VOLUME 2

THINK ENVIRONMENT IN MATH

WATER

SOUTHWEST IN

HIDEKA YAMAGUCHI, PH.D.

PREFACE

The objective of this ***Think Environment in Math*** is to provide the quality education to young children in Southwest Indiana. This book is specifically designed for elementary students (grade 1-5) in this community.

Environmental problems have been a part of our human history since human activities started negatively affect the ecological balance of the earth thousands of years ago. Excessive human activities have induced local environmental destruction such as air pollution, water degradation, and resource depletion and have adversely impacted the local people and society.

Now with the emergence of global-scale ecological destruction, environmental problems are no longer just local problems. In this contemporary age, few societies are being left unaffected by global environmental problems. And all societies are now required to simultaneously provide concerted responses to those global environmental challenges as a part of global communities, while finding solutions for ongoing local environmental problems. , and.

In such era when redesigning each community in which all needs are met in sustainable ways is a key to success of the community, provision of education on our environmental challenges becomes more critical than ever. Our community is no exception.

Currently, however, there are two fundamental problems when promoting environmental education through public/parochial elementary schools here in Southwest Indiana. First, due to time and curriculum constraints, local elementary schools are unable to allocate time and resources to teach environmental issues. Secondly, there is no educational material that provides accurate and collective information on the environmental challenges in our community.

To address these problems, the ***Think Environment in Math*** was created. While traditional educational materials on either environment and existing subject areas, including math, language arts, science, and history, have provided information on their focuses, this book attempted to marriage of those independently existing subject areas and integrated environmental subjects into core subjects. In this book, a focus was given to mathematics. By taking this new and unique approach, this book intends to improve students' knowledge on the local environmental issues while promoting their math skills and critical thinking skills.

Math skills targeted in this book are listed below.

Skills (Gr.1-5)

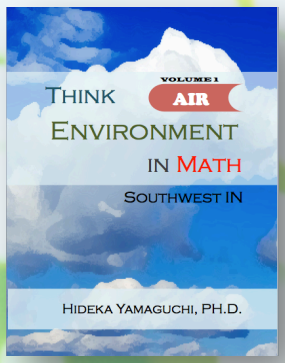
1. Addition / Subtraction
2. Rounding
3. Estimating
4. Ordinal numbers
5. Use <, >, =
6. Number comparison
7. Place value
8. Expanded notation
9. Percentage / Fraction /Decimal
10. Multiplication / Division
11. Data analysis (line, bar, circle graphs & tables)
12. Range, mean, mode & median
13. Three-dimensional objects
14. Measurement (temperature, length & weight)
15. Probability

Very importantly, this book focuses specifically on the development of young children in southwestern Indiana to make up for disadvantages of using traditional educational materials that generalize local environmental problems. This book centers on local environmental problems and local environmental protection efforts, as well as state and country-level of problems to help students understand the local environment in a wider context.

I firmly believe that the quality education is a powerful tool to influence individual behavior. I strongly hope that "Think Environment in Math" provides an opportunity to improve your students' critical thinking skills and abilities, increase their environmental awareness, lead to significant changes in their decisions and actions, invite positive bottom-up changes in this community, and help ensure an environmentally sound and economically prosperous future in Southwest Indiana, in the end.

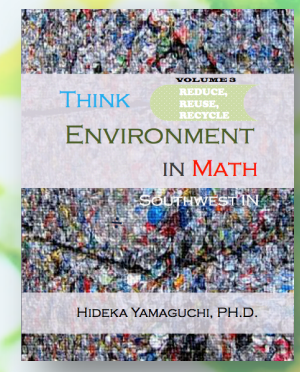
Hideka Yamaguchi, Ph.D.

Also available…



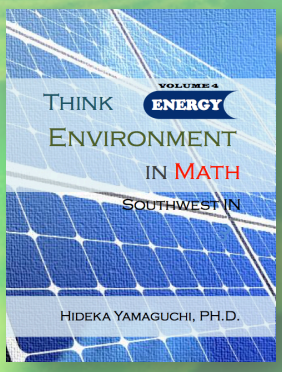
VOL. 1

AIR



VOL. 3

REDUCE
REUSE
RECYCLE



VOL. 4

ENERGY

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Area level


global


national


state


county

Prob 16
prob 17
Prob 26

prob 18
Prob 19
Prob 22
Prob 23
Prob 24

Prob 21

Prob 20
Prob 25

Overview Of problems

1 2 3 4 5

1. Our path to cleaner air

Suited grade level: In this case, this problem is suited for 4th and 5th grades

Title of the problem

Subtraction (4 digits)

Skills: Students use 4 digits subtraction to answer questions

Area level


global


national


state


county

1 2 3 4 5

16. How much of Earth's water can we use?

Percentages factions decimals

1 2 3 4 5

17. Which continent has the most water?

Circle graphs

Percentages fractions decimals

1 2 3 4 5

18. How is our water used?

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1 2 3 4 5

19. Do you think we use lots of water?

Bar graphs (up to 100)

Mean, median & range

1 2 3 4 5

20. Water tanks in Evansville

Addition & subtraction (large numbers)

Addition & subtraction (decimals)

Multiplication & division (large numbers)

Multiplication & division (decimals)

1 2 3 4 5

21. How long is our Ohio River?

Number comparison (3-4 digits)

Addition (3-4 digits)

Subtraction (3-4 digit)

Place value (3-4 digits)

Rounding

Bar graphs (3-4 digits)

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22. Apple vs. Hamburger: Which takes more water to produce?

