, notice what kind of surface is under the water, and map where the water goes on our campus

Here in East Knoxville, we have rain gardens, gravel areas, and green areas that help water soak into the ground. As you observe today, think about where our school does a good job letting water soak in, and where it does not.



GRADE 2 INTRODUCTION

You already know that rain soaks into soil, is absorbed by roots, and helps plants grow. You have measured how much rain falls. This year, we are going to investigate something new: what happens to rainwater before it reaches the soil.

When rain hits different surfaces, it behaves differently. On soft, permeable surfaces like grass, soil, or gravel, water can move down into the ground. On hard, impermeable surfaces like pavement or concrete, water cannot soak in. It has to go somewhere else, so it flows across the surface. Scientists call this runoff.

Runoff can cause problems. If too much water rushes off hard surfaces too fast, it can cause flooding. It can also carry pollutants into nearby waterways. First Creek and Second Creek run through East Knoxville and eventually join the Tennessee River. The quality and speed of runoff from our neighborhood affects those waterways directly.

Today, you will investigate where runoff occurs on our campus, what surfaces produce more runoff versus more infiltration, and how our campus design might influence where water goes.

As you observe, think like a scientist: look for patterns, ask why, and record what you find. This investigation will connect directly to our next activity, where we will visit the stormwater system our school uses to manage this exact problem.



Crosscutting Concepts & Connections

- Engineering (using tools to investigate water movement)
- Environmental observation
- Fine motor control (drawing maps)
- Math (measurement, comparison, graphing)
- Communication (describing patterns and changes)

Disciplinary Core Idea Progression

- Kindergarten: Water can exist in different states and has observable properties. Students observe rain collecting in puddles, soaking into soil, and flowing across surfaces, and use their senses to describe what they notice.
- Grade 1: Plants and animals depend on their surroundings to meet their needs, and water is part of that system. Students observe how water moves across different surfaces and begin connecting surface type to where water ends up.
- Grade 2: Flowing water can move soil and other Earth materials, changing landforms over time. Students compare how water moves across different surfaces, observe runoff and infiltration on their campus, and use simple maps to document what they find.

Learning Objectives

Students will be able to:

- Observe and describe where rainwater collects
- Identify different surfaces (grass, dirt, pavement)
- Use simple tools to investigate water movement
- Record observations through drawing and/or measurement
- Compare how water behaves in different locations

TN Academic Standards

KINDERGARTEN	GRADE 1	GRADE 2
K.PS1	1.PS3	2.ESS1-2
K.ESS2-3	1.ETS2	2.ETS2
K.ETS1-2	1.OA.B.3	2.OA.B.2
K.CC.B.5-6	1.OA.C.6	2.OA.C.3
K.CC.C.7	1.MD.A.1-2	2.NBT.A.3
K.MD.A.1-2	1.MD.C.5	2.NBT.B.5-7
K.G.A.1	1.G.A.1	2.MD.A.1-4
K.G.B.5-6	1.G.A.3	2.MD.B.6
K.RI.KID.1-2	1.RI.KID.1-2	2.MD.D.10
K.RI.CS.4	1.RI.CS.4	2.G.A.3
K.RI.CS.6	1.RI.RRTC.10	2.RI.KID.1
K.RI.IKI.8	1.SL.CC.1-3	2.RI.KID.3
K.RI.RRTC.10	1.SL.PKI.4-6	2.RI.CS.4
K.SL.CC.1-3	1.W.TTP.1-3	2.RI.CS.6
K.SL.PKI.4-6	1.W.PDW.4-5	2.RI.IKI.7-8
K.W.TTP.1-3	1.W.RBPK.8	2.RI.RRTC.10
K.W.PDW.4-5	1.W.RW.10	2.SL.CC.1-3
K.W.RBPK.8		2.SL.PKI.4-6
K.W.RW.10		2.W.TTP.2-3
		2.W.PDW.4-5
		2.W.RBPK.8
		2.W.RW.10

Materials

1. Clipboards or hard surfaces (cardboard and binder/paper clips)
2. Magnifying glass or ruler
3. Paper and pencils/crayons
4. Sidewalk chalk (optional for outdoor mapping)
5. Rulers or non-standard measurement tools (craft sticks, hand spans)
6. Small watering cans or cups (if rain is not available)

Vocabulary

KINDERGARTEN

puddle
soak
flow
surface

GRADE 1

absorb
runoff
pavement
surface

GRADE 2

infiltration
impermeable
runoff
sediment

Activity Introduction

1. Gather students outside after rainfall, or simulate rain using watering cans.
2. Ask:
 - a. "It rained. Where do you think the water went?"
 - b. "Is the ground wet everywhere?"
 - c. "Do you see puddles?"
3. Explain in simple terms:
 - a. "When rain falls, it doesn't always stay in one place. Sometimes it soaks into the ground. Sometimes it flows away."

Observation & Discussion

1. Walk slowly through the outdoor space.
 - a. Where do you see water?
 - b. Are some puddles bigger than others?
 - c. What kind of ground is under the water—grass, dirt, or pavement?
2. Encourage noticing patterns:
 - a. Do puddles form in low spots?
 - b. Are there fewer puddles on grass than pavement?
 - c. Does water in the puddles seem to flow in a certain direction, or does it stay still?
3. Students may carefully touch the ground with supervision.



Activity Instructions

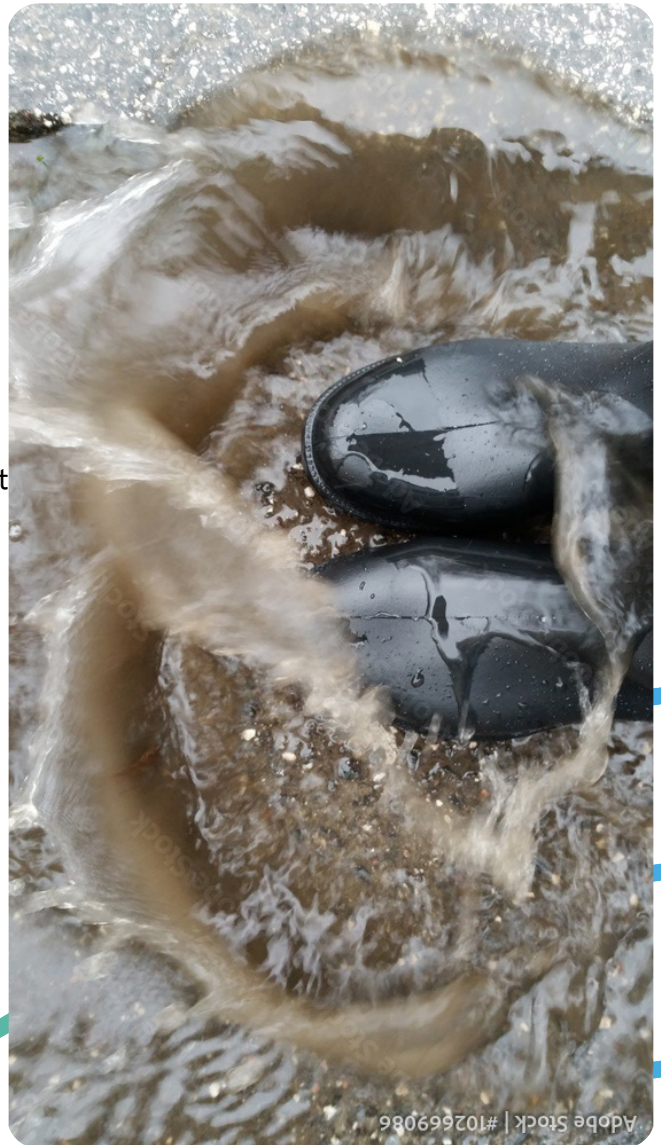
1. Observation and Mapping (outside):
 - a. Students work in pairs or small groups. They draw a simple map of the area and mark where puddles are.
 - i. K: draw puddles as shapes
 - ii. 1-2: label surfaces (grass, dirt, pavement) or use chalk to outline puddles directly on pavement.
2. Measurement (optional extension):
 - a. Choose one puddle per group.
 - b. Measure width or length of the puddle.
 - i. K: compare (bigger/smaller) or count hand spans
 - ii. 1-2: measure with ruler or consistent non-standard unit
 - c. Record the measurement.
 - i. 2nd graders should be encouraged to collect measurements from multiple puddles (multiple data points to graph later)
3. Surface Test (alternative if no rain):
 - a. Pour small amounts of water on grass, dirt, and pavement.
 - b. Observe where the water stays longest.
 - c. Ask:
 - i. "Which surface soaked up the water?"
 - ii. "Which surface made the water move?"

Sharing and Speaking

- a. As a group, ask:
 - i. Where did we find the most puddles?
 - ii. Did the water act the same on every surface?
 - iii. What types of surface made puddles? Talk about hardness, texture, and absorbency.
 - iii. What did we learn about where water goes?
- b. Encourage students to point to maps and use vocabulary.

Performance Indicators

- Student participates in observation and mapping
- Student can identify at least one surface type
- Student can describe where water collected
- 1-2: Student can explain a pattern (for example, "More puddles were on the pavement.")



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Extensions & Variations

- Compare puddle maps from two different rainy days.
- Create a class bar graph showing number of puddles on each surface.
- Pair with a rain gauge to connect rainfall amount to puddle size. (See Rain Watcher activity)
- Revisit the same area later in the season to observe differences.
- Revisit the same area on a sunny day to observe differences.
- Connect to plant growth by observing whether plants look healthier in wetter areas.
- Introduce simple erosion observations (Grade 2).
- Write about where the water went and why they think that happened.



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QR Code for Feedback Form

Conclusion

Students have now done something that scientists do: they paid sustained, deliberate attention to something most people walk past without noticing. That shift from passive observer to active investigator is worth naming and celebrating!

Review observations as a class. Where did water pool? Where did it drain quickly? What surfaces seemed to hold water, and which seemed to let it go? For Grades 1 and 2, look at the maps students made and discuss the patterns they noticed.

This is a natural moment to introduce or reinforce one core idea: not all surfaces behave the same way. Pavement and grass interact with rainfall very differently. That difference has real consequences for our campus, our neighborhood, and the creeks that run through East Knoxville.

Where does all that runoff eventually go? In our next activity, students will discover that their school has a system specifically designed to answer that question, and to do something about it.

In **Meet Our Stormwater System**, students will visit the Gravel Tree Stormwater System on campus and observe firsthand how it slows water down, encourages it to soak into the ground, and supports the trees growing within it. The patterns they noticed today (where water moves quickly, where it collects, where it disappears) will give that visit meaningful context.

Meet Our Stormwater System

Grades: K-2

Time: 30–45 minutes (can become an ongoing seasonal observation activity)

Lesson: Observe and measure how the Gravel Tree Stormwater System (GTSS) or rain garden collects, stores, and soaks in rainwater to support trees and reduce flooding.

Introductions

TEACHER INTRODUCTION

The Gravel Tree Stormwater System is not an abstraction. It is a physical thing on your campus that students can walk up to, crouch beside, and observe. (Some campuses may have a rain garden they can interact with instead!) This is a rare and meaningful opportunity in science education: the subject of study is literally outside the classroom door.

The GTSS was designed and installed in East Knoxville as part of a partnership between the University of Tennessee, the USFS, and SEED to address a real and local problem. Urban surfaces like sidewalks, parking lots, and building rooftops prevent rain from soaking into the soil. That causes faster, higher runoff flows, which can overwhelm drainage systems and carry pollutants into First Creek, Second Creek, and ultimately the Tennessee River. The GTSS addresses this by creating a permeable gravel bed around a tree, allowing water that falls on surrounding pavement to flow toward the tree opening and infiltrate slowly into the soil below.

For K–2 students, the goal of this visit is not technical understanding of hydrology. It is something more foundational: a sense that this system exists, that someone built it on purpose, and that it is doing something useful right now. Students who internalize that built environments can be designed to work with water (not just around it) are far better prepared for the engineering thinking that comes in later grades.

Before the visit, a few practical notes:

- If the GTSS is behind a fence or has restricted access, position students where they can see it clearly. Binoculars can help for distant details. Campuses with restricted GTSS access should have a rain garden for direct interaction, but observations can still be made about the GTSS from behind a fence.
- If possible, conduct this visit the day after rainfall. The contrast between dry pavement and damp soil inside the system is one of the most concrete observations students can make.
- Encourage students to use their senses: What does the gravel *sound* like when you walk on it? What does the soil *smell* like?
- The observation well, if present, gives students a literal window into what is happening below the surface. Encourage them to look.

FUN FACT:

Humans are better at smelling fertile soil after a rain than sharks are at smelling blood in the water!

This activity works best as a brief, focused outdoor experience followed by in-class sense-making. Thirty minutes outside, followed by fifteen minutes of drawing, discussing, and writing, is more effective than a longer but less structured visit.

KINDERGARTEN INTRODUCTION

We have been watching the rain and following the water. Today, we are going to visit a special place on our school campus.

This is called a Gravel Tree Stormwater System.

It looks a little different from regular ground. Do you see the gravel? Do you see the tree growing in the middle of it?

When it rains, water runs across the pavement toward this area. Then something special happens: the water moves down through the gravel and soaks into the soil underneath. The tree's roots can reach that water and drink it.

Our job today is to look very carefully and ask questions.

- What do you see?
- What does the gravel look like?
- How is this different from the sidewalk?
- Where do you think the water goes when it rains here?

This system is helping our tree grow and helping keep our sidewalks from flooding.

GRADE 1 INTRODUCTION

Last time we went outside, we found where water goes after it rains. We found puddles on pavement and noticed that water soaks into soil and grass more easily.

Today, we are going to visit a system that was built to help rainwater move in the right direction.

This is called a Gravel Tree Stormwater System, or GTSS. Engineers and scientists designed it and installed it at our school on purpose. They wanted rainwater to soak into the ground near the tree instead of rushing away across the pavement.

Here is how it works: when it rains, water flows from the surrounding pavement toward the gravel. The gravel lets the water move down into the soil, where the tree roots can absorb it.

As we visit today, we will look at the rain gauge and check on the tree. We will compare this area to nearby pavement and ask:

- Does water behave differently here than on the sidewalk?
- Can you see any signs that water has been here recently?
- How does the tree look compared to other trees around it?



The installation of a GTSS - this is what's going on underneath the gravel. The box in the center will be filled with soil and have a tree planted on top, and the PVC pipe with holes around the box will be buried under gravel.

GRADE 2 INTRODUCTION

You have now observed that water moves differently across different surfaces. Pavement creates runoff. Soil absorbs water. Gravel can let water pass through to the soil below. But what if you could design a place in a city (on a campus, on a sidewalk, in a parking lot) where water is guided toward the soil on purpose?

That is exactly what this system does. The Gravel Tree Stormwater System was installed at our school as a working solution to a real stormwater problem. The pavement around our school creates runoff that used to flow away quickly, too quickly for the trees and plants to use it. This system was designed to slow that water down and direct it into the ground where roots can absorb it.

Today we are going to investigate the system the way a scientist would. We will:

- Measure how much rain the gauge shows
- Check the water level in the observation well
- Measure the tree's growth
- Compare the surface inside the system to pavement nearby

East Knoxville is one of the first places in Knoxville where this kind of system has been installed in a school setting. You are studying something real, new, and local. Take good notes! Your data will build on observations made by students before you, and students after you will build on yours.

The progressive growth of a tree planted in a GTSS over a three-year period.



Crosscutting Concepts & Connections

- Cause and effect
- Systems
- Stability and change
- Engineering solutions
- Measurement
- Comparison

Disciplinary Core Idea Progression

- Kindergarten: The environment meets the basic needs of living things, including water. Students observe the GTSS or rain garden as a place where water and plants interact, and use drawings and labels to communicate what they see.
- Grade 1: Plants depend on water, air, minerals, and light to grow, and their environment provides those resources. Students describe the parts of the stormwater system and connect its function to what plants need to survive.
- Grade 2: People design systems to address practical problems. Students observe and describe how the GTSS or rain garden slows or redirects water, compare it to an unmanaged area, and use appropriate tools to record and refine their observations.

Learning Objectives

Students will be able to:

- Describe what the GTSS or rain garden looks like.
- Explain that plants need water.
- Use simple tools to measure rainfall, tree growth, or water levels.
- Describe how the system helps manage rainwater.

TN Academic Standards

KINDERGARTEN	GRADE 1	GRADE 2
K.ESS2-3	1.LS1-2	2.ESS1-2
K.ETS2	1.ETS2	2.ETS2
K.MD.A.1	1.MD.A.2	2.MD.A.1-3
K.G.A.1-2	1.G.A.1	2.MD.D.10
K.G.B.5	1.RI.KID.1-2	2.RI.KID.1
K.RI.KID.1-2	1.RI.CS.4	2.RI.KID.3
K.RL.CS.4	1.RI.IKI.7-8	2.RI.CS.4
K.RI.CS.4	1.RI.RRTC.10	2.RI.CS.6
K.RI.CS.6	1.SL.CC.1-3	2.RI.IKI.7-8
K.RI.IKI.8	1.SL.PKI.4-6	2.RI.RRTC.10
K.RI.RRTC.10	1.W.TTP.1-3	2.SL.CC.1-3
K.SL.CC.1-3	1.W.PDW.4-5	2.SL.PKI.4-6
K.SL.PKI.4-6	1.W.RBPK.8	2.W.TTP.2-3
K.W.TTP.1-3	1.W.RW.10	2.W.PDW.4-5
K.W.PDW.4-5		2.W.RBPK.8
K.W.RBPK.8		2.W.RW.10
K.W.RW.10		

Materials

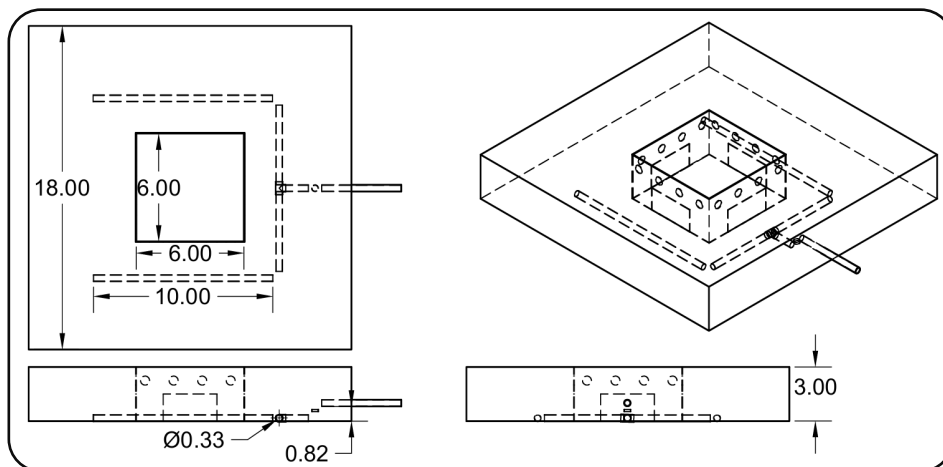
1. Rain gauge
2. Measuring tape (or string and rulers)
3. Clipboards (or cardboard and binder/paper clips)
4. Pencils or crayons
5. Student recording sheets
6. 3D model of GTSS for classroom

Vocabulary

KINDERGARTEN	GRADE 1	GRADE 2
gravel	stormwater	stormwater
soak	gravel	filtration
roots	observation well	water level
stormwater	roots	engineered solution

Activity Introduction

1. Gather students near the GTSS or rain garden, or near the fence if access is limited.
2. Remind students that they are observing or carefully engaging with the GTSS
3. Ask:
 - a. "What happens when it rains at our school?"
 - b. "Where does the water go?"
 - i. "Do trees and plants need water?"
 - ii. "How does this tree look different from others you see nearby?" (i.e. where is it planted?)
 - 1). Is it bigger than nearby trees? Smaller? What do the leaves look like?
 - c. Explain in simple language:
 - i. "This system is built to help rainwater soak into the ground. It helps make sure the water that soaks into the ground is cleaner. The trees and plants use that water to grow. It also helps keep water from flooding our sidewalks and buildings."



