

Lesson 2: Where's The Water Audit

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Purpose

Students will understand the connection between the water cycle and human consumption of water as a natural resource.

Objective

Students will measure and record water use in their home by evaluating monthly water bills and daily water use and reading water meters. Students understand the connection between themselves and water as a limited natural resource.

Arkansas Framework Correlation

Language Arts

4th Grade

OV.1.4.2 Adjust language and vocabulary to fit an audience, topic, or purpose

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OV.1.4.9 Encourage others to participate in discussions (i.e., avoid monopolizing the conversation and raise pertinent questions)

OV.1.4.12 Ask and answer relevant questions and make contributions in small or large group discussions

OV.2.4.2 Listen and evaluate information

W.4.4.3 Select relevant information from a variety of sources

W.5.4.1 Write for a general audience (i.e., newspaper and website, etc.)

W.6.4.1 Use a variety of simple, compound, and complex sentences (i.e., completeness and standard word order, etc.)

W.7.4.6 Use purposeful vocabulary

5th Grade

OV.1.5.2 Use standard English in classroom discussion

OV.1.5.6 Contribute appropriately to class discussion

OV.2.5.1 Demonstrate effective listening skills by exhibiting appropriate body language

OV.3.5.1 View a variety of media (e.g., posters, film clips, periodicals, charts, cartoons, etc.) to enhance and show understanding of a specific topic

W.4.5.1 Generate ideas using such strategies as reading, discussing, *focused free-writing*, observing, and brainstorming

W.5.5.1 Write to describe, to inform, to entertain, to explain, and to persuade

W.6.5.1 Use a variety of simple and compound sentences of varied lengths

W.7.5.4 Use purposeful vocabulary for emphasis or elaboration

6th Grade

OV.1.6.2 Use standard English in classroom discussion

OV.1.6.6 Contribute appropriately to class discussion

OV.2.6.1 Demonstrate effective listening skills by exhibiting appropriate body language

OV.3.6.1 View a variety of media (e.g., posters, film clips, periodicals, charts, cartoons, graphs, statistics, etc.) to enhance and show understanding of a specific topic

W.4.6.1 Generate ideas using such strategies as reading, discussing, *focused free-writing*, observing, brainstorming, and reading logs

W.4.6.3 Demonstrate an awareness of purpose and audience for all modes of written *discourse*

W.4.6.14 Publish/share according to purpose and audience

Mathematics

4th Grade

NO.2.4.3 Use conventional mathematical symbols to write *equations* for *contextual problems* involving multiplication

NO.3.4.4 Solve simple problems using operations involving addition, subtraction, and multiplication using a variety of methods and tools (e.g., objects, mental computation, paper and pencil and with and without appropriate *technology*)

NO.3.4.5 Use *estimation strategies* to solve problems and judge the reasonableness of the answer

A.6.4.1 Create a chart or table to organize given information and to understand relationships and explain the results

M.12.4.2 Distinguish the temperature in contextual problems using the Fahrenheit scale on a thermometer

M.13.4.1 Using a calendar to determine *elapsed time* from month to month

M.13.4.2 Solve problems involving conversions between minutes and hours

M.13.4.6 Read temperatures on Fahrenheit and Celsius scales

5th Grade

NO.1.5.3 Identify decimal and *percent equivalents* for *benchmark fractions*

NO.3.5.3 Solve, with and without appropriate *technology*, two-step problems using a variety of methods and tools

A.4.5.1 Solve problems by finding the next term or missing term in a *pattern* or *function* table using real world situations

A.6.5.1 Draw conclusions and make predictions, with and without appropriate *technology*, from models, tables and *line graphs*

M.12.5.2 Make conversions within the customary measurement system in real world problems Ex. hours to minutes, feet to inches, quarts to gallons, etc

M.12.5.4 Understand when to use linear units to describe *perimeter*, square units to describe *area* or *surface area*, and cubic units to describe *volume*, in real world situations

DAP.14.5.2 Collect *numerical* and *categorical data* using surveys, observations and experiments that would result in *bar graphs*, *line graphs*, *line plots* and *stem-and-leaf plots*

DAP.15.5.1 Interpret graphs such as *line graphs*, *double bar graphs*, and *circle graphs*

DAP.16.5.1 Make predictions and justify conclusions based on data

6th Grade

NO.1.6.1 Demonstrate conceptual understanding to find a specific *percent* of a number, using models, real life examples, or explanations