Addition (2 digits)

Subtraction (2 digit)

Addition (3 digits)

Subtraction (3 digit)

Multiplication (2 digits x 1 digit)

WATER

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1 2 3 4 5

23. How much water do I use?

- Number comparison (1 digit)
- Addition (1 digit)
- Multiplication (1 digit x 1 digit)
- Multiplication (2 digits x 1 digit)

1 2 3 4 5

24. How can I save water?

- Subtraction (2 digit)
- Double bar graphs

1 2 3 4 5

25. What will you find in the Ohio River?

- Three-dimensional objects

1 2 3 4 5

26. Global water shortage

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- Subtraction (3 digit)

List of Problems by Contents

#	Title	Area level	Grade	Skills	Page
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			G4-5	Percentages, fractions & decimals (conversion)	
17	Which continent has the most water?	Global		**Number & Operations**	122
			G3-5	Percentages, fractions & decimals (conversion)	
				Data Analysis	
			G2-5	Circle graphs	
18	How is our water used?	National		**Number & Operations**	128
			G2-3	Number comparison (3-4 digits)	
			G4-5	Addition & subtraction (3-4 digits)	
				Data Analysis	
			G4-5	Bar graphs (3-4 digits)	
			G4-5	Circle graphs	
19	Do you think we use lots of water?	National		**Data Analysis**	138
			G3-4	Create and interpret bar graphs (up to 100)	
			G4-5	Find the mean, range & median	
20	Water tanks in Evansville	County		**Number & Operations**	144
			G4-5	Addition & subtraction (large numbers or decimals)	
			G4-5	Multiplication & division (large numbers or decimals)	
21	How long is our Ohio River?	State		**Number & Operations**	154
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#	Title	Area level	Grade	Skills	Page
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List of Problems by Math Skills

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Number and Operations				
Addition & Subtraction				
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3 digits	22	Apple vs. Hamburger: Which takes more water to produce?	G3-5	164
	26	Global water shortage	G4-5	191
4 digits	18	How is our water used?	G4-5	128
	21	How long is our Ohio River?	G3-4	154
Large numbers	20	Water tanks in Evansville	G4-5	144
Decimals	20	Water tanks in Evansville	G4-5	144
Addition				
1 digit	23	How much water do I use?	G1	173
Subtraction				
2 digits	24	How can I save water?	G2-3	180
Rounding				
Whole numbers	21	How long is our Ohio River?	G3-4	154
Number comparison				
1 digit	23	How much water do I use?	G1	173
4 digits	18	How is our water used?	G2-3	128
	21	How long is our Ohio River?	G3-4	154
Place value				
	21	How long is our Ohio River?	G3-4	154

Number and Operations

Percentages, fractions & decimals

	Problem #	Title	Grades	Page
	16	How much of Earth's water can we use?	G2-5	114
	17	Which continent has the most water?	G3-5	122

Multiplication

1 digit x 1digit	23	How much water do I use?	G2-3	173
2 digits x 1digit	22	Apple vs. Hamburger: Which takes more water to produce?	G3-5	164
	23	How much water do I use?	G3-5	173

Multiplication and division

Large numbers	20	Water tanks in Evansville	G4-5	144
Decimals	20	Water tanks in Evansville	G4-5	144

Data Analysis

Bar graphs

Up to 100	19	Do you think we use lots of water?	G3-4	138
3-4 digits	18	How is our water used?	G4-5	128
3-4 digits	21	How long is our Ohio River?	G3-4	154

Double bar graphs

	24	How can I save water?	G4-5	180

Circle graphs

	17	Which continent has the most water?	G2-5	122
	18	How is our water used?	G4-5	128

Geometry

Three-dimensional objects

	Problem #	Title	Grades	Page
	25	What will you find in the Ohio River?	G3-4	187

Mean, median, mode & range

Mean, median & range	19	Do you think we use lots of water?	G3-4	138

WATER

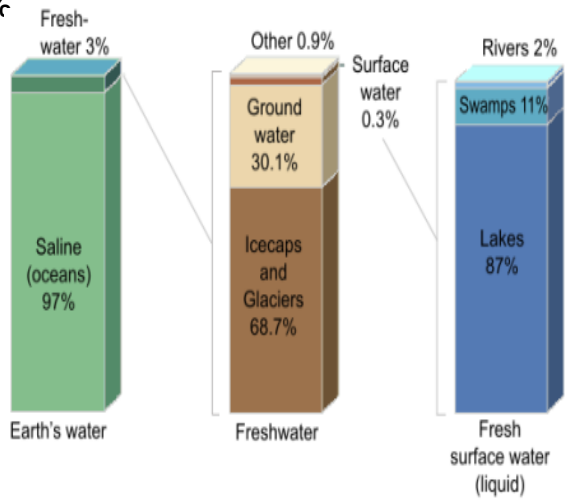
Residents and businesses in Southwest Indiana rely on the Ohio River for much of their water supply. It seems that we have plenty of water resources. However, the availability of water in the world has become scarce, and it is predicted that 47% of world's population will live under extremely low water conditions by 2030. In addition, there are many other problems relating to water such as disrupted water cycle and water pollution.

Our Precious River Water

The Ohio River provides water to most of the residents in Southwest Indiana every day. Water from the Ohio River may look plentiful, however, river water is not actually abundant when considered in the context of distribution of Earth's water.

Earth's water is broadly categorized into *saltwater* and *freshwater*. Almost all of the Earth water is regarded as saltwater in the oceans that cannot be consumed by humans, and freshwater accounts for only 2.5%.