An engineering drawing showing the internal measurements of the GTSS. The centre 6' x 6' box holds gravel, soil, and a tree, and the ring around the outside is filled with gravel to a depth of 3 feet. A perforated PVC pipe runs along the bottom of the pit, assisting with infiltration.

Observation & Discussion

1. If accessible, walk carefully around the system. If behind a fence, guide close visual observation. If the campus has a rain garden, focus the observation, discussion, and data collection there.
2. Ask students to notice:
 - a. Do you see gravel or soil?
 - b. Where are the plants?
 - c. Do you see a tree?
 - d. Where might the water collect?
 - e. Where does the water go? Into the ground? Is there a waterway nearby?
3. Point out the rain gauge and the observation well (if present).

Activity Instructions

1. Measurement Stations
 - a. Students rotate through short observation tasks.
 - b. Rain Gauge Station
 - i. Look at the rain gauge.
 - ii. Kindergarten: Teacher reads the number. Students draw rain or record with support.
 - iii. Grades 1–2: Students help read and record the measurement. Compare to a previous day if available.
 - c. Tree Growth Station
 - i. Measure around the tree trunk.
 - ii. Kindergarten: Use string. Teacher records number.
 - iii. Grades 1–2: Use measuring tape and record number. Compare to last measurement if available.
 - d. Water Level Station
 - i. Look safely into the observation well.
 - ii. Kindergarten: Describe as high or low.
 - iii. Grades 1–2: Record approximate measurement and compare to rainfall.
 - iv. If no well is accessible, gently press soil in rain garden to feel wet or dry and describe moisture level.
2. Data Recording
 - a. Create a simple class chart with:
 - i. Rainfall amount
 - ii. Water level
 - iii. Tree measurement
 - b. Grade 2 students may create a picture graph of rainfall over several days.

Sharing and Speaking

- a. Writing and Discussion Prompts
 - i. “What happened to the rain after it fell?”
 - ii. “Did it stay on top or soak into the ground?”
 - iii. “How does this help trees?”
 - iv. “How does this help our school?”
- b. Encourage students to reference the graph and use vocabulary.

Performance Indicators

- Student can identify parts of the system such as gravel, soil, tree, or rain gauge.
- Student can describe what happens to rainwater.
- Student can use or observe a simple measuring tool.
- Student can explain that plants need water.

Extensions & Variations

- Visit the system after heavy rain and again after several dry days.
- Compare the rain garden or GTSS to a paved area on the school's campus.
- Track tree growth over the school year.
- Draw and label the system using vocabulary words.
- Connect observations to water cycle lessons.
- Connect observations to forestry lessons. Ex. tree identification, leaves and leaf shape.
- If possible, share and preserve data from each class to build graphs in future years of historical data.



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QR Code for Feedback Form

Conclusion

Students have now seen the GTSS not as a diagram or a model but as a real, functioning system on their own campus. That is worth taking a moment to savor: the science they are studying is not somewhere else; it is right here.

Bring students back together to share what they observed. What did the gravel feel like? What did the soil look like near the tree compared to the pavement? Did the observation well show water? Grounding the debrief in specific sensory observations helps cement the experience.

For Kindergarten: draw what they saw and label one part. For Grades 1 and 2: write a sentence or two describing what the system does and why it was built.

The next activity asks a related question: if the GTSS is designed to help water soak into the ground, how clean is that water? Stormwater picks up pollutants like oils, sediment, and chemical residue as it runs across pavement.

In **Engineering Clean Water**, students will investigate how natural materials filter water and begin to understand that the system they just visited is not just managing water quantity, but also contributing to water quality.

Engineering Clean Water

Introductions

TEACHER INTRODUCTION

Students have now watched rainwater move across their campus and observed a system designed to manage it. This activity introduces a question they may not have considered: is that water clean?

In East Knoxville, as in any urban neighborhood, stormwater picks up what it flows across. Oil from a parking lot. Residue from a road. Fine sediment disturbed by foot traffic. Plastic grocery bags and fast-food containers. By the time water reaches a drain or a creek, it is carrying a complex mixture of particulates and pollutants. First Creek, which runs through East Knoxville before joining the Tennessee River near the old Forks of the River industrial area, is a waterway that receives this urban runoff. Water quality in that creek reflects, in part, how well stormwater is managed upstream — including at schools like this one.

This activity uses the analogy of filtration, pouring simulated dirty water through natural materials, to give students a concrete, hands-on understanding of how soil and gravel clean water as it passes through. The materials students test (gravel, sand, soil, layered combinations) mirror the actual filter layers present in green infrastructure systems like the GTSS and rain gardens.

Pedagogically, this is a strong engineering design activity: students predict, test, observe, and compare. The key teaching moves are:

- Take the moment of building hypotheses seriously. Ask students to commit to a prediction before testing, and write it down for Grades 1 and 2. This is formative assessment and scientific practice simultaneously.
- Control the variable. Use the same amount of water in each funnel. If students notice one cup received more, that is a teachable moment about experimental design, not a ruined experiment.
- Take your time with the observation. The rate at which water passes through is as important as the clarity of the output. Some students will focus only on which water “looks cleanest” and miss the flow rate entirely.

For Kindergarten: the key learning is that some materials let water through and some materials clean it. For Grades 1–2: students begin making comparisons with simple data, including time and visual clarity. This sets the stage for the quantitative work in Grades 3–5.

Grades: K-2

Time: 30–45 minutes

Lesson: Investigate how different natural materials filter water and observe how quickly water moves through them.



KINDERGARTEN INTRODUCTION

Have you ever seen water in a puddle that looks brown or muddy? That water is not clean. It has picked up dirt from the ground.

When rainwater flows across our schoolyard, it picks things up. It can get dirty.

Today we are going to be engineers. Engineers figure out how to solve problems. Our problem is: how do we make dirty water cleaner?

We are going to test different materials — gravel, sand, and soil — to see what happens when we pour dirty water through them.

- Which material do you think will clean the water the most?
- Which do you think will let the water move through the fastest?

Watch carefully. What you discover today is connected to how the gravel system at our school helps keep water clean.

GRADE 1 INTRODUCTION

Last time we visited the GTSS, you saw gravel, soil, and a tree all working together to help rainwater soak into the ground.

But here is a question: when water soaks through gravel and soil, does it come out cleaner or dirtier?

Today you are going to find out. You will test different materials by pouring the same amount of dirty water through each one and observing what comes out the other side.

Before we start, you will write a prediction. Scientists always record what they think will happen before they test it. That way, they can compare their prediction to the real result, even when they are wrong. Especially when they are wrong!

Pay attention to two things today:

- How clear is the water that comes out?
- How fast does the water move through?

Both are important. A material that cleans water perfectly but never lets it through would not work well in a real stormwater system.

GRADE 2 INTRODUCTION

You know that the GTSS and rain gardens allow stormwater to infiltrate, to soak down through gravel and soil rather than running off the surface. You have seen that system in person.

Now consider this: the water that flows across a parking lot or sidewalk before it reaches the GTSS is not clean water. It carries sediment, oil residue, and other pollutants picked up along the way.

As water passes through gravel, sand, and soil, something happens to it. The particles in the water get trapped. The water that emerges from the bottom is different from the water that went in.

This process of using natural materials to trap particles and clean water is called biofiltration. It happens in rain gardens, wetlands, and stormwater systems like the one on our campus.

Today, you will design and run a filtration experiment. You will:

- Write a hypothesis predicting which material or combination will produce the clearest water in the shortest time
- Control your variables, making sure you use the same amount of water in each test
- Record both flow rate and water clarity
- Compare your results and explain what you found

As you work, think about the real system outside. The layers you test today are a simplified model of what happens in the ground beneath the GTSS.



Crosscutting Concepts & Connections

- Cause and effect (materials affect water flow and clarity)
- Systems (water interacting with soil, gravel, sand, and plants)
- Engineering (designing systems to clean water)
- Math (comparison, simple timing, graphing)
- Communication (describing observations and results)

TN Academic Standards

KINDERGARTEN	GRADE 1	GRADE 2
K.PS1	1.ETS1-2	2.ESS1-2
K.ESS3	1.MD.B.3	2.ETS1-2
K.ETS1	1.MD.C.5	2.MD.C.7
K.ETS2	1.RI.KID.1-2	2.MD.D.10
K.MD.A.1-2	1.RI.CS.4	2.RI.KID.1
K.RI.KID.1-2	1.RI.IKI.7-8	2.RI.KID.3
K.RI.CS.4	1.RI.RRTC.10	2.RI.CS.4
K.RI.CS.6	1.SL.CC.1-3	2.RI.CS.6
K.RI.IKI.8	1.SL.PKI.4-6	2.RI.IKI.7-8
K.RI.RRTC.10	1.W.TTP.1-3	2.RI.RRTC.10
K.SL.CC.1-3	1.W.PDW.4-5	2.SL.CC.1-3
K.SL.PKI.4-6	1.W.RBPK.8	2.SL.PKI.4-6
K.W.TTP.1-3	1.W.RW.10	2.W.TTP.2-3
K.W.PDW.4-5		2.W.PDW.4-5
K.W.RBPK.8		2.W.RBPK.8
K.W.RW.10		2.W.RW.10

Disciplinary Core Idea Progression

- Kindergarten: Materials have observable properties including absorbency. Students investigate which materials let water pass through more easily than others and classify them based on what they observe.
- Grade 1: Plants and animals depend on clean water to survive. Students observe how different natural materials interact with water, describe what happens when water moves through each one, and make simple comparisons.
- Grade 2: Engineering design can be used to compare and improve solutions to practical problems. Students design and test layered filtration systems, use tools to observe and record results, and compare the effectiveness of different material combinations.

Learning Objectives

Students will be able to:

- Observe how water moves through different materials.
- Compare how quickly water passes through various materials.
- Describe how some materials filter or trap particles.
- Record and compare results.

Materials

1. Large plastic bottles
 - a. Carefully cut the bottom off of a plastic 2-liter bottle to create a large, clear funnel.
2. Coffee filters or mesh (to hold materials)
3. Gravel
4. Sand
5. Soil
6. Leaves or grass
7. Clear cups to collect water
8. Water mixed with a small amount of soil (to simulate dirty water)
9. Stopwatch or timer
10. Paper and crayons/pencils

Vocabulary

KINDERGARTEN

filter
material
clear
trap

GRADE 1

filter
hypothesis
particle
speed

GRADE 2

biofiltration
tradeoff
fair test
clarity

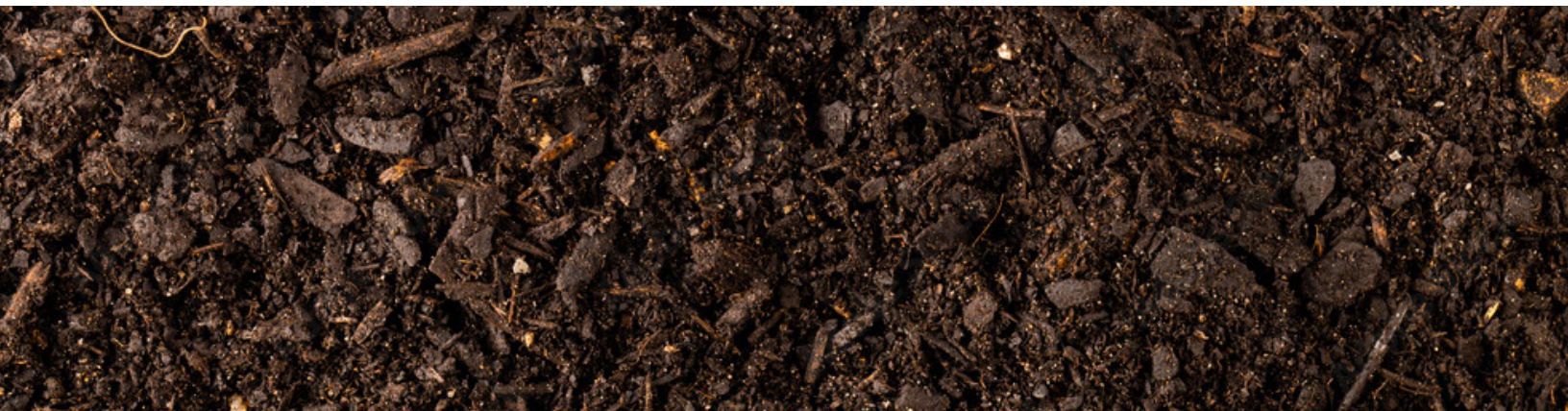
Activity Introduction

1. Show students a cup of “dirty” water mixed with soil.
2. Ask:
 - a. “Would you want to drink this?”
 - b. “How could we make it cleaner?”
- c. Explain:
 - i. “Today we will test different natural materials to see how they filter water.”



Observation & Discussion

1. Place a coffee filter or piece of mesh at the bottom of each funnel, and place each funnel in a clear collection cup.
2. Fill each funnel with different materials (for example: gravel only, sand only, soil only, mixed layers).
 - a. Based on the stability of your cup and funnel, you may need to work with one funnel at a time.
 - b. Show students the different materials and explain that water will move through the funnel, through the material, into the collection cup.
3. Ask:
 - a. “Which material do you think will let water pass through the fastest?”
 - b. “Which do you think will make the water look cleaner?”
 - c. Grades 1-2: Have students write hypotheses for the above questions.



Activity Instructions

1. Testing Filtration
 - a. Pour the same amount of dirty water into each material.
 - b. Observe:
 - i. How quickly water comes out the bottom.
 - ii. How clear or cloudy the water looks.
2. Recording
 - a. K:
 - i. Circle the material that made the clearest water.
 - ii. Use words like fast, slow, clear, cloudy.
 - iii. Draw what happened.
 - b. 1-2:
 - i. Time how long water takes to pass through.
 - ii. Record results in a simple chart.
 - iii. Compare which material filtered best.
 - iv. Optional: Create a simple bar graph of speed or clarity.

Sharing and Speaking

- a. Have students revisit their original hypotheses. Were they correct? What differed?
 - b. Ask:
 - i. "Which material filtered water the best?"
 - ii. "Which was the fastest?"
 - iii. "Why do you think that happened?"
3. Encourage use of words such as filter, material, clear, and compare.



Performance Indicators

- Student participates in testing and observation.
- Student can identify which material filtered water best.
- Student can compare materials using descriptive words.
- Grades 1-2: Student records results and explains cause and effect through writing and speaking.

Extensions & Variations

- Collect materials as a class from the school's campus to connect students to local soil makeup and materials (i.e. East TN generally has clay soils, garden beds will likely have richer/loamier soil)
- Create a layered "best design" using multiple materials.
- Compare single-material filters to layered filters.
- Connect to GTSS discussion about how gravel and soil help manage stormwater. (See **GTSS Observations** activity)
- Test clean water versus muddy water for flow speed differences.
- Write a short explanation of how biofiltration helps protect water systems.



Conclusion

Students have now made an important discovery: natural materials do not just let water pass through, they change it. Gravel removes larger particles. Sand catches finer sediment. Soil, with its complex organic structure, filters at a finer level still. Layered combinations work better than any single material alone.

Bring students together to share results. Which combination produced the clearest water? Which allowed the fastest flow? Were there tradeoffs? (There almost always are! Finer filtration usually slows the flow rate.) Naming that tradeoff explicitly is a preview of the engineering design thinking students will do in the next activity.

Connect explicitly back to the GTSS: the gravel bed students observed on campus is not just a drainage solution, it is also a filtration system. Water that passes through it arrives at the roots of the tree in better condition than the stormwater that entered.

In **Flood Prevention Engineering**, students will take the next step: using what they know about surfaces, water movement, and filtration to design their own stormwater system. They will face real constraints like limited materials and limited space, and they will have to make decisions about what matters most. The experiments they ran today are part of the evidence base they will bring to that design challenge.

Flood Prevention Engineering

Introductions

TEACHER INTRODUCTION

This is the capstone activity of the K–2 sequence. Students are not passively learning about stormwater systems, they are building one!

The shift from observer to designer is one of the most significant cognitive and affective transitions in a child’s relationship to science. When a student stands in front of their model and asks, “will this work?” they are engaged in the same fundamental reasoning process as the engineers who designed the GTSS. The materials are smaller and the stakes are lower, but the thinking is real.

East Knoxville, like many urban neighborhoods with a mix of older infrastructure and new development, has genuine stormwater challenges. During heavy rain events (which are not uncommon in Knoxville’s climate) water can accumulate near buildings, undercut soil, and overwhelm drainage. Students are not designing a toy solution to a made-up problem. They are practicing for the real work.

A few teaching notes for this activity:

- Let the first test fail. Design-test-improve is the cycle. A student whose first design sends water directly toward the building has learned something essential. Don’t rescue them too quickly.
- For Kindergarten, maintain teacher guidance through the design phase. The goal is not independent design but guided participation in the reasoning process: “where should the water go?” “which material might slow it down?”
- For Grades 1 and 2, insist on written predictions before testing. The act of committing a hypothesis to paper, even a simple one, sharpens the observation that follows.
- When evaluating designs, hold students to the two criteria: did water move away from the building, and did water reach the plant zone? Everything else is secondary.

This activity is also a meaningful moment for students to reflect on the year-long arc they have traveled: from watching a seed wake up, to measuring rain, to following water across the campus, to visiting the GTSS, to filtering water, to building their own system. In Grade 2, they’ll be able to compare the system they design here to the systems they designed in past years, and witness their own growth over time. They have been thinking about water for a long time, and this is their chance to use all of that thinking.

Grades: K-2

Time: 45-60 minutes, can be split across 2 days (design/build day 1, test/graph day 2)

Lesson: Design and test a simple stormwater pathway that guides rainwater away from a building and toward plants where it can soak into the soil.

KINDERGARTEN INTRODUCTION

We have learned so much about water this year.

We watched a seed wake up because of water. We measured rain. We followed puddles. We visited the gravel tree. We made dirty water cleaner.

Today, we are going to build something.

Here is the problem: when it rains at our school, some water flows toward buildings. That is not good for the building. We want the water to go somewhere better! We want the water to go toward plants, where it can soak into the soil and help things grow.

Today you are going to work with your teacher to design a path for the water. You will use different materials to guide water away from the building and toward the plants.

Let's build something that works.

GRADE 1 INTRODUCTION

Think about everything you have learned this year.

Water moves downhill because of gravity, from high spots toward low spots.

Some surfaces absorb water; others make it run off. Plants need water to survive. Systems like the GTSS guide water toward the soil on purpose.

Today, you are the engineer.

Your challenge: design a simple stormwater pathway that moves water away from a building and toward a plant zone where it can soak in. You have a limited set of materials and limited space. Your design has to work within those constraints.

Before you build, write down your plan. What materials will you use? Why? Where will the water go first? Where will it end up?