NO.3.6.3 Solve, with and without appropriate *technology*, multi-step problems using a variety of methods and tools (i.e., objects, mental computation, paper and pencil)

NO.3.6.7 Determine the *percent* of a number and solve related problems in real world situations

A.4.6.1 Solve problems by finding the next term or missing term in a *pattern* or *function* table using real world situations

M.12.6.1 Identify and select appropriate units and tools from both systems to measure Ex. angles with degrees, distance with feet/meters

M.12.6.2 Make conversions within the same measurement system in real world problems Ex. hours to minutes to seconds, meters to centimeters, feet to inches, liters to milliliters, quarts to gallons, etc

M.13.6.2 Determine which unit of measure or measurement tool matches the context for a problem situation

DAP.15.6.1 Interpret graphs such as *double line graphs* and *circle graphs*

DAP.16.6.1 Use observations about differences in data to make justifiable inferences

Science

4th Grade

NS.1.4.1 - Communicate observations orally, in writing, and in graphic organizers:

- T-charts
- pictographs
- Venn diagrams
- bar graphs
- frequency tables
- line graphs

NS.1.4.2 - Refine questions that guide scientific inquiry

NS.1.4.3 - Conduct scientific investigations individually and in teams: lab activities, field studies

NS.1.4.5 - Communicate the designs, procedures, and results of *scientific investigations* (e.g., age-appropriate graphs, charts, and writings)

NS.1.4.6 - Estimate and measure length, *mass*, *temperature*, capacity/volume, and elapsed time using International System of Units (SI)

NS.1.4.7 - Collect and interpret measurable *empirical evidence* in teams and as individuals

NS.1.4.8 - Develop a *hypothesis* based on prior knowledge and observations

NS.1.4.9 - Identify *variables* that affect investigations

NS.1.4.10 - Identify patterns and trends in data

NS.1.4.11 - Generate conclusions based on evidence

NS.1.4.12 - Evaluate the quality and feasibility of an idea or project

ESS.8.4.2 -Analyze the impact of using *natural resources*

ESS.8.4.3 - Differentiate between renewable and non-renewable resources

ESS.8.4.4 - Evaluate the impact of water pollution

ESS.8.4.5 - Evaluate the impact of Arkansas' *natural resources* on the economy, including but not limited to

ESS.8.4.6- Evaluate human use of Arkansas' *natural resources* on the *environment*

ESS.8.4.7 - Describe the processes of the *water cycle*:

- *precipitation*

- *evaporation*
- *condensation*

5th Grade

NS.1.5.4_ Interpret data using data tables.

LS.4.5.16 Evaluate positive and negative human effects on ecosystems.

NS.1.5.5 Communicate results and conclusions from scientific inquiry.

NS.1.5.9 Define and give examples of hypotheses.

6th Grade

NS.1.6.4 Construct and interpret scientific data using data tables.

NS.1.6.5 Communicate results and conclusions from scientific inquiry

Social Studies

4th Grade

G.3.4.4 Explain how people are influenced by, adapt to, and alter the environment (e.g., agriculture, housing, occupation, industry, transportation, communication, acid rain, global warming, ozone depletion)

G.3.4.6 Research ways in which the school and community can improve the physical environment by practicing conservation

E.7.4.1 Evaluate the priority of economic wants and consequences of the opportunity cost

E.7.4.3 Recognize and use the decision making model to make an economic decision: state the problem, list the alternatives, state the criteria, evaluate the criteria, make a decision

E.8.4.3 Examine the impact of scarcity of natural resources on production decisions

E.9.4.4 Research public goods and services that are provided by taxes

5th Grade

G.1.5.5 Identify a variety of charts and graphs used to display data on a variety of topics such as climate or population

G.3.5.1 Recognize factors that influence migration (e.g., employment, natural resources)

G.3.5.5 Identify renewable and nonrenewable resources (e.g., fossil fuels, fertile soils, timber)

G.3.5.7 Discuss ways in which Arkansans adapted to and modified the environment

E.7.5.1 Identify the basic economic wants and needs of all people

E.7.5.2 Recognize that choices have both present and future consequences

E.7.5.3 Identify the causes of scarcity and why scarcity of resources makes it necessary to make choices

E.7.5.5 Identify why federal, state, and local governments have to make choices because of limited resources

E.8.5.4 Examine the need for natural resources in determining settlement patterns