Most of the freshwater is stored in glaciers/icecaps or underground. The remainder—surface water (lakes, swamps, rivers, and snow on the top of the mountains)—is only 1.3% of the total freshwater. In fact, river water accounts for only 0.00015% of the total water on the earth! (USGS)



Source: US Geological Survey (GSGS)

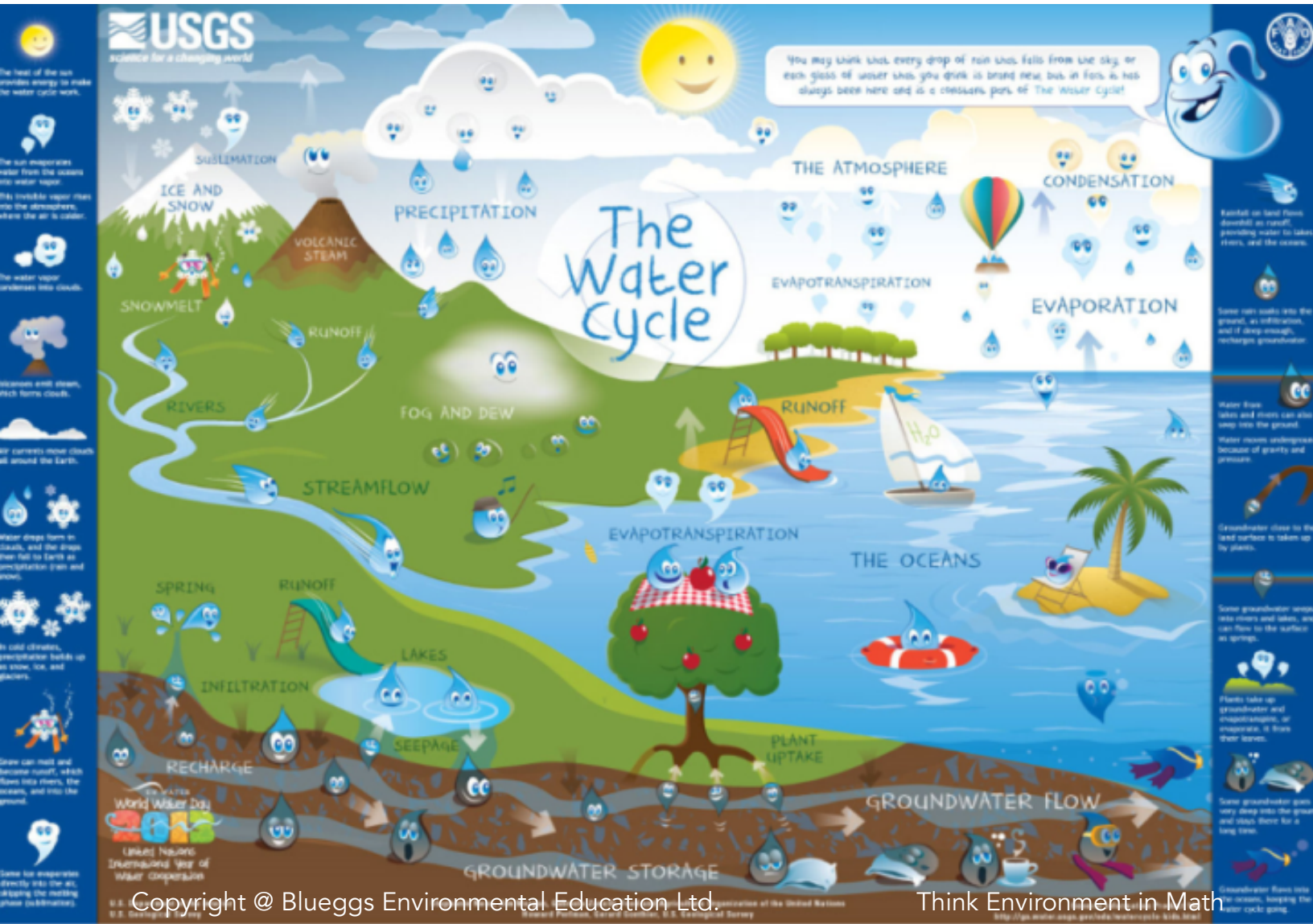
DISRUPTED WATER CYCLE

The water balance of the Earth has long been kept through a stable *water cycle*. However, recent human activities have significantly altered this water cycle, disrupting the environment's natural balance.

Human activities such as the use of river water at power plants to generate electricity, water extraction from rivers for industrial use, destruction of forests for agriculture, removal of groundwater for irrigation, and exploitation of water to support urbanization are some of the contributors to the alteration of the water cycle. The disrupted water cycle has resulted in erosion, pollution, floods, and mudslides.

Furthermore, climate scientists suggest that climate change has also aggravated the alternation of the water cycle.
In addition to with more water moving through the cycle due to the melting Arctic and sea ice, climate change has caused more intense rains, floods, droughts, snow, and extreme heat and heat waves. Scientists predict that dry regions will become drier and wet regions will become wetter if current trends continue.

The Water Cycle for Kids, USGS



 Think Environment in Math

PROBLEM 16

Number & Operations

G2 G3 Percentages

G4 G5 Percentages, fractions & decimals (conversion)

HOW MUCH OF EARTH'S WATER CAN WE USE?

PURPOSE

Through this activity, **2nd – 3rd grade** students will

- Practice solving percent problems—**PROBLEM A** & **C**
- Learn distribution of saltwater and freshwater on Earth—**PROBLEM A**
- Learn components of freshwater—**PROBLEM C**
- Understand scarcity of our freshwater resources
- Develop awareness of water quality