Then you will test it. If it doesn't work the way you hoped, you will improve it.

That process of "design, test, improve" is exactly what engineers do.



GRADE 2 INTRODUCTION

You have measured rainfall. You have mapped runoff. You have investigated how different materials filter and absorb water. You have visited a real stormwater system built to manage water on an urban campus.

Now it is time to put all of that together.

Your engineering challenge: design, build, and test a model stormwater system that protects a building and directs water toward a plant zone where it can infiltrate into the soil. Your design must meet specific criteria (water must reach the plant zone; water must not accumulate near the building) and you are working within specific constraints: limited materials and a defined space.

Before you build, write your hypothesis: what do you predict your design will do? After you test, compare the result to your prediction.

Think carefully about the materials. Gravel lets water pass through it quickly. Soil absorbs slowly.

Barriers redirect flow. How you arrange these materials will affect where and how the water moves.

You are designing a system. A system has parts that work together toward a goal. The GTSS you visited is a system. Today, yours will be too.



Crosscutting Concepts & Connections

- Cause and effect (rain affects buildings and plants differently)
- Systems (water moving through land into soil and roots)
- Structure and function (materials change how water flows and soaks in)
- Stability and change (land can flood or absorb water)
- Engineering (design, test, improve)
- Math (categorizing and graphing results)

TN Academic Standards

KINDERGARTEN	GRADE 1	GRADE 2
K.PS1	1.PS3	2.ESS1-2
K.ESS2-3	1.LS2	2.ETS1-2
K.ESS3	1.ETS1-2	2.MD.A.1-4
K.ETS1-2	1.MD.A.2	2.MD.D.10
K.ETS2	1.MD.C.5	2.RI.KID.1
K.MD.A.1	1.RI.KID.1-2	2.RI.KID.3
K.G.A.1-2	1.RI.CS.4	2.RI.CS.4
K.G.A.2	1.RI.IKI.7-8	2.RI.CS.6
K.G.B.5-6	1.RI.RRTC.10	2.RI.IKI.7-8
K.RI.KID.1-2	1.SL.CC.1-3	2.RI.RRTC.10
K.RL.CS.4	1.SL.PKI.4-6	2.SL.CC.1-3
K.RI.CS.4	1.W.TTP.1-3	2.SL.PKI.4-6
K.RI.CS.6	1.W.PDW.4-5	2.W.TTP.2-3
K.RI.IKI.8	1.W.RBPK.8	2.W.PDW.4-5
K.RI.RRTC.10	1.W.RW.10	2.W.RBPK.8
K.SL.CC.1-3		2.W.RW.10
K.SL.PKI.4-6		
K.W.TTP.1-3		
K.W.PDW.4-5		
K.W.RBPK.8		
K.W.RW.10		

Disciplinary Core Idea Progression

- Kindergarten: Materials have different observable properties, and some can be used to solve practical problems. Students explore how different materials interact with water and use drawings to communicate simple design ideas.
- Grade 1: Engineering design begins with identifying a problem and developing a solution. Students observe how water moves across land, consider which materials might redirect or slow it, and develop simple sketches or models of their ideas.
- Grade 2: Flowing water can change landforms, and multiple solutions can be compared for effectiveness. Students design and test a system to manage stormwater on a model landscape, evaluate results against their criteria, and use evidence to identify strengths and weaknesses in their designs.

Learning Objectives

Students will be able to:

- Describe how water moves across land.
- Explain that plants need water.
- Classify materials based on observable properties.
- Design a simple system to guide water toward plants and away from a building.
- Compare solutions and represent results using a simple graph.

Materials

Vocabulary

1. Shallow trays or bins
2. Soil shaped into a small hill and low area
3. Small cup or block to represent a building
4. Small artificial plant or marked “plant zone”
5. Watering cans
6. Materials such as gravel, small rocks, sand, craft sticks, mulch, leaves, cardboard pieces
7. Chart paper for class graph
8. Student recording sheets

KINDERGARTEN	GRADE 1	GRADE 2
design	solution	criteria
protect	design	constraint
flow	criteria	infiltrate
material	improve	evidence

Activity Introduction

1. Show students a tray with soil shaped into a small hill and low area. Place a “building” at the top and a “plant zone” lower down.
2. Ask:
 - a. “What happens when it rains?”
 - b. “Do plants need water?”
 - c. “Where should we send the rain?”
3. Pour a small amount of water and observe where it flows. Notice whether water moves toward the plant or stays near the building.
4. Explain that engineers help move rainwater away from buildings and toward plants so it can soak into the ground.

Observation & Discussion

1. Show available materials and allow students to touch and describe them.
2. Kindergarten focus:
 - a. Encourage describing with simple words such as rough, smooth, hard, soft, big, small.
 - b. Ask: “Do you think this will help water move?”
3. Grades 1–2 focus:
 - a. Have students write predictions about whether each material will slow water, speed it up, or help it soak into the soil.
 - b. Discuss student predictions and how material properties affect water movement.

tray setup picture/diagram

Activity Instructions

1. Design
 - a. Kindergarten:
 - i. Work in small teacher-guided groups. Provide 2–3 material choices. Help students place materials to create a path from the building to the plant zone. Focus on guiding water in the correct direction.
 - b. Grades 1–2:
 - i. Students work in small groups to design their own pathway using available materials. Encourage intentional choices and discussion about why they selected certain materials.
2. Test
 - a. Pour the same amount of water for each group.
 - b. Observe and record:
 - i. Did water move away from the building?
 - ii. Did water reach the plant zone?
 - iii. Did water soak into the soil?
 - c. Kindergarten:
 - i. Use simple categories such as “Yes” or “Not yet.” Teacher records results.
 - d. Grades 1–2:
 - i. Students help categorize results as “Reached plant well,” “Some water reached plant,” or “Did not reach plant.” Students assist in recording.
3. Compare
 - a. Create a class picture graph or bar graph showing which designs guided water to plants most effectively.
 - b. Kindergarten:
 - i. Use pictures or symbols to represent each group’s result. Count together.
 - c. Grades 1–2:
 - i. Students help label graph and interpret results.

Sharing and Speaking

- a. Ask:
 - i. “How did your design help the plant?”
 - ii. “What material helped the water move?”
 - iii. “Why is it important to move rain away from buildings?”
- b. Encourage students to use vocabulary such as flow, soak, protect, and compare.

Performance Indicators

- Student participates in design and testing.
- Student can explain that plants need water.
- Student can explain that water moves downhill.
- Student can identify at least one material used in their design.
- Student contributes to interpreting the class graph.
- Grades 1–2 students can compare two solutions and explain which worked better.



Extensions & Variations

- Modify one part of the starting design and retest, such as moving the building or increasing the height of the hill.
- Compare designs that focus on slowing water versus guiding water.
- Draw and label the final improved design with arrows showing water flow.
- Connect the model to the school's GTSS and discuss how gravel and soil help water soak into plant areas. (See **Meet Our Stormwater System Activity**)
- Observe school campus after rainfall and identify places where water moves toward plants or away from buildings. (See **Where Does The Water Go? Activity**)



Conclusion

Students have completed the K–2 stormwater arc. This is a genuine accomplishment, not just a box-checked formality!

Facilitate a short design gallery: each group shows their model and describes what worked and what they would change. For Kindergarten, the teacher facilitates. For Grades 1 and 2, students explain in their own words. The act of explaining a design decision (“we put gravel here because we thought it would slow the water down”) is cognitively demanding and communicatively rich.

Draw students’ attention to the full journey they have taken this year. They started by watching a seed respond to a drop of water. They end by designing a system that manages water at scale. That progression, from microscopic observation to macroscopic design, is exactly the trajectory of environmental science.

For students entering Grades 3–5 next year, the work continues. They will return to many of the same systems and questions like the rain gauge, the GTSS, and the behavior of water on different surfaces, but they will investigate them more rigorously, collect more systematic data, and begin explaining not just what happens but why. The understanding they built in K–2 is the foundation everything else will rest on.

K-2 Student Data Sheets and Printables

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From Rain to Root

Kindergarten Printables

Name: _____ Date: _____

BEFORE WE START

Draw your seed. Circle words that describe it.

Hard / Soft

Big / Small

Smooth / Bumpy

My seed before water

WHAT I PREDICT

What do you think will happen when we add water?

Draw or tell your teacher.

WATCHING EVERY DAY

Day 1	Draw what you see	Circle: Same / Bigger / Different What changed? Tell your teacher or a partner.
Day 2	Draw what you see	Circle: Same / Bigger / Different What changed? Tell your teacher or a partner.
Day 3	Draw what you see	Circle: Same / Bigger / Different What changed? Tell your teacher or a partner.
Day 4	Draw what you see	Circle: Same / Bigger / Different What changed? Tell your teacher or a partner.
Day 5	Draw what you see	Circle: Same / Bigger / Different What changed? Tell your teacher or a partner.

AFTER IT SPROUTED

Draw your seed after it begins to grow.

My seed after water

WHAT DO YOU SEE? Circle what you can find on your plant.

Root

Stem

Leaf

Nothing yet

WHAT CHANGED?

My seed is now: Same / Bigger / Very Different

What helped it change? _____

TALK IT OUT

Tell a partner or your teacher:

"My seed changed because _____. It needed _____ to grow."

Teacher notes / student dictation: _____

A Seed Wakes Up

From Rain to Root – Informational Reading

BEFORE WE READ

Show students a seed.

Ask: What do you notice about this seed? Do you think it is alive? What does it need?

VOCABULARY

seed — a small package that holds a baby plant and the food it needs to start growing.

soak — when water goes all the way into something and fills it up

root — the part of a plant that grows down into the soil

sprout — when a seed starts to grow and pushes up through the soil

READING PASSAGE

Look at a seed. It is small and dry and still.

Something is waiting inside it — a tiny plant, ready to grow.

When rain falls, water **soaks** down into the soil. That water finds the seed. The seed begins to change.

First, a **root** pushes down. Then a small stem pushes up toward the light.

We call this “**sprouting**”. The seed woke up because of the water.

COMPREHENSION QUESTIONS

1. What happens to a seed when water reaches it?

2. What does a root do?

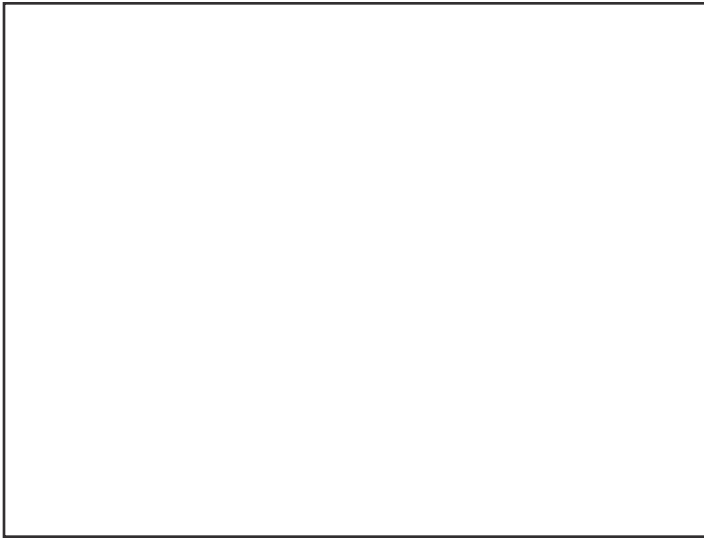
3. Why does the author say the seed “woke up”?

THINK ABOUT THE WORDS

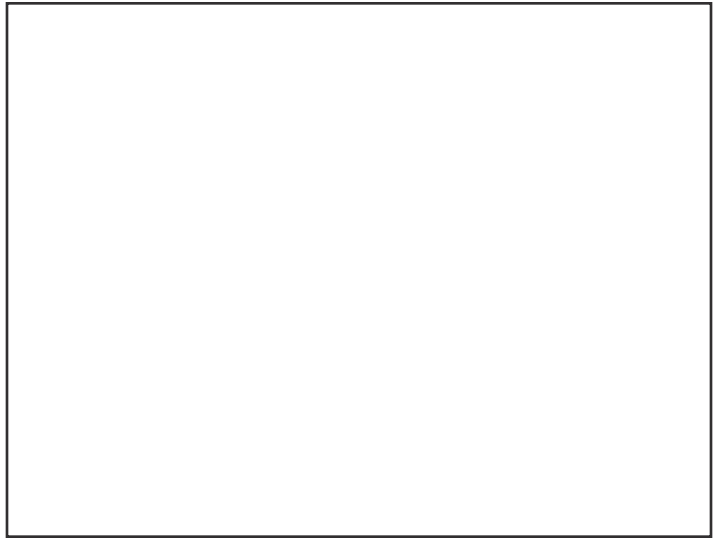
The author says “The seed woke up.” Plants do not really sleep — what do you think the author means? How is “woke up” different from “started to grow”?

DRAW IT

My seed at the start



My seed now



TALK IT OUT

Tell a partner: What did the seed need to wake up? Use the word root or sprout in your answer.

Hint: "The seed needed _____ to wake up. Then it _____."

From Rain to Root

Grade 1 Printables

Name: _____ Date: _____ Seed type: _____

MY PREDICTION

What do you think will happen when we add water? What parts do you think will appear first?

I think _____

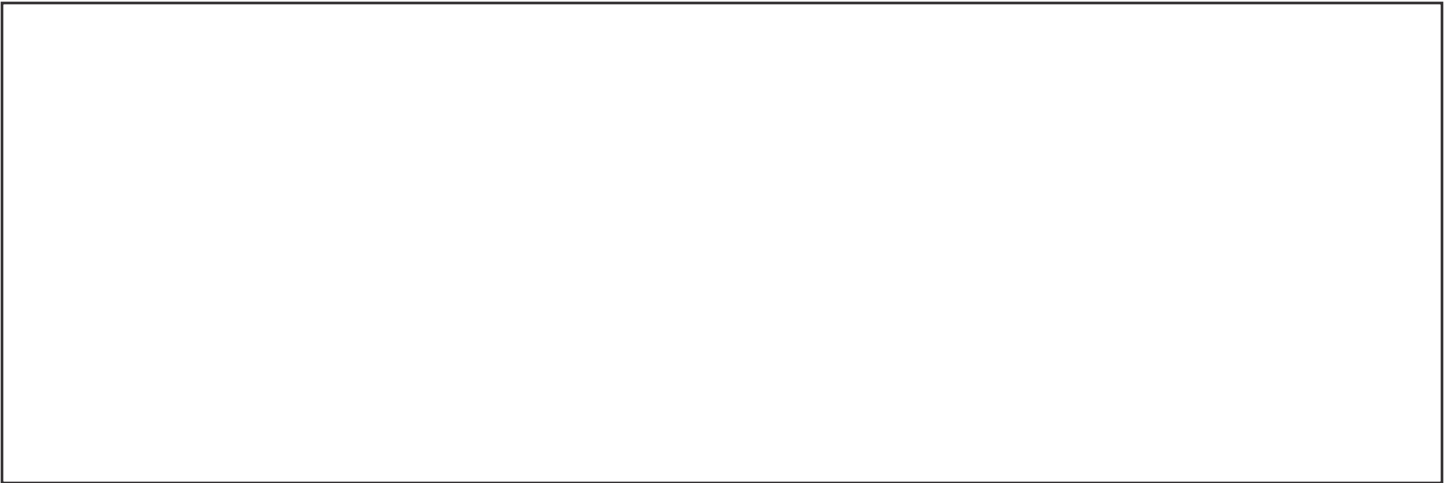
I think the _____ will appear first because _____

DAILY MEASUREMENTS

Day	Draw what you see	Root length	Plant height	What changed?
1		_____ cm	_____ cm	
2		_____ cm	_____ cm	
3		_____ cm	_____ cm	
4		_____ cm	_____ cm	
5		_____ cm	_____ cm	
6		_____ cm	_____ cm	
7		_____ cm	_____ cm	
8		_____ cm	_____ cm	
9		_____ cm	_____ cm	
10		_____ cm	_____ cm	

MY PLANT DRAWING

Draw your plant and label the parts you can see. Use the word: root, stem, leaf.



THINK ABOUT IT

What helped your seed grow?

My seed grew because _____

What do you think would happen if the seed got no water?

If there was no water, the seed would _____

WRITE ABOUT IT

Write one or two sentences explaining what you observed. Use the words root, stem, or leaf.

TALK IT OUT

Tell a partner what you saw. Use these sentence starters:

"First I noticed _____. Then _____. I think this happened because _____."

What a Root Does

From Rain to Root – Informational Reading

BEFORE WE READ

Think about the seed from our last lesson. It sprouted! Now talk with a partner: Where do you think the water goes after a seed sprouts? What part of the plant do you think handles the water?

VOCABULARY

soak — to take in liquid slowly, like a sponge takes in water
root — the plant part that grows down into soil and takes in water
absorb — to soak up — what a root does when it takes water from soil
stem — the plant part that carries water up from roots to leaves

READING PASSAGE

You know that seeds need water to wake up and start growing. But where does that water go after the seed sprouts?

Water travels through a plant. It starts underground.

When rain falls, water soaks into the soil. The soil holds the water like a sponge holds water. Roots grow down into that wet soil.

A root's job is to absorb water. Absorb means to soak something up. The root pulls water in from the soil and sends it up through the plant.

The water moves up through the stem. The stem is like a straw. It carries water from the roots all the way up to the leaves.

Without roots, a plant cannot absorb water. Without water, a plant cannot survive.

The next time it rains, think about what is happening underground. Roots are working — absorbing water, sending it upward, keeping the plant alive.

COMPREHENSION QUESTIONS

1. What does a root do?

2. How does water get from the roots up to the leaves?

3. What would happen to a plant if it had no roots?

THINK ABOUT THE WORDS

The passage says the stem is “like a straw.” What does that comparison help you understand? Have you ever used a straw? How is a stem similar to a straw?

CAUSE AND EFFECT

Complete each step. Use words from the passage.

Rain falls on the soil. → Water soaks into the soil.

Water soaks into the soil. → _____

Roots absorb water. → _____

FIND IT IN THE TEXT

Look back at the passage. Find the sentence that explains what “absorb” means. Write it here:

WRITE AND DRAW

Write one sentence explaining what a root does for a plant.

Draw a picture of a plant showing its roots absorbing water.



TALK IT OUT

Tell a partner: What would happen to a plant during a long dry summer with no rain? Use the words root, absorb, and survive in your answer.

Sentence starter: “If there is no rain, the roots cannot _____, and the plant will _____.”

From Rain to Root

Grade 2 Printables

Name: _____ Date: _____ Seed type: _____

MY HYPOTHESIS

If we add water to a seed, I think _____

I think the _____ will appear first because _____

If we give one seed more water than another, I predict: _____

DAILY DATA TABLE

Day	Draw	Root (cm)	Height (cm)	Leaves #	Observations
1		_____	_____	_____	
2		_____	_____	_____	
3		_____	_____	_____	
4		_____	_____	_____	
5		_____	_____	_____	

MY PLANT'S CONDITIONS

How much water did your plant get each day?