6th Grade

G.1.6.5 Illustrate information relating to population, climate, weather patterns, or other specific topics on selected types of charts or graphs

G.3.6.1 Describe the location of major cities in Arkansas and the United States and the availability of resources and transportation in those areas

G.3.6.5 Describe the physical processes that produce renewable and nonrenewable resources

G.3.6.6 Describe ways in which technology influences capacity to modify the physical environment

G.3.6.7 Analyze the consequences of environmental modification on Arkansas and specific areas of the United States: acid rain, global warming, ozone depletion erosion, desertification

E.7.6.2 Demonstrate an understanding that choices have both present and future consequences

E.7.6.3 Examine the causes of scarcity and the choices made due to scarcity

E.7.6.5 Explain why federal, state, and local governments have to make choices because of limited resources

E.7.6.8 Determine why trade-offs allow people to get the most from scarce resources

Materials

- KWL Wall Charts
- Transparencies of monthly water bills for a household (teacher or a student's household).
- Worksheet copy of monthly water bill from students' or teacher's home (same as transparency)
- Meter Reader Worksheet
- Water Bill Reader Worksheet
- Eye or medicine dropper
- Calculators
- Map of Beaver Lake Watershed
- Computer lab (optional)
- Home Water Audit Data Entry Student Sheet

Resources for materials not included:
UA Center for Math & Science Education
<http://www.uark.edu/~k12info/>
 479.575.3875
Northwest Arkansas Education Co-Op
<http://starfish.k12.ar.us/web/>
 479.267.7450
Beaver Water District
www.bwdh2o.org
 479.717.3807
 Know of other resources? Please let us know!
awilson@bwdh2o.org or 479.756.3651

Procedure

Part 1 - Large Group Discussion

1. Tape the KWL wall chart where the entire class can see them.
2. Ask questions to find out what the students know about the water cycle, where drinking water comes, and uses of drinking water. Write down whatever the students say on the strips and tape them to the wall under "What We Know" (leave the strips on the wall for future reference during the water cycle & use study).
3. When students have told "what they know," then have them wonder about what they would like to know. Use more blank strips to record their questions and tape these under "What We Want to Know."
4. As the lesson (or unit) study continues, refer back to these strips to see if the students have changed their answers or have more questions. Allow them to take a strip from the wall and change "what they know" to "what we learned" if their first answers were wrong.
5. At the end of the lesson(s) or unit, go back over any of the strips that haven't been moved and address each "What We Know" and "What We Want to Know."

6. New "What We Learned" strips may be added each time a student states something that the teacher can write for the "What We Learned" column.
7. Be sure to leave the KWL wall chart on the wall through the entire lesson(s) or unit. Use it, specifically, during the Water Audit wrap up.
2. With the water bill transparency on the wall, discuss what students know about their water bill, water meter reading and how it relates to water consumption.
3. Pass out Water Bill Worksheets. Go through the water bill and ask:
 - What was the most recent reading recorded by the meter reader?
 - When was the meter last read?
 - How many days were in the service period?
 - How many units of water were used during the service period?
 - What formula did the water company use to determine this figure? (Total gallons used divided by number of days)

Part 2 – Home Water Audit

1. Lead students through the KWL activity. Ask questions such as, "Where do we get our water?" or "How do we measure water?" or "What do we use water for in our home?" or "Why is it important to keep water from leaking from our faucets and pipes?"
2. Ask each student to take home the Home Water Audit sheet home and fill out with family. (Option: Ask them to bring a copy or general information from their monthly water bill.)
3. Review scores in class the next day. Use score ranges and ask groups within those scores to raise their hands. Calculate what percentage is in each group ("room for improvement," "off to a good start," or "doing a great job").
4. (Option) Compare to their water bills – do they correlate? Less conservation, higher water bill? Discuss.
5. Take the class percentages and put into nationwide perspective... "If our classroom represented the whole U.S., there is ____% of the country that has 'room for improvement'."
6. Present a challenge to improve home water use during the next month (or water billing cycle). Repeat the following month and put into nationwide improvement perspective.
4. Revisit any discussion on how the water bill relates to the meter and pass out the Water Meter Reader Worksheet.
5. Discuss where water meters may be found and that the City sends Meter Readers to measure the water usage. Relate this back to the Water Bill. Note that water meters are used by schools, businesses and homes – everyone who uses tap water has a meter.
6. Look at the Water Meter Worksheet and discuss the different types of meters:
 - Straight reading meters use gallons, resemble a car odometer, and are a straightforward recording
 - Circular reading meters measure in cubic feet and have six to seven dials. (Note: Cities measure in units of 100 cubic feet so the One Foot and 10 dial are disregarded in recording use. However, the One Foot is used to test for water leaks by turning off the water and seeing if the dial moves, which would indicate a leak.)