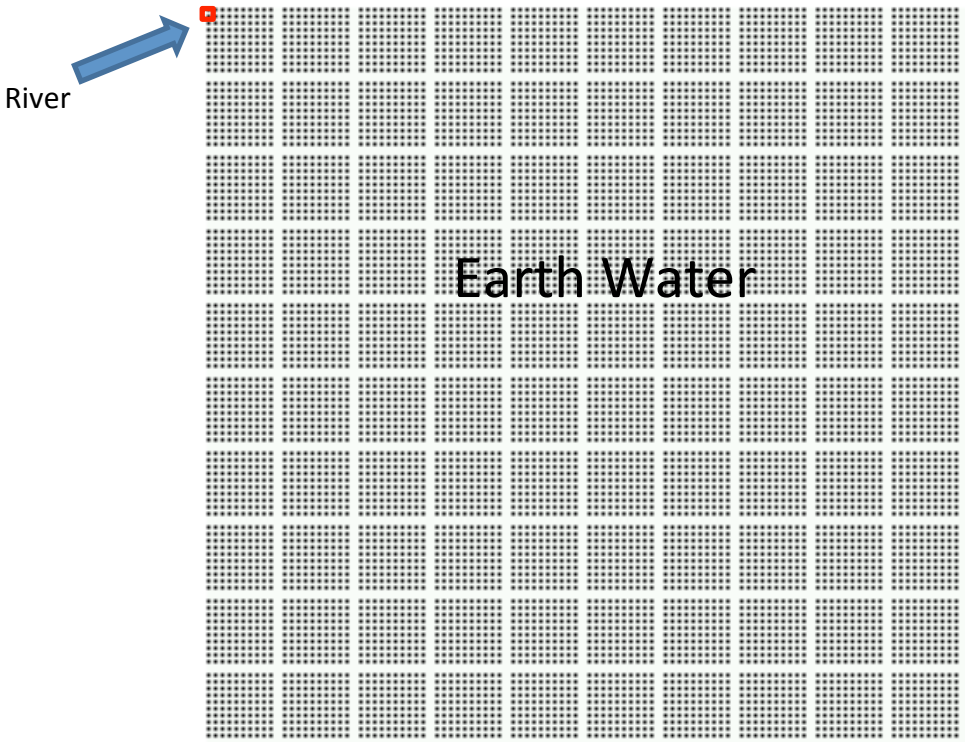
Through this activity, **4th – 5th grade** students will

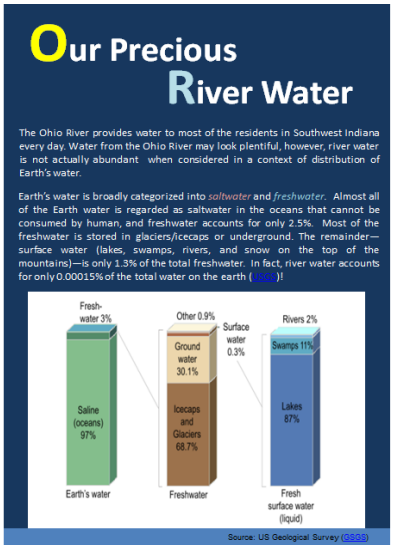
- Practice solving percent problems—**PROBLEM B** & **D**
- Convert from percentage to decimal and fraction—**PROBLEM B** & **D**
- Learn distribution of saltwater and freshwater on Earth—**PROBLEM B**
- Learn components of surface freshwater—**PROBLEM D**
- Understand scarcity of our freshwater resources
- Develop awareness of water quality

BACKGROUND FOR THE TEACHER

Almost all of the Earth's water is classified as saltwater in the oceans that cannot be consumed by humans. Freshwater accounts for only 2.5% of the Earth's water.

As the Ohio River is the major source of fresh water in Southwest Indiana, river water is a very valuable water resource to us. Rivers are particularly precious because the total volume of rivers equals only one millionth of the total volume of Earth's water. (See page 112 for information on distribution of water on Earth)





Our Precious River Water (page 112)

TEACHER GUIDE

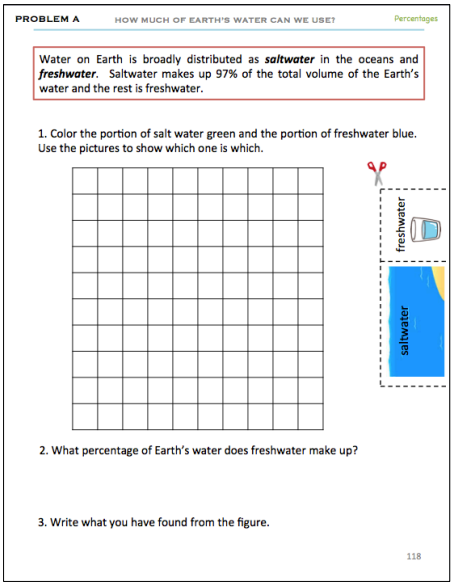
The purpose of this activity is to practice solving percent problems while giving your students an idea of the preciousness of the water that we daily consume. This activity was created based on data obtained from U.S. Geological Survey.

Ohio River

PROBLEM A

- *Percentages*

Using the percentage of saltwater and freshwater on Earth, rounded to 97% and 3%, respectively, students are asked to color the portion of salt water green and the portion of freshwater blue on a grid of 100 boxes. Students are then asked to write their opinions based on the grid they just colored.



PROBLEM A HOW MUCH OF EARTH'S WATER CAN WE USE? Percentages

Water on Earth is broadly distributed as ***saltwater*** in the oceans and ***freshwater***. Saltwater makes up 97% of the total volume of the Earth's water and the rest is freshwater.

1. Color the portion of salt water green and the portion of freshwater blue. Use the pictures to show which one is which.

freshwater

saltwater

2. What percentage of Earth's water does freshwater make up?

3. Write what you have found from the figure.

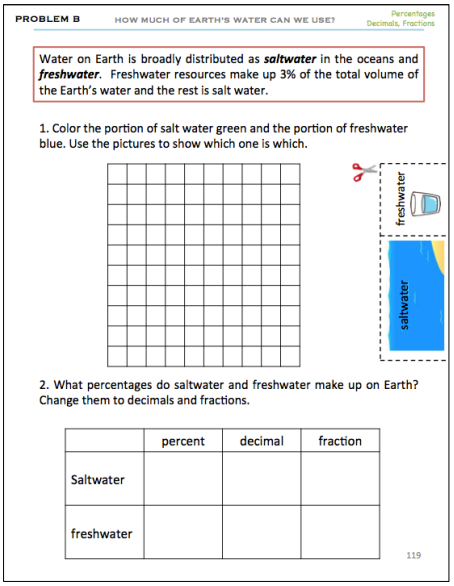
118

P 118—Student Sheet

PROBLEM B

- *Percentages*
- *Decimals*
- *Fractions*

Using the percentage of saltwater and freshwater on Earth, rounded to 97% and 3%, respectively, students are asked to color the portion of salt water green and the portion of freshwater blue on a grid of 100 boxes. Students are then asked to convert them to decimals and fractions.