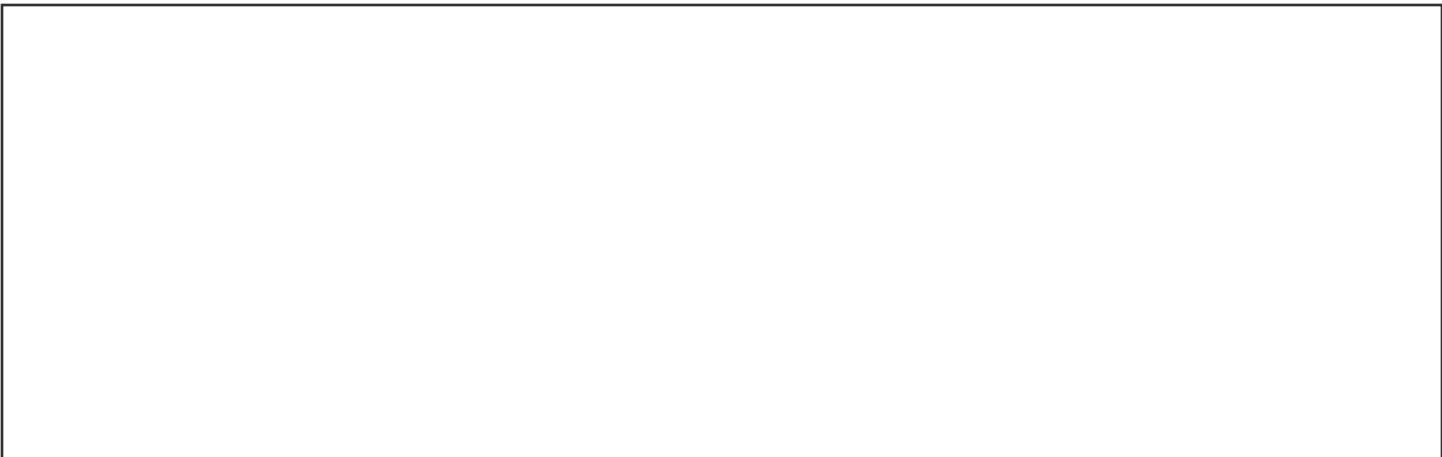
Circle: A lot / A little / Some

Did your plant get sunlight?

Circle: Full sun / Partial shade / No sunlight

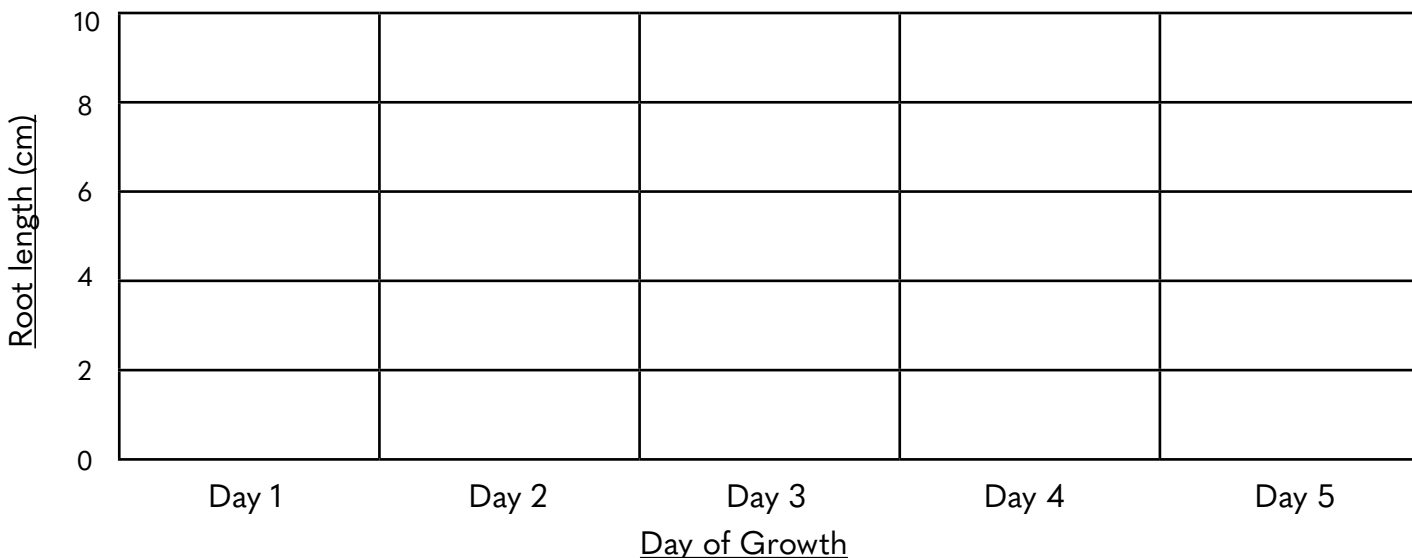
LABELED DIAGRAM

Draw your plant and label all the parts you can see. Add an arrow to each part.



MY GROWTH BAR GRAPH

Use your data table to draw a bar showing root growth for each day. Color in the bars.



PATTERNS AND EXPLANATION

What pattern do you notice in your data? Did the plant grow the same amount every day?

Write 2–3 sentences explaining what happened. Use the words: germinate, absorb, root.

Rain, Soil, and Seeds

From Rain to Root – Informational Reading

BEFORE WE READ

Think about what you observed when we planted seeds. Our seeds grew in soil — not in a cup of gravel, not on paper. Why do you think soil matters? Write or share your thinking before you read.

VOCABULARY

germinate — when a seed begins to grow and sprout for the first time

infiltration — when water soaks down into the soil instead of flowing off the surface

nutrient — a substance in soil that helps plants grow strong and healthy

runoff — water that flows across the ground surface instead of soaking in

READING PASSAGE

You have watched a seed sprout. You have seen roots appear and a stem push upward. But have you thought about why that only works in soil and not on a sidewalk?

When rain falls, it lands on every surface. On pavement, the water has nowhere to go. It flows across the top and drains away. Scientists call this **runoff**.

But when rain falls on soil, something different happens. The water soaks down into the tiny spaces between soil particles. Scientists call this **infiltration**, when water moves from the surface down into the ground.

Soil does two important things for plants. First, it holds water after rain like a sponge. Second, it contains nutrients: tiny substances that help plants grow strong.

When a seed is planted in soil, the water that infiltrated the soil surrounds it. That water causes the seed to **germinate** — to wake up and begin growing. The first root reaches down into the moist soil and begins to **absorb** water and **nutrients**.

This is why plants grow in gardens but not in parking lots. Soil makes infiltration possible. Infiltration makes germination possible. Germination starts the plant's life.

VOCABULARY IN CONTEXT

Find the word "germinate" in the passage. Read the sentence it is in.

What clue in that sentence helps you understand what it means?

Write the clue: _____

Now find the word "runoff." Write your own definition using context clues:

COMPREHENSION QUESTIONS

1. What is infiltration? Use the passage to explain in your own words.

2. Why can plants grow in soil but not on a sidewalk?

3. What two things does soil do for plants?

PUT IT IN ORDER

Number the steps in order (1–5) to show how rain helps a seed germinate.

___ The seed germinates and a root begins to grow.

___ The soil holds the water like a sponge.

___ Water infiltrates the soil and surrounds the seed.

___ Roots absorb water and nutrients from the soil.

___ Rain falls on soil.

USE TEXT FEATURES

This passage uses bold words to help you find key ideas. Find the bold word in paragraph 3.

What is that word? _____

What does it mean?

WRITING

Write about the difference between runoff and infiltration. Use at least two vocabulary words.

Runoff is _____.

Infiltration is _____.

They are different because _____.

Rain Watchers

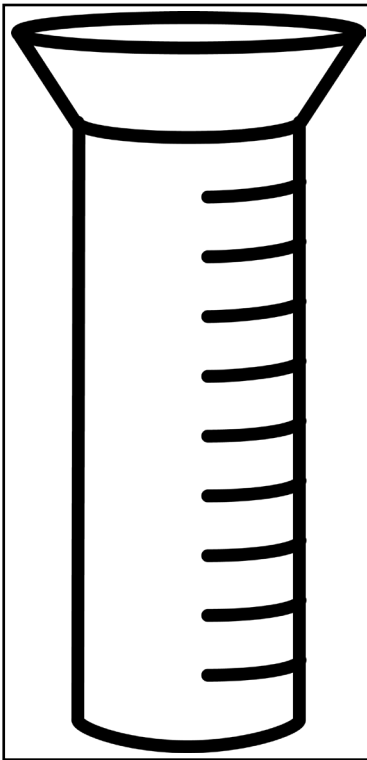
Kindergarten Printables

Teacher notes: The first page of the data sheets (Daily Observation Sheet) is designed for daily repeated use. Print one copy per student per observation day, or in a weekly packet of five. At the end of the week, students will combine their observations into one End-of-Week Sorting activity.

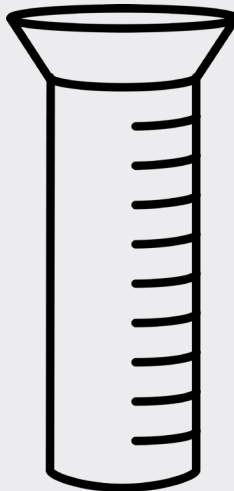
Name: _____ Date: _____

DAILY OBSERVATION SHEET

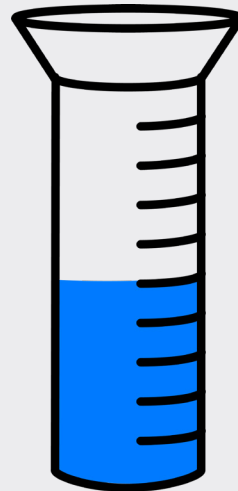
Color the rain gauge to show what you see.



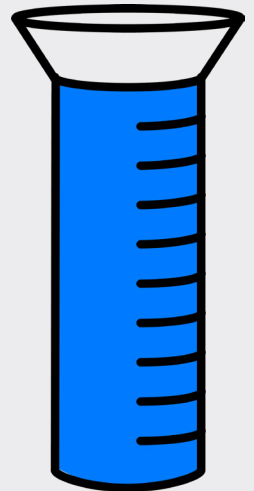
Circle what you see.



EMPTY



A LITTLE



A LOT

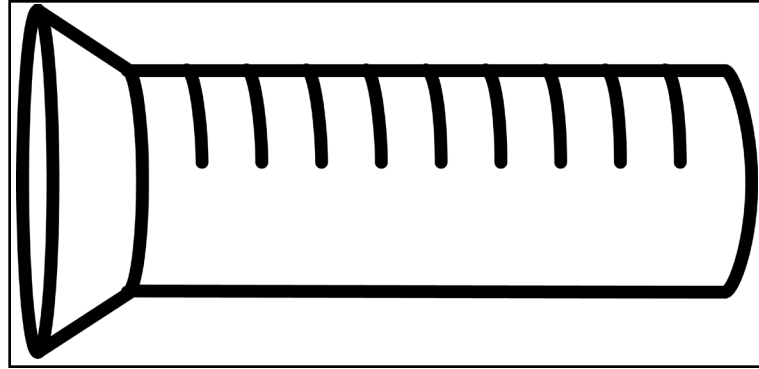
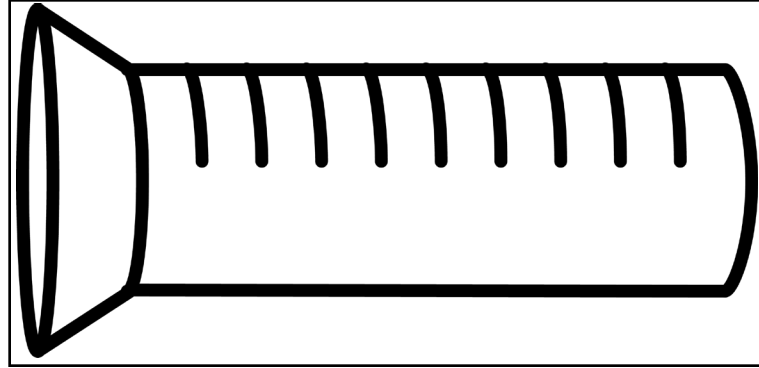
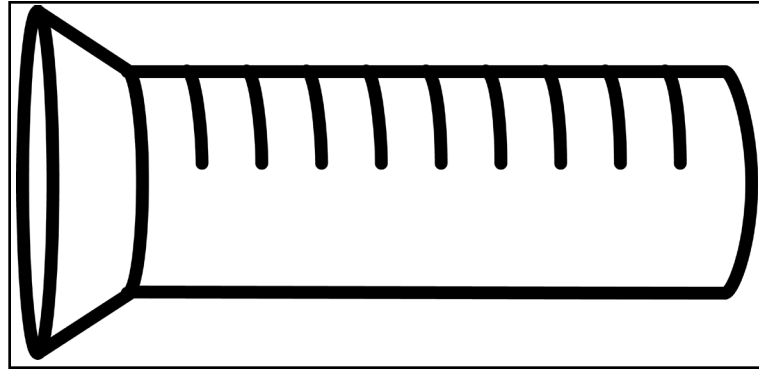
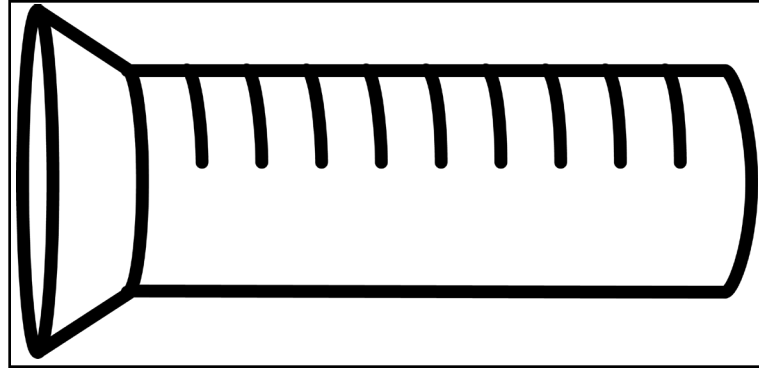
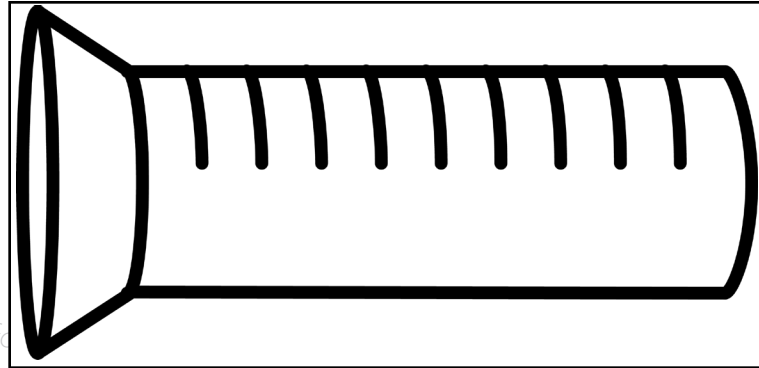
WRITE & DRAW ABOUT IT

One thing I noticed outside today:

Name: _____ Date: _____

END-OF-WEEK SORTING

Cut out your daily drawings and glue them here in order, or draw the gauge each day from your data sheets.



Circle the day with the MOST rain. Scribble over the day with NO rain. How many days had rain? _____

Rain and What It Tells Us

Rain Watchers — Informational Reading

BEFORE WE READ

Close your eyes. What does rain sound like? What does it feel like on your skin? Turn and tell a partner about a time you were outside in the rain.

VOCABULARY

rain gauge · measure · puddle · drop

READING PASSAGE

It rained last night, or maybe this morning, or maybe it is raining right now. You can hear it before you see it. Little taps on the window. Soft thumps on the roof.

Then you look outside. **Drops** on the sidewalk. **Drops** on the leaves. Dark patches on the pavement where the water is pooling up in the low places, the same spots where puddles always show up.

How much rain is that? A little? A lot? Enough to fill a bathtub?

There is a tool that can tell us. It is called a **rain gauge**. A **rain gauge** sits outside in the rain and catches the water as it falls, like a measuring cup left out in a storm. When the rain stops, you look at the lines on the side and **measure** how much came down.

Some mornings this week, the **rain gauge** will be empty.

Some mornings, it will surprise you.

COMPREHENSION QUESTIONS

1. What does a rain gauge do? _____
2. Name one place where rain lands. _____
3. How do we know how much rain fell? _____

THINK ABOUT THE WORDS

The passage says the rain gauge "will surprise you." What do you think it means for a number to be surprising?

DRAW IT

Draw the rain gauge outside in the rain. Show the water level inside.

TALK IT OUT

Tell a partner: What do you think the rain gauge will show us tomorrow? Use the word measure or rain gauge.

Hint: "Tomorrow, I think the rain gauge will show _____. I think that because _____."

Rain Watchers

Grade 1 Printables

Name: _____ Date: _____

DAILY MEASUREMENT LOG

Day	Did it rain? Circle your answer.	Reading on the gauge	More, less, or the same as yesterday? Circle your answer.
	YES NO		- FIRST DAY -
	YES NO		MORE LESS SAME
	YES NO		MORE LESS SAME
	YES NO		MORE LESS SAME
	YES NO		MORE LESS SAME

How many days had rain? _____

Which day had the most rain? _____

Name: _____ Date: _____

TALLY CHART

Make a tally mark for each day.

Days with rain	Days without rain

MAKE A PICTOGRAPH

Fill in one square for each unit of rain that fell that day. If no rain, leave that row empty.

Each square = ___ inch/cm (your teacher will tell you the key).

Rainfall this week

Day	How much rain fell?				

Which day has the longest row? _____

Which day has the shortest? _____

Name: _____ Date: _____

ADDITION AND SUBTRACTION

Add Monday, Tuesday, and Wednesday's rainfall together:

Monday: _____ + Tuesday: _____ + Wednesday: _____ = _____

Write a number sentence to show the difference between the longest and shortest row:

_____ - _____ = _____

Rewrite your number sentence using addition instead:

_____ + _____ = _____

WRITE ABOUT IT

This week in Knoxville, it rained on _____ days out of 5.

The rainiest day was _____. The gauge showed _____ on that day.

On days with no rain, the gauge showed _____.

I think the rain from this week went somewhere. I think it went _____.

What Scientists Do with Rain

Rain Watchers — Informational Reading

BEFORE WE READ

You are starting to measure rainfall this week. Before you read, write or share one question you have about rain or about measuring it.

My question: _____

VOCABULARY

precipitation · rain gauge · measure · record

READING PASSAGE

East Tennessee gets a lot of rain. It rains in spring, when the redbuds are blooming pink on the hillsides above Knoxville. It rains in summer, during those big afternoon storms that roll in fast and leave the air smelling different. It rains in fall, and in winter too. All that water falling from the sky has a name. It is called **precipitation**.

Not every rainstorm is the same size, though. Sometimes a storm barely wets the sidewalk. Sometimes it soaks everything and keeps going for hours. If you want to know the difference between one storm and another, you have to **measure**.

A **rain gauge** collects **precipitation** as it falls. The lines on the side give you an exact number you can write down.

One number by itself does not tell you much. But write down a number every day for a week, and you can start to see things. Which day brought the most rain. Which days had none. Whether the week got wetter or drier as it went. Scientists call that a pattern, and finding patterns is a big part of what weather scientists do.

Meteorologists in Knoxville have been collecting rainfall numbers like this for years and years. Your class is doing the same thing they do. Pay attention, **record** it every day, and see what the numbers show you.