Part 3 – Water Bill & Meter Reader

1. Use water bill transparencies and worksheet copies (teacher's, student's or other – vital information can be blacked out with a marker).

7. Go through worksheet together. Enter the Straight reading meter numbers and subtract current from previous. To read the Circular reading meter, start with the greatest measurement (10,000) and record the dials in descending order down to the 100Ccf dial in the chart of the worksheet. If the dial is between numbers, the lower number is recorded (enter number from image). Subtract current from previous and convert to gallons by multiplying by 748.
8. Discuss how this relates to the Home Water Audit.

Part 4 – Drip Calculator

1. Use medicine dropper to illustrate the amount of water that may drip from a leaky faucet. Demonstrate slowly at first and put in context of “drips per second.” Note: 5 drips per second amounts to a steady stream of water.
2. Estimate that $\frac{1}{4}$ mL is the amount in a drip of water (estimate based on faucet drip/drop volume of between $\frac{1}{5}$ and $\frac{1}{3}$ and a bathtub drip/drop at approx $\frac{1}{2}$ mL). Discuss how “it seems like a drop of water down the drain is insignificant. But, what do you think happens when all those drops flow over time?” Lead students through the KWL activity. Ask questions such as “And, what happens when it is more than one sink in a home?”, “And what happens when it is multiple sinks, in multiple homes?”, “And what happens when it is multiple sinks, in multiple homes, in multiple cities?”
3. Pass out the calculation sheet. “Let’s look at it mathematically.” Complete worksheets with calculators.
4. (Option) Divide into groups for a computer lab exercise. Each group can visit <http://ga.water.usgs.gov/edu/sc4.html> . With the baseline measurements they figured out for themselves, they can calculate up to 1 million homes with up to 5 faucets and 120 drips per minute.
5. Refer to KWL chart assumptions.

6. To add impact and illustrate how many gallons of water are being wasted, ask how many students have been to Beaver Lake. Show a map of the Beaver Lake Watershed and the Lake. There are approximately 500 billion gallons of water in Beaver Lake.

Discussion

1. At the conclusion of each or all parts of the lesson, use the KWL Wall Charts to guide discussion and emphasize important points from the science frameworks.
2. Tie in with the true/false questions that were debated during game play.
3. Discuss the connections between the Beaver Lake Watershed, the water cycle, where drinking water comes from in Northwest Arkansas as a whole and water use. Ask questions of the class such as, “What is a watershed?” and show them a map of the Beaver Lake Watershed. Pose the question, “Where in the watershed can one find the water cycle taking place?” Students may respond by mentioning the streams and the lakes. Guide them into thinking about the soil, the caves and springs of the Northwest Arkansas region. Ask them, “How do these connect to water use?”

Assessment

Students can work through a series of stations around the room that ask specific questions related to the water use that has been created.

1. Copy or cut out questions (ideally 10) from the “What We want to Know” KWL Strip and place them in a variety of locations around the room – on student desktops, on the countertops, or on the walls. To make them stand out, put colored paper behind them.

2. Ask students to number their paper 1 to 10 and to skip lines between numbers in order to give enough room for their responses. Point out the questions that have been placed around the room. Students move about the room to answer the questions. Have them write down the question and the answer. They have 1-2 minutes per question to respond. They can answer the questions in any order and can be completed in pairs or individually, depending on the type of assessment desired.
3. The KWL charts can be left up to be used as reference or this can be completed without references after the Part(s) to determine comprehension and retention of the concepts covered in the Part(s) used.
4. Students return to their seats. With a partner, they turn to face each other. Have students take turns asking each other the questions. If the students have differing answers, have them highlight or circle the response so that they can tell about it during a large group discussion.
5. Students regroup as a class. Have students raise their hands if they had differences with any of their partners' responses. Have students share the responses upon which they disagreed and discuss as a class. Guide the discussion as discovery rather than toward "right" or "wrong" answers.
6. Refer to the KWL charts to guide discussion and close.