PROBLEM B HOW MUCH OF EARTH'S WATER CAN WE USE? Percentages Decimals, Fractions

Water on Earth is broadly distributed as ***saltwater*** in the oceans and ***freshwater***. Freshwater resources make up 3% of the total volume of the Earth's water and the rest is salt water.

1. Color the portion of salt water green and the portion of freshwater blue. Use the pictures to show which one is which.

freshwater

saltwater

2. What percentages do saltwater and freshwater make up on Earth? Change them to decimals and fractions.

	percent	decimal	fraction
Saltwater			
freshwater			

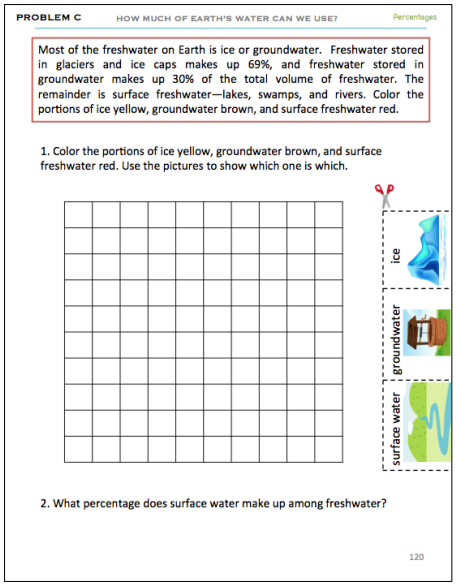
119

P 119—Student Sheet

PROBLEM C

- *Percentages*

Using the distribution of freshwater on Earth, in which ice, groundwater, and surface water make up 69%, 30%, and 1%, respectively, students are asked to color the portion of ice yellow, groundwater brown, and surface freshwater red on a grid of 100 boxes.


PROBLEM C HOW MUCH OF EARTH'S WATER CAN WE USE? Percentages

Most of the freshwater on Earth is ice or groundwater. Freshwater stored in glaciers and ice caps makes up 69%, and freshwater stored in groundwater makes up 30% of the total volume of freshwater. The remainder is surface freshwater—lakes, swamps, and rivers. Color the portions of ice yellow, groundwater brown, and surface freshwater red.

1. Color the portions of ice yellow, groundwater brown, and surface freshwater red. Use the pictures to show which one is which.

ice
groundwater
surface water

2. What percentage does surface water make up among freshwater?

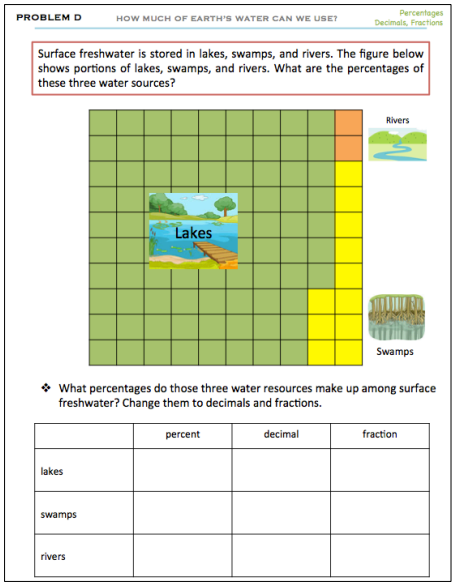
120

P 120—Student Sheet

PROBLEM D

- *Percentages*
- *Decimals and fractions*

Using the colored grid of 100 boxes which shows the distribution of surface water on Earth, students are asked to find out the percentages of lakes, rivers, and swamps. Students are then asked to convert them to decimal and fraction.


PROBLEM D HOW MUCH OF EARTH'S WATER CAN WE USE? Percentages Decimals, Fractions

Surface freshwater is stored in lakes, swamps, and rivers. The figure below shows portions of lakes, swamps, and rivers. What are the percentages of these three water sources?

Rivers
Lakes
Swamps

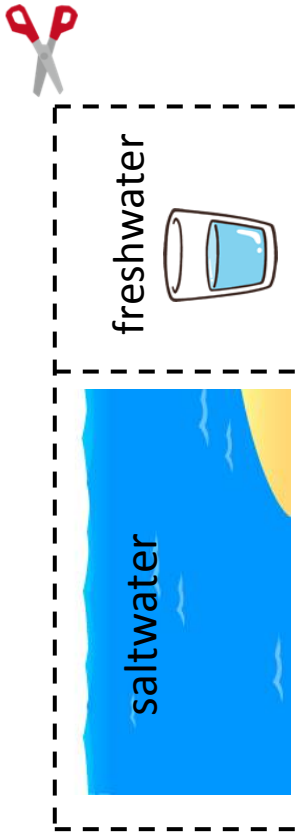
❖ What percentages do those three water resources make up among surface freshwater? Change them to decimals and fractions.

	percent	decimal	fraction
lakes			
swamps			
rivers			

P 121—Student Sheet

Water on Earth is broadly distributed as ***saltwater*** in the oceans and ***freshwater***. Saltwater makes up 97% of the total volume of the Earth's water and the rest is freshwater.

1. Color the portion of salt water green and the portion of freshwater blue. Use the pictures to show which one is which.

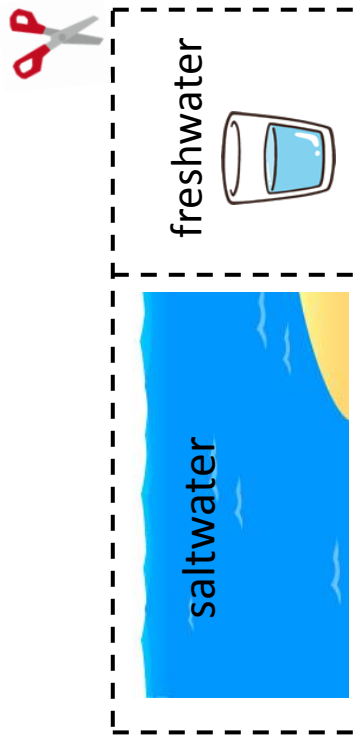


2. What percentage of Earth's water does freshwater make up?

3. Write what you have found from the figure.

Water on Earth is broadly distributed as ***saltwater*** in the oceans and ***freshwater***. Freshwater resources make up 3% of the total volume of the Earth's water and the rest is salt water.