COMPREHENSION QUESTIONS

1. What does the word "precipitation" mean? Use a clue from the passage. _____

2. Why does writing down a number every day matter more than writing it down just once? _____

3. What is a pattern, and why do scientists look for them? _____

CAUSE AND EFFECT

Complete each step. Use words from the passage.

Rain falls. → A rain gauge _____ the precipitation.

You write the number down every day. → At the end of the week, you can see a _____.

Scientists find a pattern. → They learn something true about the _____ where they live.

FIND IT IN THE TEXT

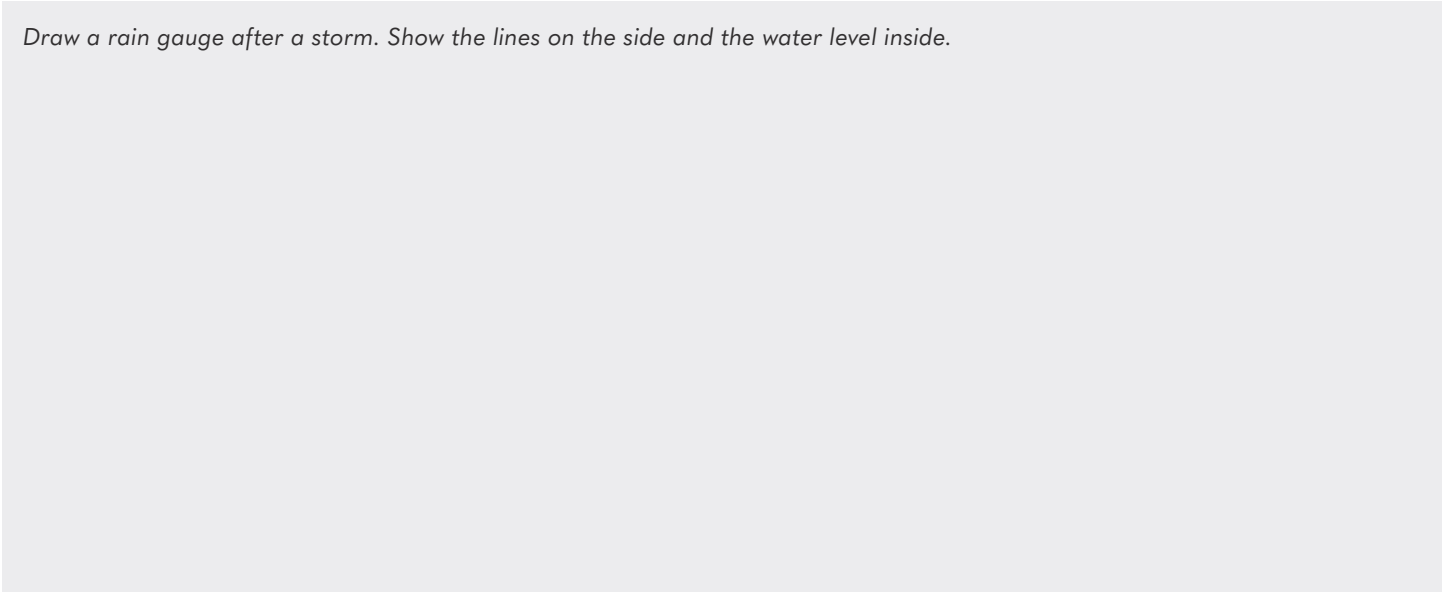
Look back at the passage. Find the sentence that explains what a pattern is.

Write it here: _____

WRITE AND DRAW

Write one sentence explaining why scientists measure rain every day instead of just once.

Draw a rain gauge after a storm. Show the lines on the side and the water level inside.



TALK IT OUT

Tell a partner: What do you think our class's rainfall pattern will look like this week? Use the words precipitation, record, and pattern.

Sentence starter: "I think our pattern will show _____. I think that because _____."

Rain Watchers

Grade 2 Printables

Name: _____ Date: _____

DATA TABLE

Fill out the table each day with the information from the rain gauge.

To find the difference in rainfall, subtract yesterday's amount from today. If today had more, the answer is positive. If less, write a minus sign.

Date	Rainfall amount inches OR cm (circle one)	More or less than yesterday?	Difference from yesterday (write the number)
		- FIRST DAY -	
		MORE LESS SAME	
		MORE LESS SAME	
		MORE LESS SAME	
		MORE LESS SAME	
		MORE LESS SAME	
		MORE LESS SAME	

Total rainfall this week: _____

Show your addition here:

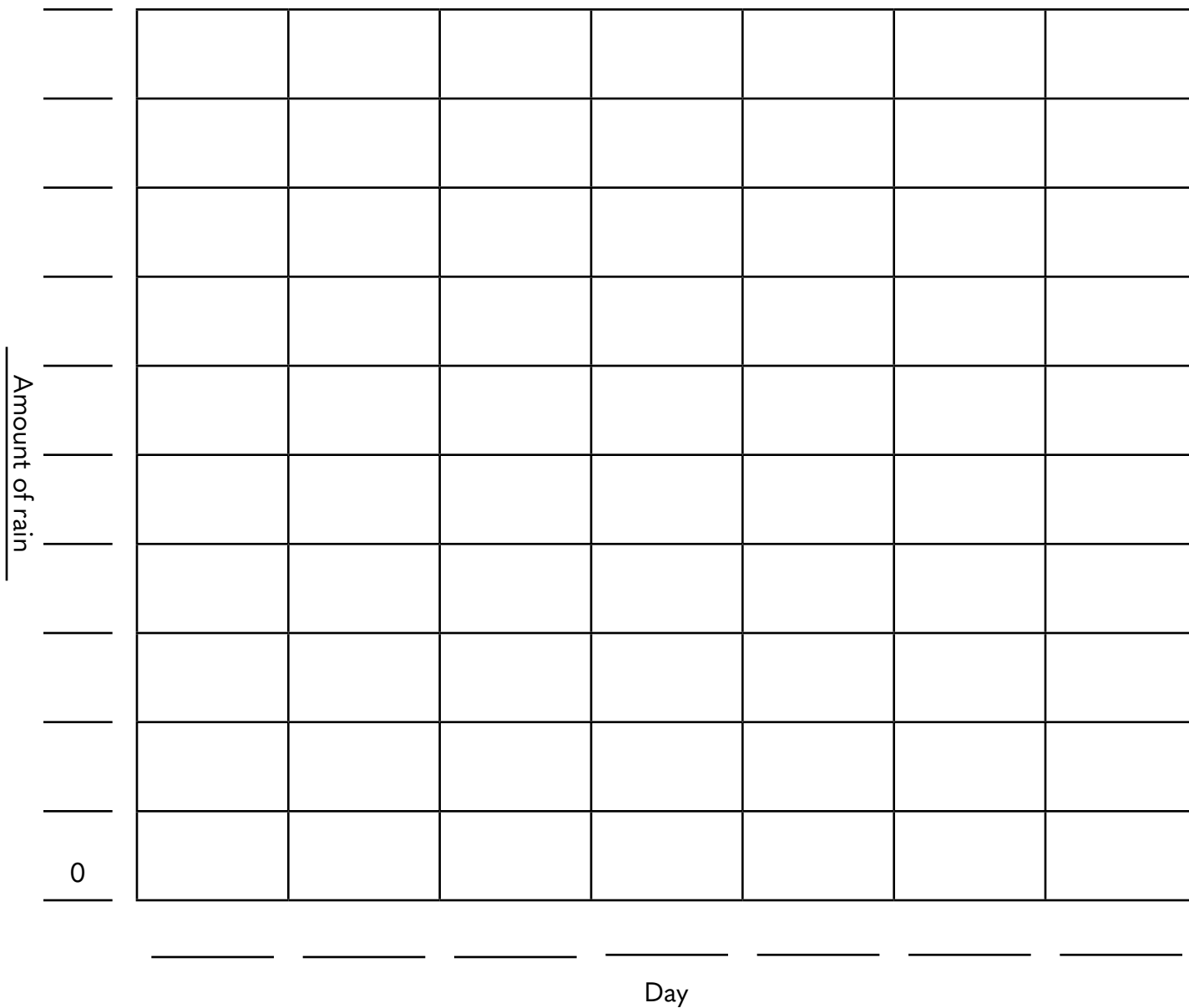
Name: _____ Date: _____

BAR GRAPH

Fill in the numbers on the left side of the page. Start at 0 and count up by _____ (your class will decide the scale together). Fill in the days at the bottom of the page.

Draw a bar for each day. A day with no rain gets a bar that touches zero.

Rainfall this week



Which day had the most rain? _____
 Which day had the least? _____
 How much more rain fell on _____ than on _____?
 Show your subtraction:

Name: _____ Date: _____

WRITE ABOUT IT

In our investigation, I found that _____.

I know this because _____.

The rainiest day was _____. The driest day was _____.

The difference between them was _____ inches / centimeters.

If all this rain fell on pavement with nowhere to soak in, it would _____.

Where the Rain Goes

Rain Watchers — Informational Reading

BEFORE WE READ

You have been measuring rainfall this week. Before you read, write one thing you noticed about the data your class collected. I noticed: _____

VOCABULARY

watershed · infiltration · data · gravity

READING PASSAGE

You live inside a **watershed**. That means every raindrop that falls on your school, your street, or your backyard is draining to the same place. The land around East Knoxville slopes toward First Creek. Water follows that slope. It does not matter if the rain fell on your roof, the parking lot, or the woods behind someone's house. **Gravity** pulls all of it in the same direction, toward the creek, and from there into the Tennessee River. Your school is part of that system. So are you.

When a big storm hits, something has to happen to all that rain. On soil and grass, water soaks down into the ground, pulled downward by **gravity**. Scientists call this **infiltration**. You cannot see it happening, but the water is moving down through the soil instead of running across the top of it.

On pavement, there is no soil for water to soak into. It has nowhere to go but sideways. It sheets off parking lots, rushes down gutters, and picks up speed. The more pavement a neighborhood has, the more water races off the surface instead of soaking in. When enough water moves fast enough in the same direction, the creek cannot handle it. That is when flooding happens. Streets flood. Basements flood. The fast-moving water picks up oil, trash, and pollution from the road and carries it into the creek along with everything else.

This is the problem the gravel tree system at your school was built to solve. That patch of gravel and soil is designed to slow water down and let it soak in before it can race off to First Creek. The scientists and engineers who built it studied rainfall **data** from storms just like the ones you are measuring this week.

So when you read your rain gauge this Friday, as you collect your own **data**, think about where your number fits. One school. One rain gauge. One week. Somewhere, someone who studies watersheds would want to know what you found.

VOCABULARY IN CONTEXT

Find the word "infiltration" in the passage. Read the sentence it is in.

What clue in that paragraph helps you understand what it means?

Write the clue: _____

Now find the word "watershed." Write your own definition using context clues: _____

PUT IT IN ORDER

Number the steps in order (1–5) to show what happens to rain that falls on pavement during a storm.

- ___ The water races off the pavement and rushes down gutters.
- ___ Rain falls on a parking lot.
- ___ The fast-moving water reaches First Creek.
- ___ The water cannot infiltrate the pavement.
- ___ The creek fills up faster than it can handle.

USE TEXT FEATURES

This passage uses bold words to help you find key ideas. Find the bold words in the third paragraph.

What is one of those words? _____

What does it mean? _____

WRITING

Write an introduction sentence, then 2–3 sentences explaining how pavement changes what happens to rainwater, then a concluding statement. Use at least two vocabulary words.

Introduction: _____

2–3 sentences: _____

Concluding statement: _____

COMPREHENSION QUESTIONS

1. What is a watershed? Explain in your own words. _____
2. What is the difference between what happens to rain on soil and rain on pavement? _____

3. Why does fast-moving water on pavement become a problem? _____

Where Does the Water Go?

Kindergarten Printables

Name: _____ Date: _____

CAMPUS MAP

Draw a map of your campus, and mark where you find the puddles.

Name: _____ Date: _____

PUDDLE OBSERVATIONS

<p>Grass</p> 	<p>Did we find puddles here?</p> <p>YES NO</p>	<p>Draw what you saw:</p>
<p>Dirt</p> 	<p>Did we find puddles here?</p> <p>YES NO</p>	<p>Draw what you saw:</p>
<p>Pavement</p> 	<p>Did we find puddles here?</p> <p>YES NO</p>	<p>Draw what you saw:</p>

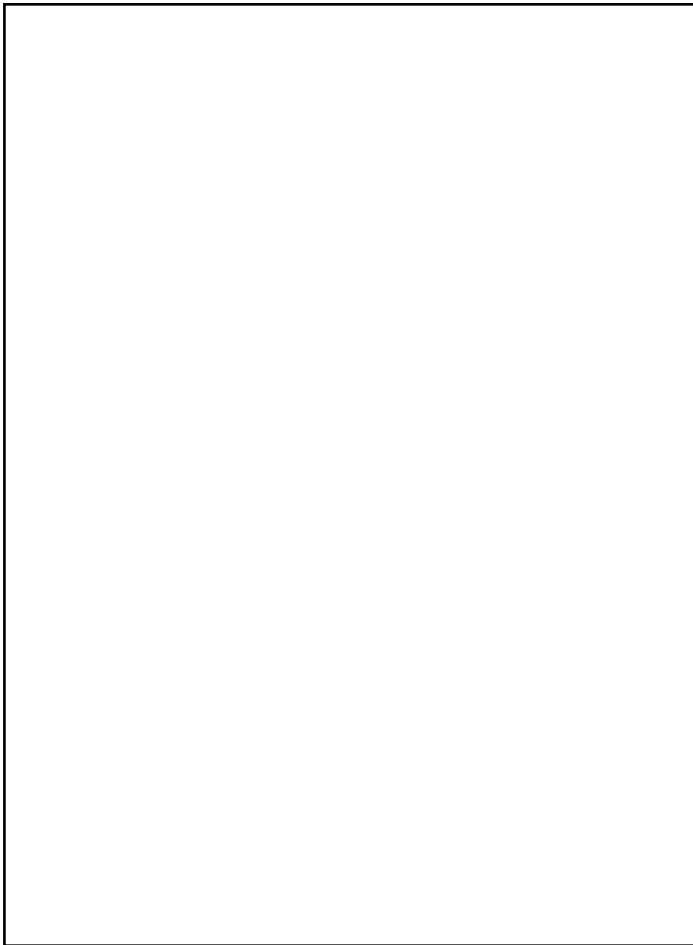
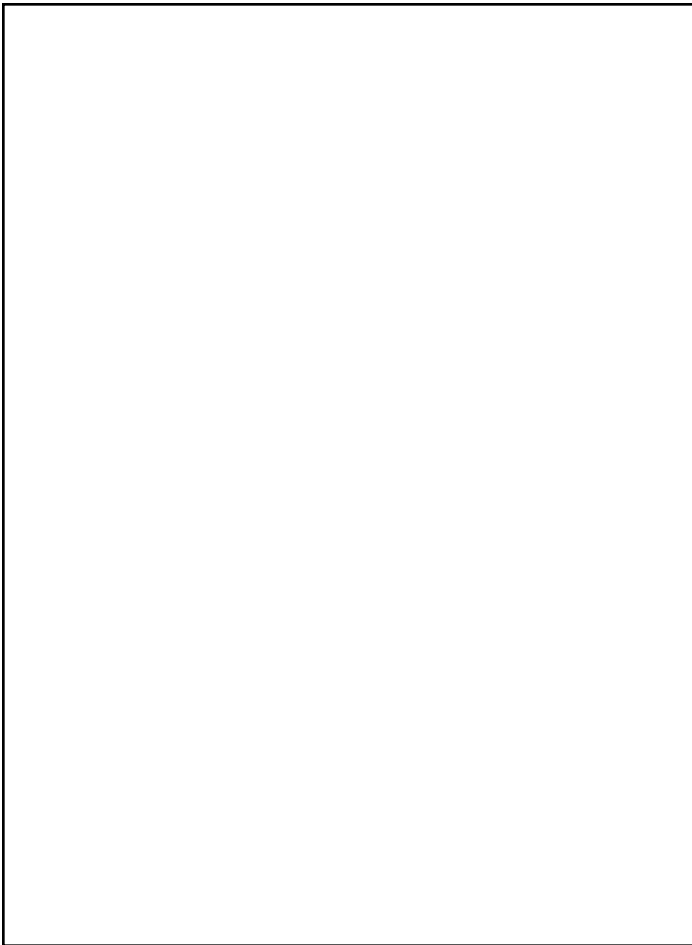
WRITE & DRAW ABOUT IT

Where did we find the most puddles? Draw it here:

Name: _____ Date: _____

PUDDLE COMPARISONS

Draw two puddles you found. Put one puddle in each box.



Circle the ground under this puddle:

- GRASS
- DIRT
- PAVEMENT

Circle the ground under this puddle:

- GRASS
- DIRT
- PAVEMENT

Circle the bigger puddle.

Circle your answer. The water we saw in the puddle was:
STILL or MOVING

Water Finds a Way

Where Does the Water Go? — Informational Reading

BEFORE WE READ

Go outside with your class. Look around. Can you find any puddles or wet spots?

Ask: Where do you think the water goes after it stops raining?

VOCABULARY

puddle · soak · flow · surface

READING PASSAGE

After it rains, everything gets wet.

The rain falls from clouds in the sky. It lands on the grass, the dirt, and the sidewalk.

Then something interesting happens. The water starts to move.

On the grass, the water moves down into the soil. It **soaks** into the soil. The soil holds it. You cannot always see where it goes.

On the sidewalk, the water cannot move through. The sidewalk is too hard. So the water **flows**. It slides across the **surface** and collects in low places.

Those low places are where puddles form.

In East Knoxville, puddles show up on the playground blacktop after a storm. Water collects near the curb on the street. Even the school parking lot gets shiny and wet.

Next time you see a **puddle**, look at what is underneath it. Is it pavement? Is it dirt? Is the water still, or is it moving?

Water always finds a way to go somewhere.

COMPREHENSION QUESTIONS

1. Where do puddles form? _____
2. What happens to water when it lands on grass? _____
3. Why can't water soak through the sidewalk? _____

THINK ABOUT THE WORDS

The passage says "Water always finds a way to go somewhere." What does that mean? Where are some places water can go?

DRAW IT

Draw a puddle you found

Draw where the water came from

CIRCLE ONE

What was under the puddle?

grass dirt pavement

Was the water:

STILL MOVING

TALK IT OUT

Tell a partner: Where did the water go? Use the word flow or soak in your answer.

Hint: "The water _____ on the _____."

Where Does the Water Go?

Grade 1 Printables

Name: _____ Date: _____

CAMPUS MAP

Draw a map of your campus, and mark where you find the puddles.

Name: _____ Date: _____

OBSERVATION TABLE

Draw or write the location of three puddles. Circle the surface, write the width in units (provided by your teacher), and circle whether the water was moving or still.