Option: The questions may also be answered at their seats OR given individually as a quiz.

Resources

American Water Works Association – Online Drip Calculator

<http://www.schoolwebsites.com.au/web/Site/94/Files/34200ecf52fb446cb04aa60cc6bffcc6.pdf>

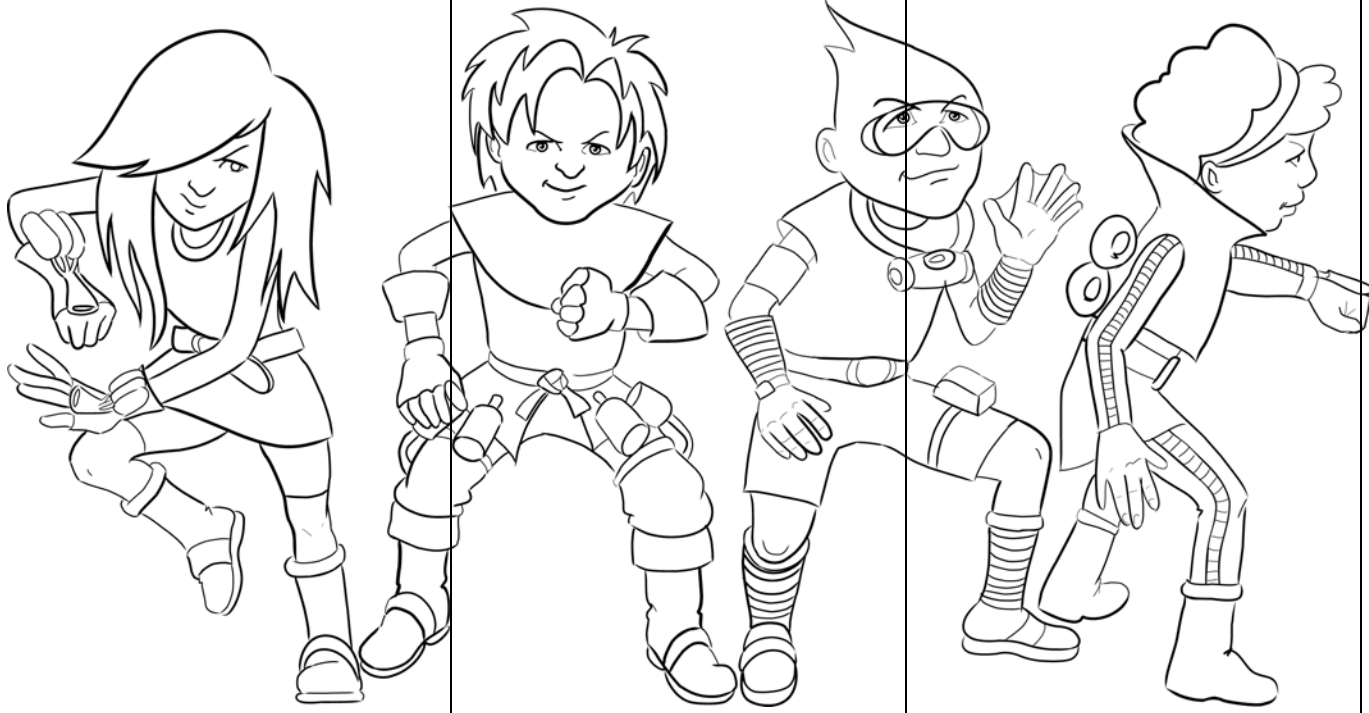
USGS Water Science for Schools

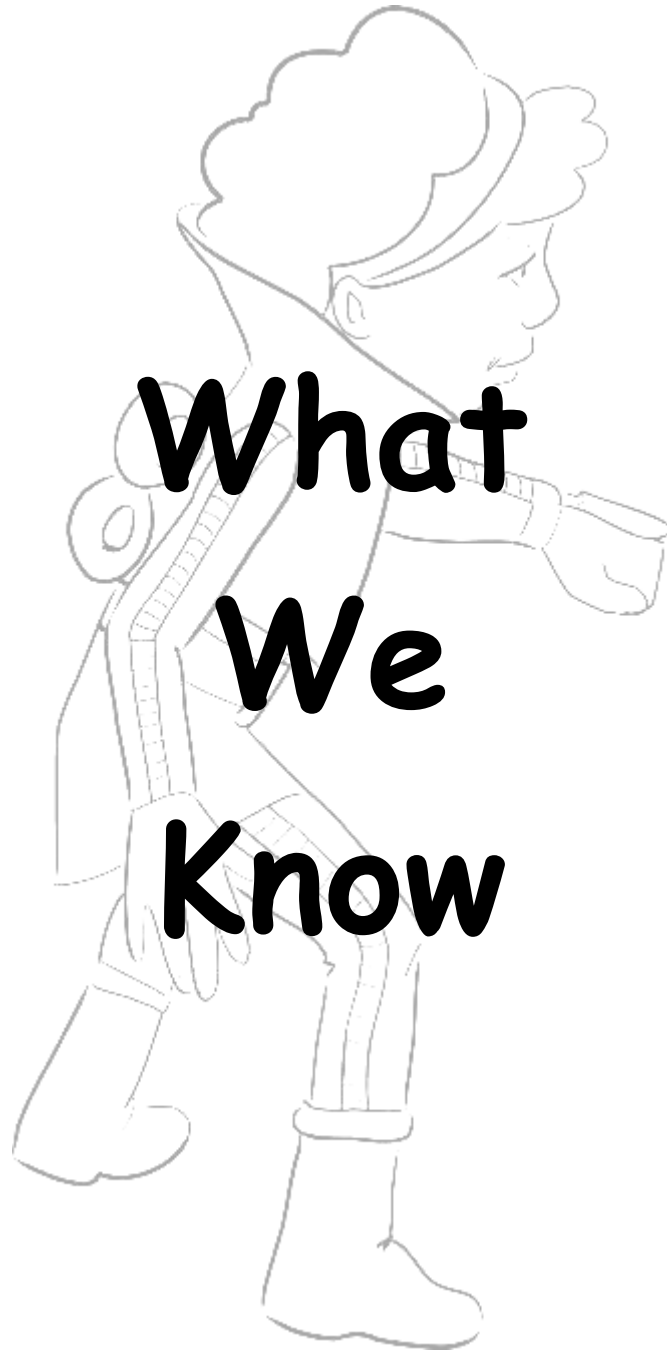
<http://www.awwa.org/awwa/waterwiser/dripcalc.cfm>

Lesson 2 Student Worksheets

KWL Chart

- Before students begin this unit, brainstorm what they know about *water use, consumption, and conservation* and write their thoughts in Column 1.
- Next, have students think of questions they have about the unit or what they would like to find out about *water use, consumption, and conservation* and list these in column 2.
- During the unit study, Column 1 may change as new information is found and Column 2 can be added to, as students think of more questions they'd like to answer.
- At the end of the unit and/or after completing all research, fill in Column 3.