1. Color the portion of salt water green and the portion of freshwater blue. Use the pictures to show which one is which.

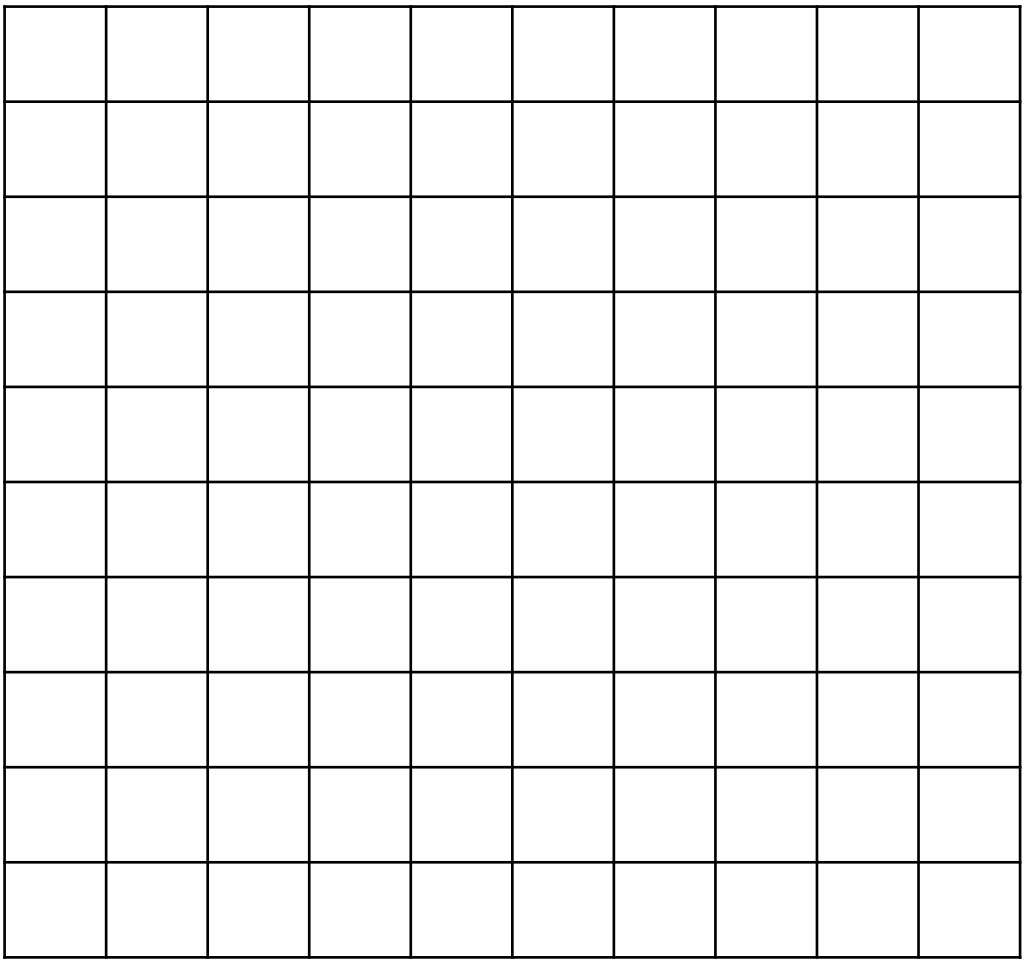


2. What percentages do saltwater and freshwater make up on Earth? Change them to decimals and fractions.

	percent	decimal	fraction
Saltwater			
freshwater			

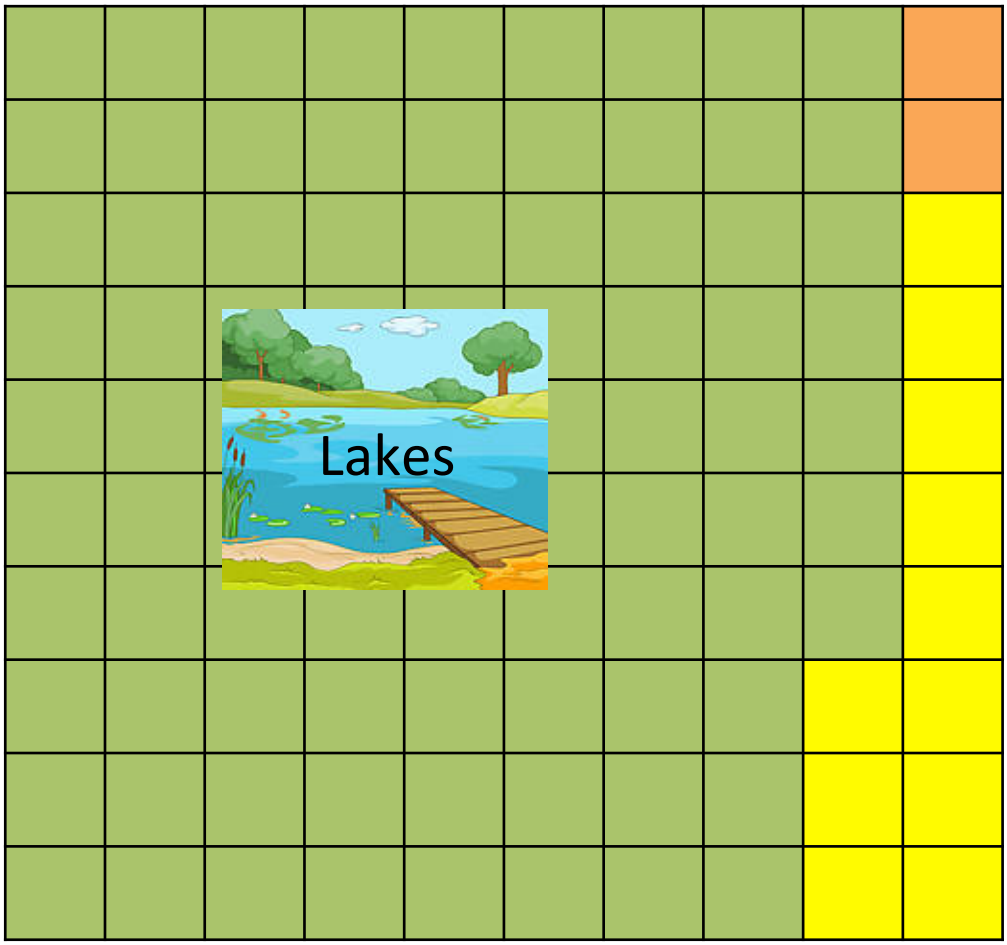
Most of the freshwater on Earth is ice or groundwater. Freshwater stored in glaciers and ice caps makes up 69%, and freshwater stored in groundwater makes up 30% of the total volume of freshwater. The remainder is surface freshwater—lakes, swamps, and rivers. Color the portions of ice yellow, groundwater brown, and surface freshwater red.