Sketch / Near (draw or write location)	Surface	Width in _____	Moving or still?
	GRASS DIRT PAVEMENT		MOVING STILL
	GRASS DIRT PAVEMENT		MOVING STILL
	GRASS DIRT PAVEMENT		MOVING STILL

What surface had the most puddles? _____

How wide was the widest puddle? _____

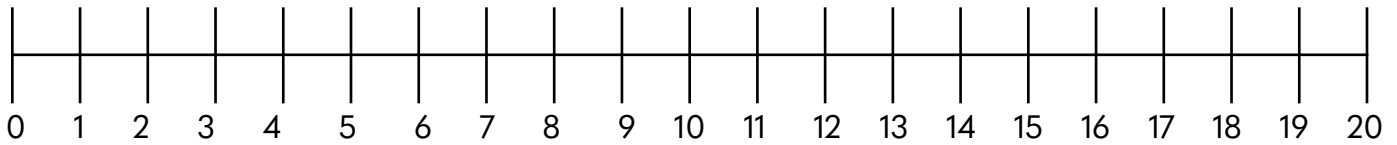
Name: _____ Date: _____

LINE PLOT

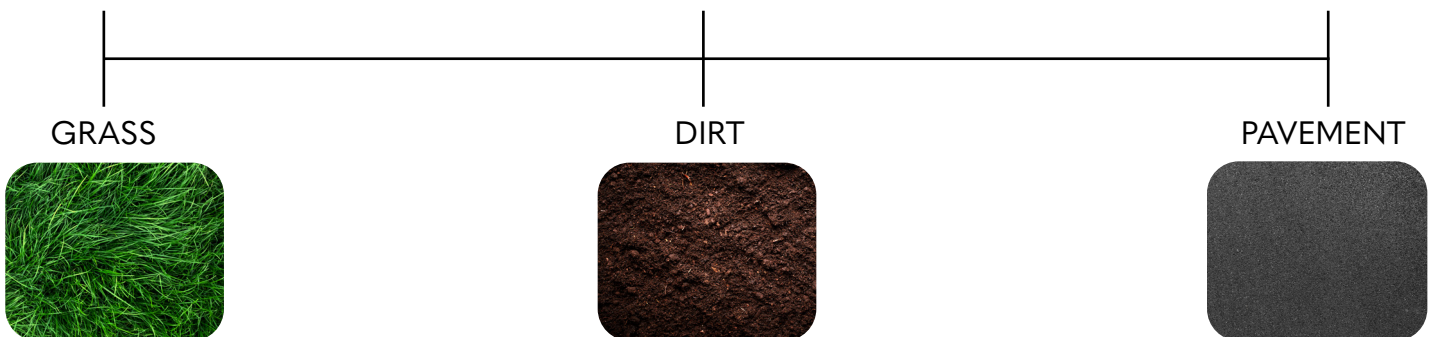
Mark an X for each puddle on the line plots.

Puddle Widths

We measured in _____.



Puddle Surfaces



Most of my puddles were about _____ wide.

I found puddles mostly on _____ surfaces.

Name: _____ Date: _____

WRITE ABOUT IT

WORD BANK

soaks in

runs off

stays still

absorb

surface

Fill in the sentences using the word bank above.

When it rains, water _____ on grass.

Water _____ on pavement.

The grass and dirt _____ more water than pavement does.

DRAW ABOUT IT

Draw what happened to water on one surface you observed.

Two Kinds of Ground

Where Does the Water Go? – Informational Reading

BEFORE WE READ

Think about the puddles you observed outside. Some surfaces had puddles and some didn't. Talk with a partner: why do you think some surfaces collect water and others don't?

VOCABULARY

absorb · runoff · pavement · surface

READING PASSAGE

When rain falls in East Tennessee, it doesn't all go to the same place.

Some of the rain lands on grass or soil. Those surfaces are soft. They have tiny spaces between the pieces of dirt. Water can move into those spaces and soak in. We say the ground **absorbs** the water.

Some of the rain lands on **pavement**. Pavement is hard and smooth: the blacktop at school, the sidewalk out front. There are no spaces for water to move through. The water cannot soak in, so it moves across the **surface** instead. We call that **runoff**.

You can see **runoff** after a rainstorm near the blacktop at school. Water streams across the **surface** and collects wherever the ground is lowest. That is why puddles form in certain places and not others.

Here in East Knoxville, you might notice puddles near the curb on Magnolia Avenue, or at the low end of the playground. Those are places where **runoff** collects.

The grass and garden areas dry faster because the water soaks in instead of sitting on top.

Next time it rains, watch carefully. Where does the water go fastest? Where does it stay the longest?

COMPREHENSION QUESTIONS

1. What happens to rain when it lands on soil? _____
2. What happens when rain lands on pavement? _____
3. Why do puddles form in low places? _____

THINK ABOUT THE WORDS

The passage mentions puddles on Magnolia Avenue. Have you noticed puddles in East Knoxville after a storm? Where were they, and what was underneath them?

CAUSE AND EFFECT

Complete each step. Use words from the passage.

Rain falls on soil. → The soil _____ the water.

Rain falls on pavement. → The water becomes _____.

Runoff collects in low places. → _____ form.

FIND IT IN THE TEXT

Look back at the passage. Find the sentence that explains what "absorb" means.

Write it here: _____

WRITE AND DRAW

Write one sentence explaining the difference between runoff and absorption.

Draw what happens to rain on pavement and on grass. Label each side.

TALK IT OUT

Tell a partner: Where did you notice runoff on our campus today? Use the words absorb, runoff, and pavement.

Sentence starter: "On our campus, I noticed runoff near _____. The water could not _____ because _____."

Where Does the Water Go?

Grade 2 Printables

Name: _____ Date: _____

CAMPUS MAP

Draw a map of your campus, and mark where you find the puddles.

Name: _____ Date: _____

DATA TABLE

Record details about five of the puddles you found.

Location	Surface type (circle which one)	Width in inches	Moving or still? (circle which one)
	GRASS DIRT PAVEMENT SIDEWALK GRAVEL		MOVING STILL
	GRASS DIRT PAVEMENT SIDEWALK GRAVEL		MOVING STILL
	GRASS DIRT PAVEMENT SIDEWALK GRAVEL		MOVING STILL
	GRASS DIRT PAVEMENT SIDEWALK GRAVEL		MOVING STILL
	GRASS DIRT PAVEMENT SIDEWALK GRAVEL		MOVING STILL

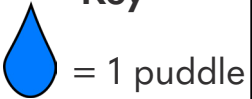
Count your puddles by surface. Make a tally mark for each puddle you found.

GRASS	DIRT	PAVEMENT	SIDEWALK	GRAVEL
<i>Total</i>	<i>Total</i>	<i>Total</i>	<i>Total</i>	<i>Total</i>

Name: _____ Date: _____

PICTOGRAPH

Draw raindrop symbols to fill in your totals from the tally chart.



How many puddles did we find on each surface?

GRASS	DIRT	PAVEMENT	SIDEWALK	GRAVEL

There were _____ more puddles on _____ than _____.

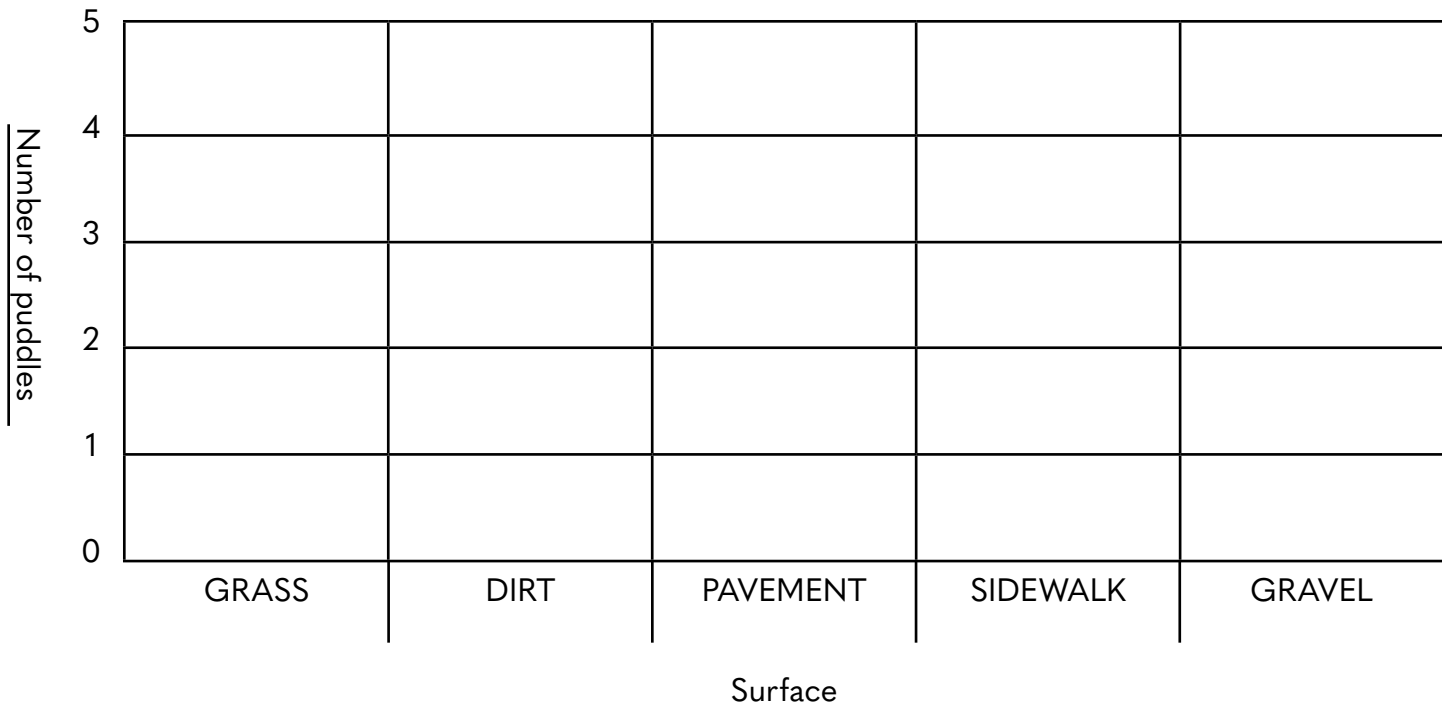
Write your own addition or subtraction problem using your pictograph. Show your work here:

Name: _____ Date: _____

BAR GRAPH

Draw a bar to show the amount of puddles on each surface. A surface with no puddle gets a bar that touches zero.

Puddles Per Surface Graph



The surface with the most puddles had _____ puddles.
 The surface with the fewest puddles had _____.
 The difference is _____.

Use your bar graph to write a number sentence.

_____ + _____ = _____ OR _____ - _____ = _____

Reading the Rain

Where Does the Water Go? – Informational Reading

BEFORE WE READ

Think about the surfaces you observed on our campus. Write or share: what did you notice about where water collected and where it didn't? Why do you think that happened? _____

VOCABULARY

infiltration · impermeable · runoff · sediment

READING PASSAGE

Every time it rains in East Knoxville, something is happening underfoot that most people never notice. When water lands on a soft surface like soil, grass, or gravel, it infiltrates. Infiltration means the water moves down through the layers of soil. From there, plant roots can reach it. Some of it keeps moving deeper into the ground.

When water lands on an **impermeable** surface like concrete or asphalt, it cannot infiltrate. The surface blocks it. So, the water becomes **runoff**. It flows across the surface, picks up speed, and moves toward the lowest point it can find. In cities and towns, there are a lot of **impermeable** surfaces. Rooftops, parking lots, and roads all shed water instead of absorbing it. That water has to go somewhere. In East Knoxville, some of that **runoff** flows toward First Creek and eventually toward the Tennessee River.

Fast-moving **runoff** can cause problems. It carries **sediment**, or loose soil and small particles, with it. It can cause flooding in low areas. It can wash pollutants into waterways.

This is why engineers design systems to slow water down and give it a chance to infiltrate instead of running off. It is one small piece of a much bigger effort to manage what happens to rainwater in our neighborhood.

VOCABULARY IN CONTEXT

Find the word "infiltrates" in the passage. What clue helps you understand what it means?

Write the clue: _____

Now find "impermeable."

Write your own definition using context clues: _____

PUT IT IN ORDER

Number the steps in order (1–5) to show what happens when rain falls on pavement.

- ___ The water carries sediment toward low areas.
- ___ Rain falls on a parking lot.
- ___ Runoff flows toward the lowest point.
- ___ The water cannot infiltrate.
- ___ Runoff reaches a waterway like First Creek.

COMPREHENSION QUESTIONS

1. What is infiltration? Explain in your own words. _____

2. Why can runoff cause problems? _____

3. What do engineers do to help manage runoff? _____

WRITING

Write an introduction sentence, then 2–3 sentences explaining the difference between infiltration and runoff. End with a concluding statement. Use at least two vocabulary words.

Introduction: _____

2–3 sentences: _____

Concluding statement: _____

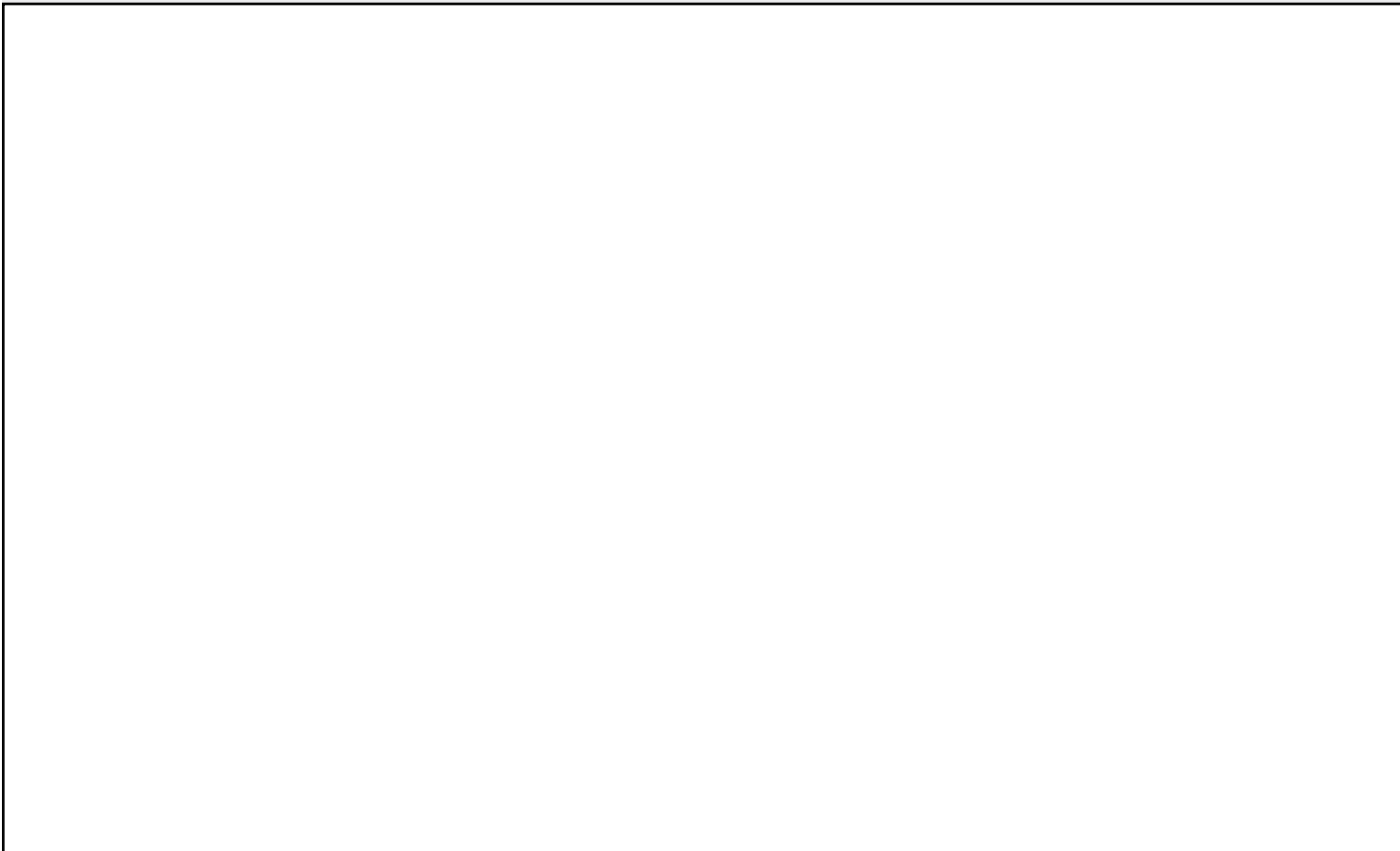
Meet Our Stormwater System

Kindergarten Printables

Name: _____ Date: _____

SYSTEM OBSERVATION

Draw what you see at the GTSS/rain garden.



Circle what you see. *Teacher reads each item aloud while students circle.*

I see



gravel

I see



a tree

I see



soil

Touch the soil carefully. Circle what it feels like.

Name: _____ Date: _____

PLACE COMPARISON

Draw the GTSS/garden area.

Draw the sidewalk/pavement nearby.

How
are they
different?
Tell your
teacher.

Draw where you think rain goes when it falls.

Our School's Special Tree

Meet Our Stormwater System — Informational Reading

BEFORE WE READ

Take students to the GTSS. Ask: What do you notice? What is the tree growing in? What does it feel like?

VOCABULARY

gravel · soak · roots · stormwater

READING PASSAGE

At our school, there is a special tree.

It does not grow in a regular patch of dirt. It grows in a big area of **gravel**. Small rocks surround it on every side.

When it rains at our school, the water does not all flow away. Some of it flows toward the tree. Then it moves down through the **gravel**. It **soaks** into the soil below.

The tree's **roots** are down there. They absorb the water and use it to grow.

Without the **gravel** and the soil, the **stormwater** would flow right across the sidewalk and away. The tree would not get as much water. Our sidewalks might flood!

This system is helping our tree grow and helping our school stay drier after a storm.

COMPREHENSION QUESTIONS

1. What is special about where the tree grows? _____
2. What do the tree's roots do with the water? _____
3. What would happen without the gravel and soil? _____

THINK ABOUT THE WORDS

The passage says our school "stays drier" because of the system. How does gravel help keep the sidewalks from flooding?

DRAW IT

Draw the tree and its roots underground

Draw where the rain goes after it reaches the gravel

CIRCLE ONE

What absorbs the water in the GTSS?
gravel soil roots trunk

TALK IT OUT

Tell a partner: What does the GTSS do when it rains? Use the word soak or roots.

Hint: "When it rains, the water _____ through the gravel and _____."

Meet Our Stormwater System

Grade 1 Printables

Name: _____ Date: _____

SYSTEM SKETCH

WORD BANK

gravel

stormwater

soil

rain gauge

observation well

Draw the GTSS/rain garden. Label at least two parts.

If the GTSS is behind a fence, sketch what you can see from where you are, or sketch the rain garden your class visited.

When rain falls here, the _____ flows toward the _____, allowing it to soak into the ground instead of making a big puddle.

The _____ tells us how much rain fell from the sky, and the _____ tells us how much water flowed into the GTSS/rain garden.

Name: _____ Date: _____

RAIN GAUGE

The rain gauge reads: _____.

Circle:

MORE than last time

LESS than last time

ABOUT THE SAME /
FIRST TIME

TREE TRUNK

We measured around the trunk (circumference). The measurement was:
_____.

MORE than last time

LESS than last time

FIRST TIME

WATER LEVEL

Circle what you saw in the observation well:

HIGH

MEDIUM

LOW

Circle what you think this means:

the water soaked into the soil

the water is still there near the surface

No observation well? Gently press the soil in the rain garden. Circle what it feels like: WET / DAMP / DRY. Circle what you think this means: the water soaked into the soil / the soil is still holding water near the surface.

Name: _____ Date: _____

COMPLETE THE SENTENCES

WORD BANK

soak

grow

reduce flooding

absorb

manage stormwater

The GTSS helps stormwater _____ into the ground.