- The following chart is a suggested KWL format and may be enlarged for large group “brainstorms” or printed as is. For individual student or small group work.

Topic _____		
What I Know	What I Want to Know	What I Learned
		







Name _____ Date: _____

What do you know about _____ ?

Handwriting practice lines consisting of solid top and bottom lines with a dashed midline, repeated 10 times for writing.

Name _____ Date _____

**What I know about water use, consumption, and
conservation.**

Draw below

Name _____ Date _____

What do you want to know about _____?

Handwriting practice lines consisting of solid top and bottom lines with a dashed midline. There are 10 sets of these lines provided for writing.

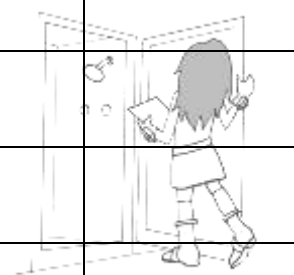
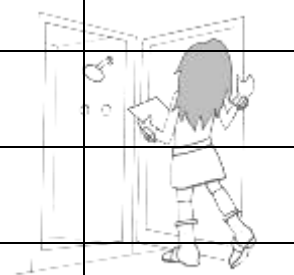


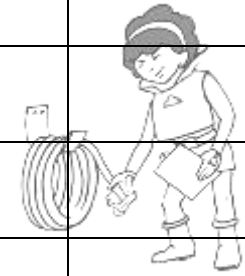
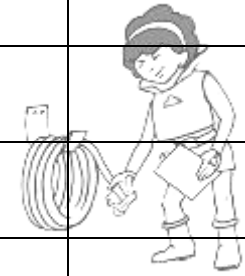
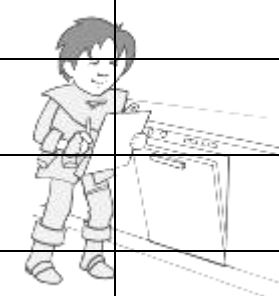
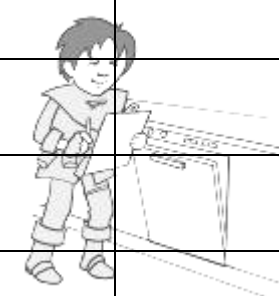
Name _____

Date _____

What did you learn about _____?