1. Color the portions of ice yellow, groundwater brown, and surface freshwater red. Use the pictures to show which one is which.

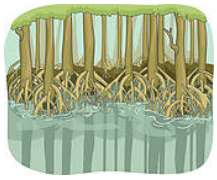


2. What percentage does surface water make up among freshwater?

Surface freshwater is stored in lakes, swamps, and rivers. The figure below shows portions of lakes, swamps, and rivers. What are the percentages of these three water sources?



Rivers



Swamps

❖ What percentages do those three water resources make up among surface freshwater? Change them to decimals and fractions.

	percent	decimal	fraction
lakes			
swamps			
rivers			

PROBLEM 17

Number & Operations

G3 G4 G5 Percentages, fractions & decimals

Data Analysis

G2 G3 G4 G5 Circle graphs

WHICH CONTINENT HAS THE MOST WATER?

PURPOSE

Through this activity, **2nd – 3rd grade** students will

- Interpret circle graphs—**PROBLEM A**
- Use percentage skills—**PROBLEM A**
- Learn distribution of river water in the world
- Raise awareness of water conservation

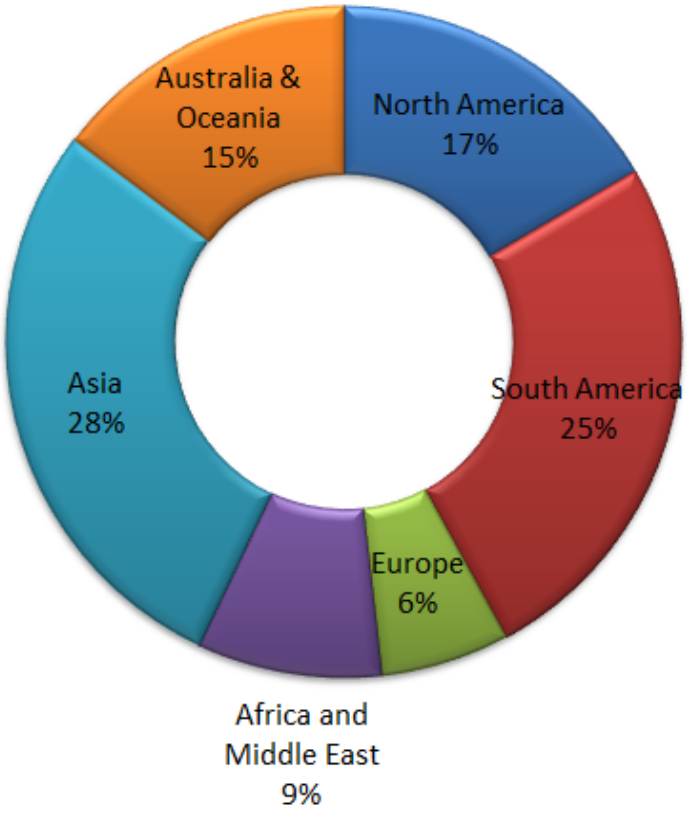
Through this activity, **3rd – 5th grade** students will

- Interpret circle graphs—**PROBLEM B & C**
- Use percentage and fraction skills—**PROBLEM B**
- Convert from percentages to decimals and fractions—**PROBLEM C**
- Learn distribution of river water in the world
- Raise awareness of water conservation

BACKGROUND FOR THE TEACHER

The total volume of river water is only about 2% of the surface fresh water on Earth. The river water is unevenly distributed in the world. For example, as much as 10% of the world's river water is located in Canada. On the other hand, only 0.3% of the river water is found in Middle East and North Africa combined.

The third largest volume of river water are located in North America after Asia and South America. The world's largest fresh water basin is in the Amazon. Together with the Orinoco basin, the Amazon basin consists of 15% of world's runoff.



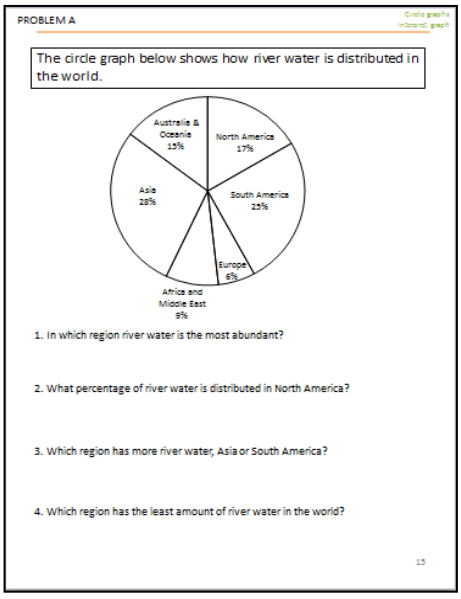
TEACHER GUIDE

The purpose of this activity is to improve students' skills in data analysis and number operations through interpreting a circle graph while giving them an idea how the river water is (unequally) distributed on earth.