The tree uses that water to _____.

Scientists and engineers built this system to _____.

Built on Purpose

Meet Our Stormwater System — Informational Reading

BEFORE WE READ

Look at the GTSS. What do you think it was designed to do?
Talk with a partner: who do you think built this, and why?

VOCABULARY

stormwater · gravel · observation well · roots

READING PASSAGE

Some things at our school happened by accident. Some things were built on purpose, to solve a problem.

The Gravel Tree Stormwater System was built on purpose.

Here is the problem it was built to solve: when rain falls on our school's pavement, the water cannot soak in. It flows quickly across the surface. If too much water moves too fast, it can flood sidewalks and carry dirt into nearby creeks.

Scientists and engineers from the University of Tennessee and the United States Forest Service noticed this problem. They designed a system to slow the water down. They dug a space in the pavement, filled it with **gravel** and soil, and planted a tree in the middle.

Now, when rain falls nearby, the **stormwater** flows toward the **gravel** instead of rushing away. The water moves down through the **gravel** and into the soil. The tree's **roots** absorb it.

The **observation well** in the system lets us see the water level underground. When it rains a lot, the water level goes up. On dry days, it drops as the **roots** absorb it.

This is how scientists and engineers manage **stormwater** — by building a solution right here at our school in East Knoxville.

COMPREHENSION QUESTIONS

1. What problem did the GTSS solve? _____
2. What happens when stormwater reaches the gravel? _____
3. What does the observation well show us? _____

THINK ABOUT THE WORDS

The passage says the GTSS was "built on purpose." What does that tell you about the difference between something that was designed and something that just happened?

CAUSE AND EFFECT

Complete each step. Use words from the passage.

Rain falls on pavement. → Water cannot soak in. → The water _____.

Stormwater reaches the gravel. → The water slows and moves _____.

It rains a lot. → The water level goes _____.

FIND IT IN THE TEXT

Who built the GTSS? Find the answer in the passage and write it here:

WRITE AND DRAW

Write one sentence explaining what the GTSS does when it rains.

Draw the GTSS and label: gravel, roots, observation well, soil.

TALK IT OUT

Tell a partner: What would happen to that area if the GTSS wasn't there? Use the words stormwater, flood, and roots.

Sentence starter: "Without the GTSS, the stormwater would _____, and the tree would _____."

Meet Our Stormwater System

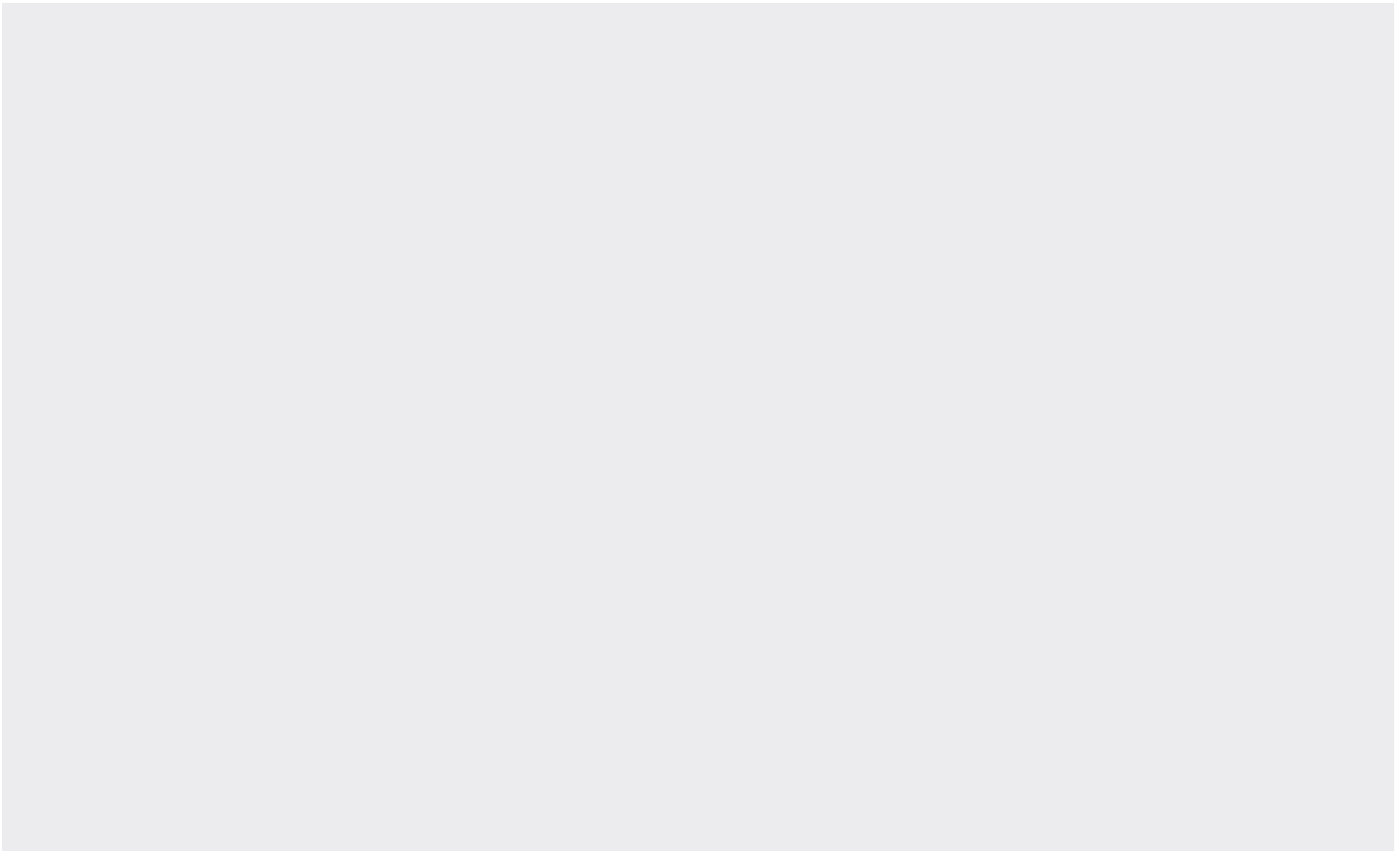
Grade 2 Printables

Name: _____ Date: _____

SYSTEM SKETCH

Draw and label the GTSS/rain garden. Include at least four parts.

gravel soil tree rain gauge observation well plants



If the GTSS is behind a fence, sketch what you can see from where you are, or sketch the rain garden your class visited.

Describe one thing you noticed: _____
_____.

Name: _____ Date: _____

MEASUREMENT TABLE

Circle the units you used at the top of each column: in / cm

Measurement	Today (in / cm)	Last time (in / cm)	More, less, or same?
Rainfall (rain gauge)			more / less / same (circle one)
Water level (observation well)			more / less / same (circle one)
Trunk circumference (circle units: in / cm)			more / less / same (circle one)

Circumference means the distance around the trunk.

No observation well? Skip the water level row and describe the rain garden soil instead: the soil felt _____ (WET / DAMP / DRY). I think this means _____.

MAKE A CONNECTION

What connection do you see between rainfall and water level? _____

Name: _____ Date: _____

INFORMATIVE WRITING

WORD BANK

gravel

soil

filtration

water level

runoff

engineered

solution

The Gravel Tree Stormwater System works by _____.

This helps the tree because _____.

Without this system, the rainwater would _____.

Write your explanation using the sentence frames above. Use at least two vocabulary words.

A System That Works

Meet Our Stormwater System — Informational Reading

BEFORE WE READ

You have visited the GTSS and taken measurements. Before reading, write or share: what do you think is happening inside the system that you cannot see? _____

VOCABULARY

stormwater · filtration · water level · engineered solution

READING PASSAGE

Most people walk past the Gravel Tree **Stormwater** System without really seeing it.

They see a tree. They see gravel. They keep walking.

But if you slow down and look at what is actually happening, it is more interesting than it appears.

When rain falls on the pavement near the GTSS, the water flows downhill toward the gravel opening. This is not an accident. The pavement was designed to slope that direction. The **stormwater** enters the gravel bed and begins moving downward. As it passes through the gravel and then the soil beneath, two things happen: the water slows down, and particles of dirt and debris are filtered out of it. This is **filtration**.

Below the soil, the tree's roots spread through the ground. They absorb the water that has filtered through. Because the system delivers water directly to the root zone, the tree gets consistent moisture even during dry periods.

Meanwhile, the water that would have rushed across the pavement and into the storm drain is doing something more useful instead. It is refilling the soil with water. It is feeding a tree. Because it is moving slowly and being filtered, it carries fewer pollutants toward First Creek and the Tennessee River.

Scientists at the University of Tennessee helped design this system. Your school was one of the first in East Knoxville to have one.

The observation well gives you a way to see inside. When the **water level** is high after rain, the system is working. When it drops during dry weather, the tree and soil are using what was stored.

That is an **engineered solution** doing exactly what it was designed to do.

VOCABULARY IN CONTEXT

Find "filtration" in the passage. The passage describes two things that happen as water moves through gravel and soil. Write them here: _____

COMPREHENSION QUESTIONS

- 1. What is filtration, and where does it happen in the GTSS? _____
- 2. Why does the tree stay healthy even when it hasn't rained recently? _____
- 3. What happens to pollutants when water passes through the system? _____

PUT IT IN ORDER

Number the steps in order (1–5) to show how the GTSS works during a rainstorm.

- ___ The tree's roots absorb the filtered water.
- ___ Rain falls on pavement near the GTSS.
- ___ Particles are filtered out as water moves through soil.
- ___ Water slows down as it enters the gravel bed.
- ___ Water flows downhill toward the gravel opening.

WRITING

Write 3–4 sentences explaining how the GTSS works and why it is called an engineered solution. Use at least two vocabulary words. _____

THINK ABOUT THE WORDS

The passage says the pavement was "designed to slope" toward the GTSS. Why does the slope matter? What would happen if it sloped the other way? _____

Engineering Clean Water

Kindergarten Printables

Name: _____ Date: _____

BEFORE WE TEST

Circle which material you think will make the CLEANEST water:

GRAVEL

SAND

SOIL

WHAT I FOUND

Draw what a filter does — show dirty water going in and what comes out:

The water that came out of the filter was:

CLEANER

THE SAME

DIRTIER

The best filter was:

Name: _____ Date: _____

DURING TESTING – Draw the water that came out of each filter

GRAVEL

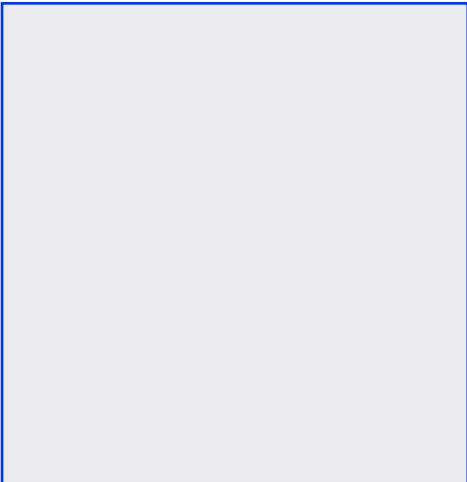
SAND

SOIL

Draw the water in the cup:

Draw the water in the cup:

Draw the water in the cup:



COMPARE

Circle the drawing above with the **CLEAREST water.**

The clearest water came from:

GRAVEL was clearest SAND was clearest SOIL was clearest

What Filters Do

Engineering Clean Water — Informational Reading

BEFORE WE READ

Show students a cup of dirty water. Ask: Would you want to drink this?
What do you think could make it cleaner?

VOCABULARY

filter · material · clear · trap

READING PASSAGE

When water runs across our schoolyard, it picks up dirt. It picks up tiny bits of soil. It might pick up other things too.

By the time it reaches a puddle, that water is not clean.

But something interesting happens when dirty water moves through certain **materials**.

If you pour dirty water through gravel, the big pieces of dirt get **trapped** between the rocks. Some of them cannot fit through. The water that comes out the other side looks a little more **clear**.

If you pour it through sand, even more particles get caught. The water moves more slowly, but it comes out cleaner still.

Gravel and sand are natural **filters**. They catch what is in the water and let the water pass through.

This is why the GTSS at our school uses gravel and soil. When stormwater flows through those **materials**, it gets a little cleaner before it reaches the tree roots underground.

COMPREHENSION QUESTIONS

1. What does a filter do? _____
2. What happens to dirt when water flows through gravel? _____
3. Why does the GTSS use gravel and soil? _____

THINK ABOUT THE WORDS

The passage says gravel and sand are "natural filters." What do you think "natural" means here? Can you think of other natural materials that might filter water?

DRAW IT

Draw dirty water going into a filter

Draw clean water coming out

CIRCLE ONE

What does a filter do?

traps dirt

makes water heavier

makes water faster

Was the water clearer before or after filtering?

BEFORE

AFTER

TALK IT OUT

Tell a partner: Which material made the cleanest water? Use the word filter or trap in your answer.

Hint: "I think _____ worked best because it _____ the dirt."

Engineering Clean Water

Grade 1 Printables

Name: _____ Date: _____

MY HYPOTHESIS

I think _____ will let water through the fastest.

I think _____ will make the water the clearest.

I think the worst filter will be _____.

Word Bank:

gravel · sand · soil

RESULTS TABLE

Material	How fast? (circle one)	How clear? (circle one)	Particles visible?
Gravel	fast / medium / slow	clear / a little cloudy / very cloudy	yes / no
Sand	fast / medium / slow	clear / a little cloudy / very cloudy	yes / no
Soil	fast / medium / slow	clear / a little cloudy / very cloudy	yes / no
Layers (if tested)	fast / medium / slow	clear / a little cloudy / very cloudy	yes / no

Name: _____ Date: _____

CONCLUSIONS

The fastest material was _____.

The material that made the clearest water was _____.

The best overall filter was _____.

I think this worked best because:

This connects to our school's GTSS because the GTSS uses _____ to filter stormwater, just like our experiment:

Word Bank:

gravel · soil · layers · filter · particles

Testing the Filters

Engineering Clean Water — Informational Reading

BEFORE WE READ

Scientists make predictions before they test. Think about your filter experiment.
Talk with a partner: which material surprised you the most, and why?

VOCABULARY

filter · hypothesis · particle · speed

READING PASSAGE

Scientists do not just guess. They test.

Before they test, they make a prediction called a **hypothesis**. A **hypothesis** is your best thinking about what will happen before you find out if you are right.

Today you made a **hypothesis** about which material would **filter** water best. Then you tested it.

Here is what usually happens in a filtration experiment like this one:

Gravel has the largest pieces, so water moves through it quickly. But the spaces between gravel pieces are large too, so only the biggest particles get trapped. The water comes out faster (at a higher **speed**), but is not always the clearest.

Sand has much smaller pieces. The spaces between them are tiny. Water moves through more slowly (at a lower **speed**), but more particles get caught. The water that comes out tends to be clearer.

Soil is different. It has a mix of **particle** sizes and it holds water for a while before releasing it. It can **filter** well, but it is also the slowest.

One common layered design puts gravel on top, sand in the middle, and soil at the bottom. The gravel catches the big pieces. The sand catches the medium ones. The soil catches what is left.

This is not just a classroom experiment. The layers you tested today are a simplified model of what happens in the ground beneath the GTSS on our campus.

COMPREHENSION QUESTIONS

1. What is a hypothesis, and why do scientists make one before testing? _____

2. Why does water move more slowly through sand than through gravel? _____

3. Where does filtration happen at our school? _____

CAUSE AND EFFECT

Complete each step. Use words from the passage.

Gravel has large spaces. → Water moves through it _____.

Sand has very small spaces. → More _____ get caught.

A layered filter combines materials. → Each layer catches _____.

FIND IT IN THE TEXT

The passage explains what a hypothesis is. Write that definition in your own words:

WRITE AND DRAW

Write one sentence explaining why a layered filter works better than a single material.

Draw a layered filter. Label: gravel, sand, soil. Show where dirt gets caught in each layer.

TALK IT OUT

Tell a partner: What was your hypothesis, and did the results match it? Use the words hypothesis, particle, and flow rate.

Sentence starter: "My hypothesis was _____. The results showed _____ because _____."

Engineering Clean Water

Grade 2 Printables

Name: _____ Date: _____

EXPERIMENTAL DESIGN

I predict that _____ will produce the clearest water in the shortest time because:

In our fair test, the one thing we changed was:

The things we kept the same were:

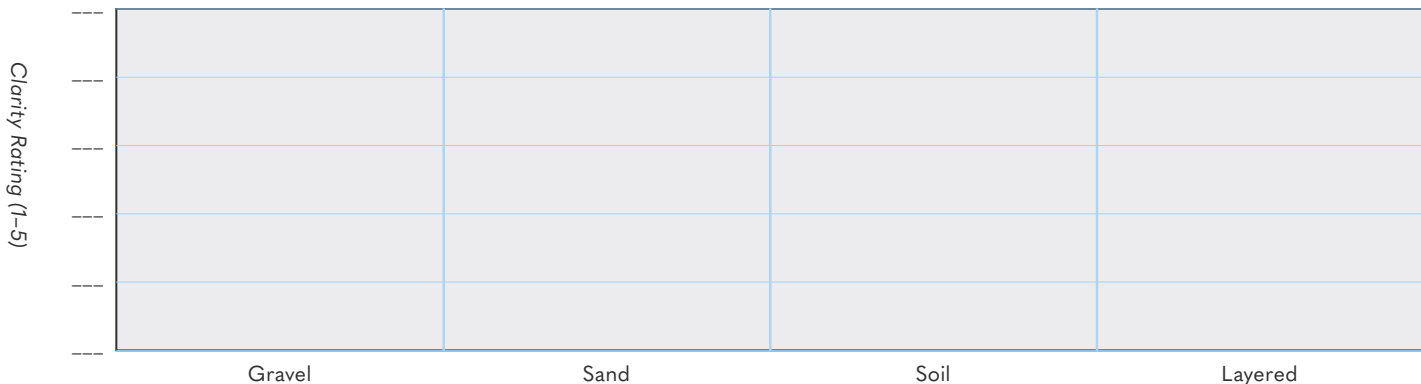
RESULTS TABLE

Material	Flow time (seconds)	Clarity rating 1-5	Particles visible?	Matches hypothesis?
Gravel			yes / no	yes / no
Sand			yes / no	yes / no
Soil			yes / no	yes / no
Layered design			yes / no	yes / no

Clarity: 1=very cloudy 2=cloudy 3=a little cloudy 4=mostly clear 5=clear

Name: _____ Date: _____

BAR GRAPH – Clarity Rating by Material



Which material had the highest clarity rating? _____

Which had the fastest flow time? _____

Was there a tradeoff between clarity and speed? Explain:

INFORMATIVE WRITING

In our experiment, we tested _____ different filter materials.

The material that worked best for clarity was _____ and the fastest was _____.

We found that

The GTSS at our school uses _____ to filter stormwater because:

Word Bank: gravel · soil · biofiltration · particles · runoff · filtration

Designing Clean Water

Engineering Clean Water — Informational Reading

BEFORE WE READ

In your experiment, you changed one thing (the filter material) and kept everything else the same.

Before reading, write or share: why do you think it matters to change only one thing at a time? _____

VOCABULARY

biofiltration · tradeoff · fair test · clarity

READING PASSAGE

Every experiment starts with a question.