Handwriting practice lines consisting of solid top and bottom lines with a dashed midline, repeated 10 times for writing.

Home Water Audit

Home Habit	Always 3 points	Sometimes 2 points	Never 1 point
Shower under 5 minutes			
Fill bathtub $\frac{1}{2}$ full or less			
Turn off water while brushing teeth			
Plug sink when washing face or hands (instead of running water)			
Only flush toilet after use (not to flush tissue or after cleaning)			
Use broom to clean driveway or sidewalk (not hose)			
Use bucket to wash cars (not running hose)			
Use adjustable nozzle on outdoor hose			
Turn off water faucet tightly			
Plug kitchen sink for washing and rinsing dishes			
Only run dishwasher when it is full			
Only run washing machine when it is full			

Score

25-36 Points: **Keep up the great work!**

13-24 Points: **You're on the right track!**

0-12 Points: **Room to grow...**

Water Drip Calculation Sheet

One Gallon = 15,140 drips

One liter = 4,000 drips

Drips per second $\times 60$ = Drips per minute

Drips per minute total $\times 60$ = Drips per hour

Drips per hour $\times 24$ = Drips per day

Drips per day total $\div 15,140$ = Gallons per day

Gallons per day total $\times 365$ = Gallons per year

1) 2 drips per second equals:

_____ drips per minute
_____ drips per hour
_____ drips per day
_____ gallons per day
_____ gallons per year

2) 1 home with 3 faucets leaking 2 drips per second equals:

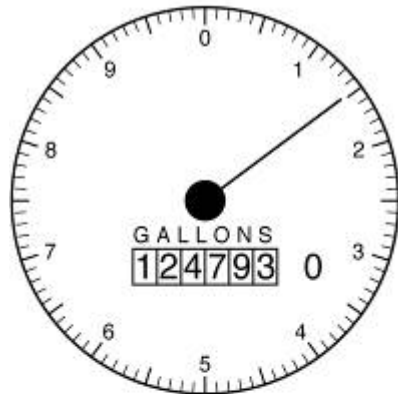
_____ drips per minute
_____ drips per hour
_____ drips per day
_____ gallons per day
_____ gallons per year

3) A neighborhood with 10 homes, each with 3 faucets leaking 2 drips per second equals:

_____ drips per minute
_____ drips per hour
_____ drips per day
_____ gallons per day
_____ gallons per year

Water Meter Reader Worksheet

STRAIGHT READING METER

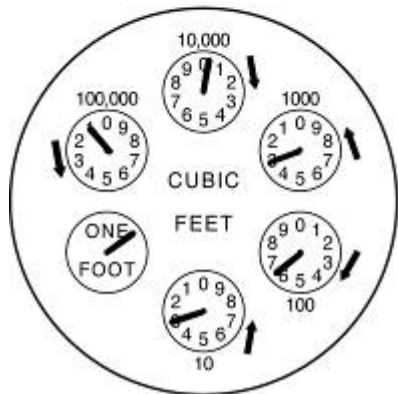


PREVIOUS

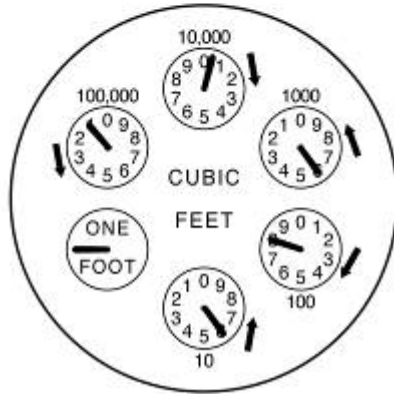


CURRENT

CIRCULAR READING METER



PREVIOUS



CURRENT

Straight

Circular

Current Gallons			Current Ccf	
Previous Gallons			Previous Ccf	
Gallons Used			Ccf's Used	
			Gallons Used (Ccf's used x 748)	