Yours was: which material filters stormwater most effectively?

To answer it properly, you had to make your experiment a **fair test**. You used the same amount of water in each test. You used the same size funnel. You changed only one thing, the filter material, so that any difference in results came from the material itself, not something else. After you repeat the test and record the results for each material, you can compare the different materials fairly.

What you discovered is something engineers who work on green infrastructure already know: there is almost always a **tradeoff**.

Materials that filter very finely, like tightly packed soil, tend to slow the flow rate but improve the **clarity** of the water. Materials that let water move quickly, like coarse gravel, trap fewer fine particles. A layered design is usually the best compromise, where each layer does what the others cannot.

This principle shows up directly in the Gravel Tree Stormwater System. The gravel layer near the surface allows fast initial movement and catches larger debris. The soil layer below filters more finely and holds water long enough for roots to absorb it. The system was not designed by guessing. It was designed by testing materials and understanding their **tradeoffs**, the same process you followed today.

Biofiltration, the use of natural materials to filter water as it moves through them, is one of the key tools in managing urban stormwater. First Creek runs through East Knoxville before joining the Tennessee River. What happens to that water, such as its **clarity** and how fast it moves, is shaped by systems like the one at your school.

VOCABULARY IN CONTEXT

The passage explains a "tradeoff" through two examples. Write both examples here:

Example 1: _____

Example 2: _____

COMPREHENSION QUESTIONS

1. What does it mean to have a fair test, and why does it matter? _____
2. What is the tradeoff between flow rate and filtration clarity? _____
3. What is biofiltration, and where does it happen near your school? _____

PUT IT IN ORDER

Number the steps in order (1–4) to describe how a fair test works.

- ___ Record results for each material.
- ___ Change only one thing, the filter material.
- ___ Keep everything else the same.
- ___ Compare results to draw a conclusion.

WRITING

Write 3–4 sentences explaining what you found in your experiment and how it connects to the GTSS. Use at least two vocabulary words. _____

THINK ABOUT THE WORDS

The passage says the GTSS was "designed by testing materials and understanding their tradeoffs." What does that tell you about how engineering works? _____

Flood Prevention Engineering

Kindergarten Printables

Name: _____ Date: _____

BEFORE WE BUILD

Draw your group's plan. Show where the water should go. Use arrows.



WE WILL USE THESE MATERIALS – Circle the ones your group chose:

GRAVEL

SOIL

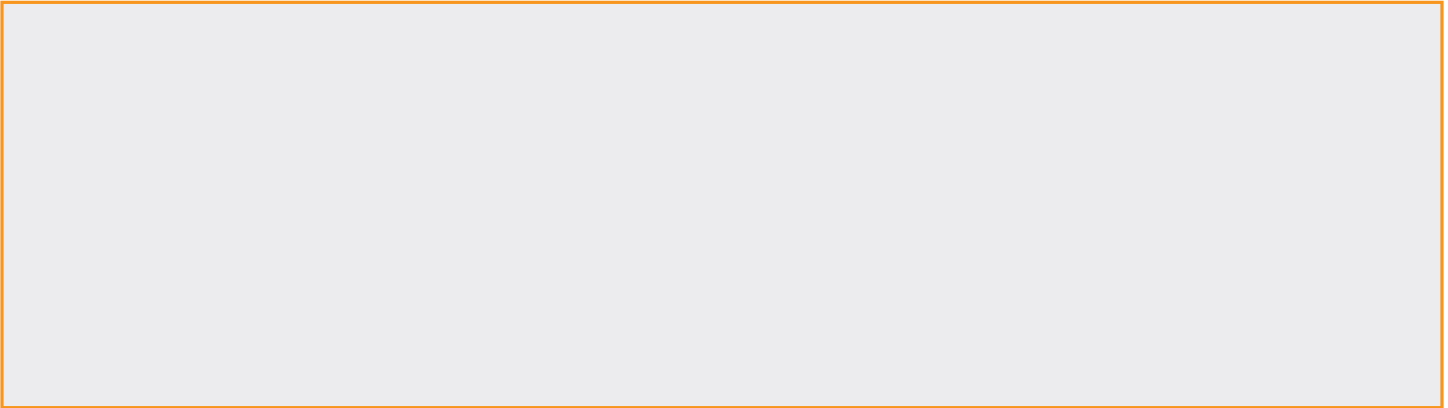
STICKS

ROCKS

OTHER (draw it)

Name: _____ Date: _____

AFTER WE TEST – Draw what the water did:



Water moved AWAY from the building:

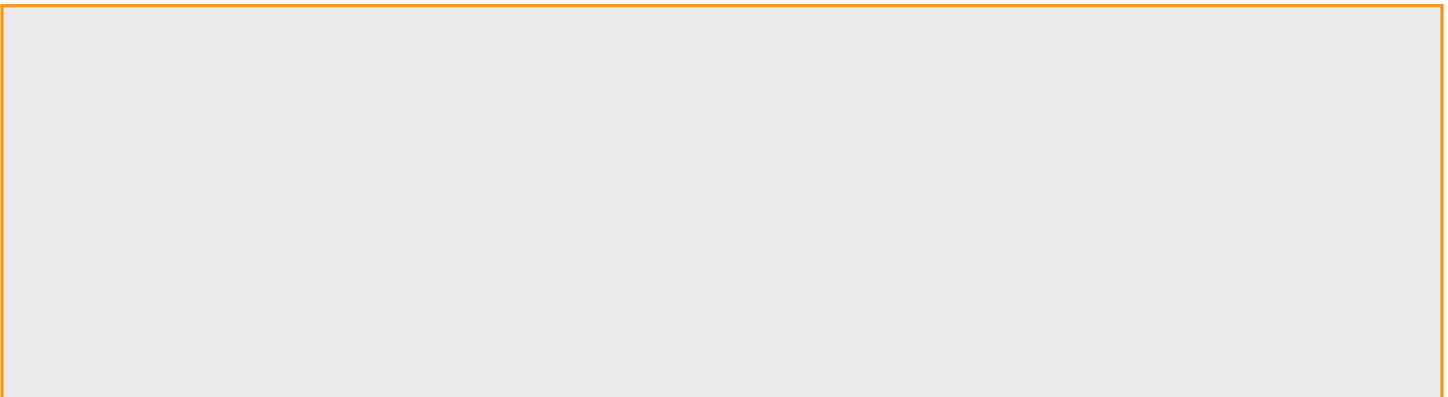
YES NOT YET

Water reached the PLANT ZONE:

YES NOT YET

WHAT WE WOULD CHANGE

Draw your improved design. Show what you changed.



If we tested again, we would _____ (tell your teacher or add to your drawing).

Building for the Rain

Flood Prevention Engineering – Informational Reading

BEFORE WE READ

Show students the model tray with the building and plant zone.

Ask: Where does the water go right now when we pour it in? Where would we want it to go instead?

VOCABULARY

design · protect · flow · material

READING PASSAGE

Rain is coming.

When rain falls on our school, some water flows toward the building. That is not good. Water near a building can cause damage. It gets our shoes and pants wet!

Where should the water go instead?

It should go toward the plants. Plants need water to grow. If rainwater flows toward the plant zone, the plants can use it. The water soaks into the soil and reaches the roots.

People who **design** and build things think about this kind of problem. They ask: where is the water going? Where do we want it to go? Then they make up, or **design**, a system to guide it there.

Today, you did that.

You used **materials** like gravel, soil, and sticks to build a pathway. You wanted the water to **flow** away from the building and toward the plants. You **protected** the building from the water.

Did your **design** work? That is what testing is for.

COMPREHENSION QUESTIONS

1. Why is it a problem when water flows toward the building? _____
2. Where do we want the water to go instead? _____
3. What materials did you use to build your pathway? _____

THINK ABOUT THE WORDS

The passage says "That is what testing is for." Why do we need to test a design after we build it?

DRAW IT

Draw the problem: water flowing toward the building

Draw your solution: water flowing toward the plants

CIRCLE THE MATERIALS YOU USED

gravel soil sticks rocks

TALK IT OUT

Tell a partner: Did your design work? What would you change? Use the word flow or design.

Hint: "Our design worked / did not work because the water _____. Next time, we would _____."

Flood Prevention Engineering

Grade 1 Printables

Name: _____ Date: _____

DESIGN PLAN

Draw your design. Label the materials. Use arrows to show where water will flow.



Materials we chose:

We think the water will:

Word Bank:

gravel · soil · sticks · rocks · pathway · barrier · slow down · soak in

Name: _____ Date: _____

TEST RESULTS

Water moved away from building:

YES PARTLY NO

Water reached plant zone:

YES PARTLY NO

What did the water actually do?

Did this match your prediction? YES / NO. What was different?

IMPROVE

One thing we changed:

We changed it because:

After the change — Water moved away from building:

YES PARTLY NO

After the change — Water reached plant zone:

YES PARTLY NO

Name: _____ Date: _____

CONCLUSION

Our best design used _____ and _____.

It worked because:

One thing we would still change is:

Word Bank:

gravel · soil · sticks · rocks · pathway · barrier · slow down · soak in

Design, Test, Improve

Flood Prevention Engineering – Informational Reading

BEFORE WE READ

Think about your design test. Did your first design work perfectly?

Talk with a partner: what did you change between Round 1 and Round 2, and why?

VOCABULARY

solution · design · criteria · improve

READING PASSAGE

Engineers do not always get it right the first time.

That is not a problem. That is the process!

When engineers face a challenge, like moving rainwater away from a building and toward plants, they start by **designing** a **solution**. A **solution** is a way to fix a problem, but a good engineer will make sure it solves the problem *and* meets the **criteria**, or the checklist that ensures the job is done well. They draw a plan. They choose materials. They think about where the water will go. Then they test it.

Sometimes the water goes exactly where they planned. Sometimes it does not. Maybe it moves too fast and misses the plant zone. Maybe it pools near the building instead of flowing away.

That is when engineers **improve**. They look at what happened, figure out why, and change one thing. Then they test again.

This is called the **design-test-improve** cycle, and it is how almost every real engineering solution gets built. The Gravel Tree Stormwater System at our school was not built perfectly on the first try. Engineers designed it, studied how it worked, and continued to refine it based on evidence.

Your **design** today followed the same process. You built something, you tested it, and if it didn't work the way you hoped, you improved it.

COMPREHENSION QUESTIONS

1. What do engineers do when their first design doesn't work? _____

2. What does the design-test-improve cycle mean? _____
3. How did your design connect to the real GTSS at our school? _____

CAUSE AND EFFECT

Complete each step. Use words from the passage.

The first design doesn't work. → Engineers _____ the design.

Engineers change one thing. → They _____ again.

Testing shows what went wrong. → Engineers use _____ to improve.

FIND IT IN THE TEXT

Describe the design-test-improve cycle in your own words. Write the three steps:

Step 1: _____

Step 2: _____

Step 3: _____

WRITE AND DRAW

Write one sentence explaining what the design-test-improve cycle means.

Draw your Round 1 design and your Round 2 design. Label what you changed.

TALK IT OUT

Tell a partner: What were the two criteria your design needed to meet? Did you meet both? Use the words criteria, improve, and engineer.

Flood Prevention Engineering

Grade 2 Printables

Name: _____ Date: _____

ENGINEERING BRIEF

The problem we are solving:

Criteria — our design must:

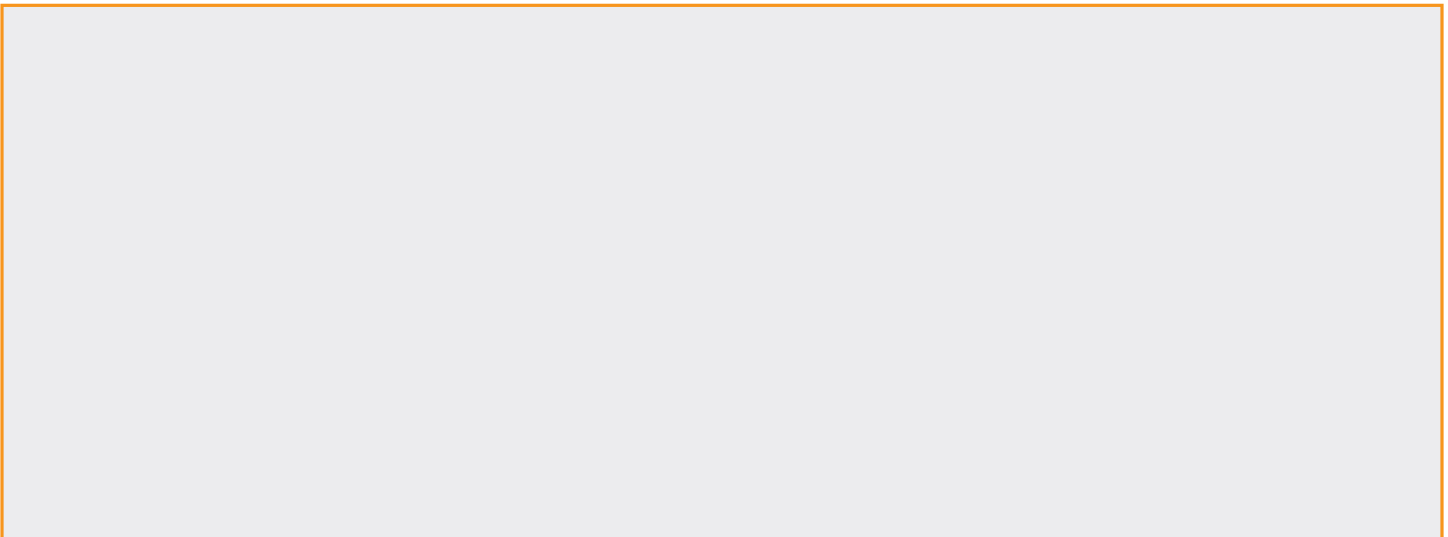
1. _____
2. _____

Constraints — our limits are:

Materials we plan to use:

DESIGN SKETCH

Draw and label your design. Use arrows to show water flow direction.



Hypothesis: I predict our design will _____ because:

Name: _____ Date: _____

TEST RESULTS – TWO ROUNDS

Round	Water reached plant zone?	Water stayed away from building?	What we observed	What we changed next round
Round 1	yes / partly / no	yes / partly / no		
Round 2	yes / partly / no	yes / partly / no		—

COMPARING SOLUTIONS

Round 1 Design

Water reached plant zone: yes / partly / no
 Water away from building: yes / partly / no
 Description: _____

Round 2 Design

Water reached plant zone: yes / partly / no
 Water away from building: yes / partly / no
 Description: _____

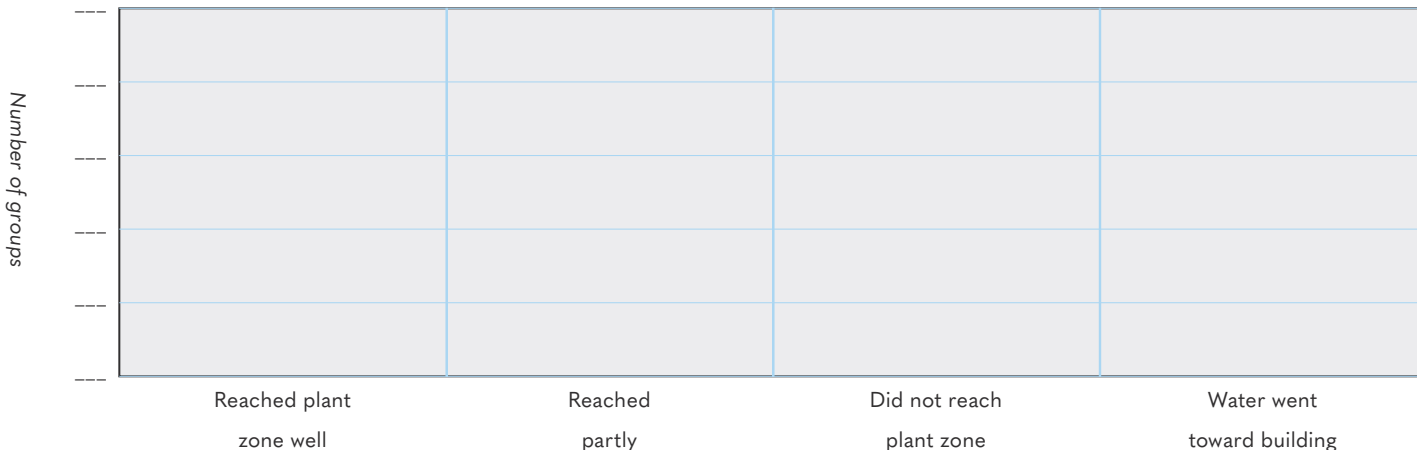
The better design was Round ___ because the evidence showed:

It worked better than the other design because:

Name: _____ Date: _____

CLASS COMPARISON GRAPH – Our Class Designs

Your teacher will share how many groups landed in each category. Draw a bar for each.



How many groups had water reach the plant zone (well or partly)?
 ___ + ___ = ___

How many MORE groups reached the plant zone well than did not?
 ___ - ___ = ___

INFORMATIVE WRITING

Engineers design systems to solve problems. Our problem was

Our best design worked by

We improved it by

This connects to the GTSS because

A Problem Worth Solving

Flood Prevention Engineering – Informational Reading

BEFORE WE READ

Think about your two test rounds. Write or share: what evidence did you use to decide which design was better? How did you know it was working? _____

VOCABULARY

criteria · constraint · infiltrate · evidence

READING PASSAGE

In East Knoxville, rain is not an unusual event. Knoxville receives about 47 inches of rain each year. That's more than Seattle and more than Chicago!

All of that rain has to go somewhere.

On natural land covered by grass, soil, and trees, rain **infiltrates** into the ground or moves slowly through plant roots. The landscape absorbs and slows it. But in neighborhoods with lots of pavement, buildings, and hard surfaces, rain cannot **infiltrate** easily. It becomes runoff. It accumulates near buildings, flows into storm drains, and rushes toward waterways like First Creek.

This is a real engineering problem, and it has real consequences.

Engineers who design stormwater systems work within **criteria** and **constraints**, just like you did today. The **criteria** define what a design must accomplish. The **constraints** define its limits, like the available materials, the space, and the cost.

A good design meets its **criteria** within its **constraints**. When it doesn't, engineers collect **evidence** from testing, figure out what went wrong, and improve the design. Then they test again.

Your model tray was not a campus. The watering can was not a storm. But the thinking was the same: define the problem, design a solution, test it, and use **evidence** to make it better.

The GTSS was built by people who went through that same cycle. It is still being studied and refined today.

VOCABULARY IN CONTEXT

The passage uses "criteria" and "constraints" together. In your own words, what is the difference between them?

COMPREHENSION QUESTIONS

1. Why does rain cause more problems in urban neighborhoods than in natural landscapes? _____

2. What does evidence from testing tell an engineer? _____
3. How is your model tray related to the real GTSS? _____

PUT IT IN ORDER

Number the steps in order (1–4) to describe the design-test-improve cycle.

- ___ Improve the design based on what the evidence showed.
- ___ Define the problem and design a solution.
- ___ Test the design and collect evidence.
- ___ Test the improved design.

WRITING

Write 3–4 sentences explaining the problem your design was solving and how you used evidence to improve it. Use at least two vocabulary words. _____

THINK ABOUT THE WORDS

The passage says the GTSS "is still being studied and refined today." What does that tell you about engineering solutions? Do you think a design is ever truly finished? _____