PROBLEM A

- *Interpreting circle graphs*

Using a circle graph that shows the distribution of river water on earth in percentages, students are asked to solve problems related to the graph, including a problem that asks for the region with the largest/least share.


PROBLEM A

The circle graph below shows how river water is distributed in the world.

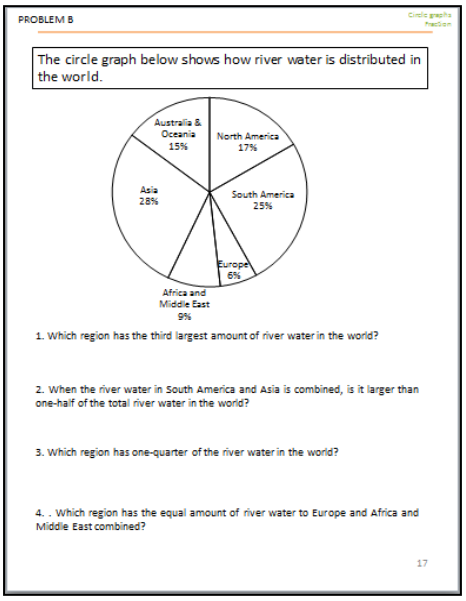
1. In which region river water is the most abundant?
2. What percentage of river water is distributed in North America?
3. Which region has more river water, Asia or South America?
4. Which region has the least amount of river water in the world?

P 125—Student Sheet

PROBLEM B

- *Interpreting circle graphs*
- *Percentages & fractions*

Using a circle graph that shows the distribution of river water on earth in percentages, students are asked to solve problems related to the graph. This worksheet also intends to strengthen their fraction skills.



PROBLEM B

The circle graph below shows how river water is distributed in the world.

1. Which region has the third largest amount of river water in the world?

2. When the river water in South America and Asia is combined, is it larger than one-half of the total river water in the world?

3. Which region has one-quarter of the river water in the world?

4. . Which region has the equal amount of river water to Europe and Africa and Middle East combined?

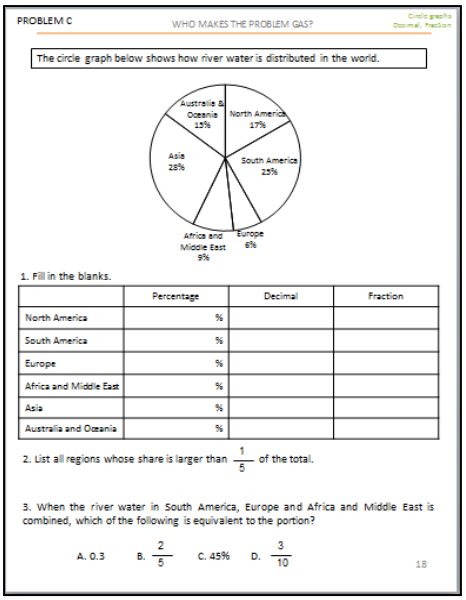
17

P 126—Student Sheet

PROBLEM C

- *Interpreting circle graphs*
- *Percentages, fractions & decimals*

Using a circle graph that shows distribution of river water on earth in percentages, students are asked to convert from percentages to decimals and fractions.



PROBLEM C WHO MAKES THE PROBLEM GAS?

The circle graph below shows how river water is distributed in the world.

1. Fill in the blanks.

	Percentage	Decimal	Fraction
North America	%		
South America	%		
Europe	%		
Africa and Middle East	%		
Asia	%		
Australia and Oceania	%		

2. List all regions whose share is larger than $\frac{1}{5}$ of the total.

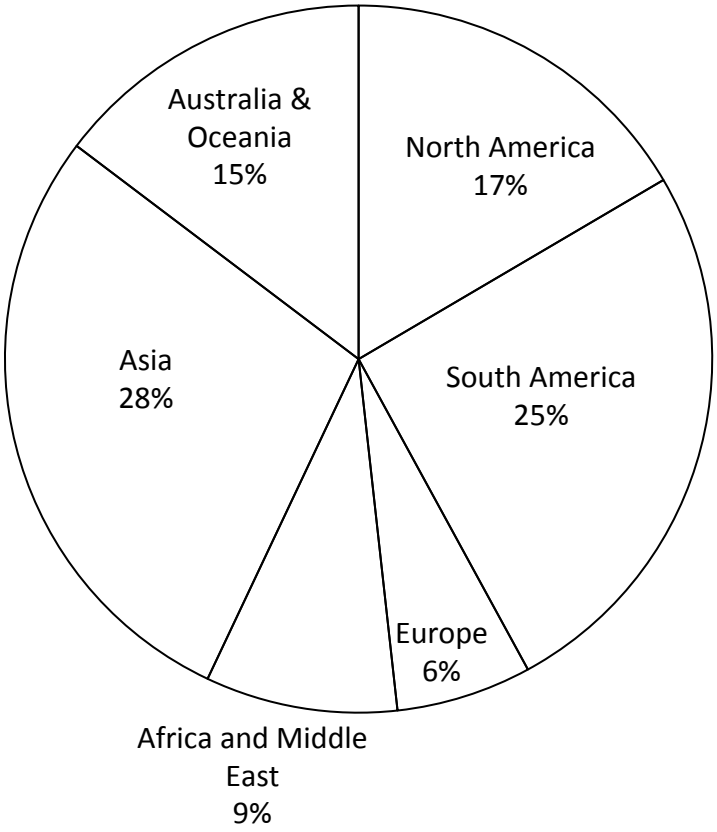
3. When the river water in South America, Europe and Africa and Middle East is combined, which of the following is equivalent to the portion?

A. 0.3 B. $\frac{2}{5}$ C. 45% D. $\frac{3}{10}$

18

P 127—Student Sheet

The circle graph below shows how river water is distributed throughout the world.



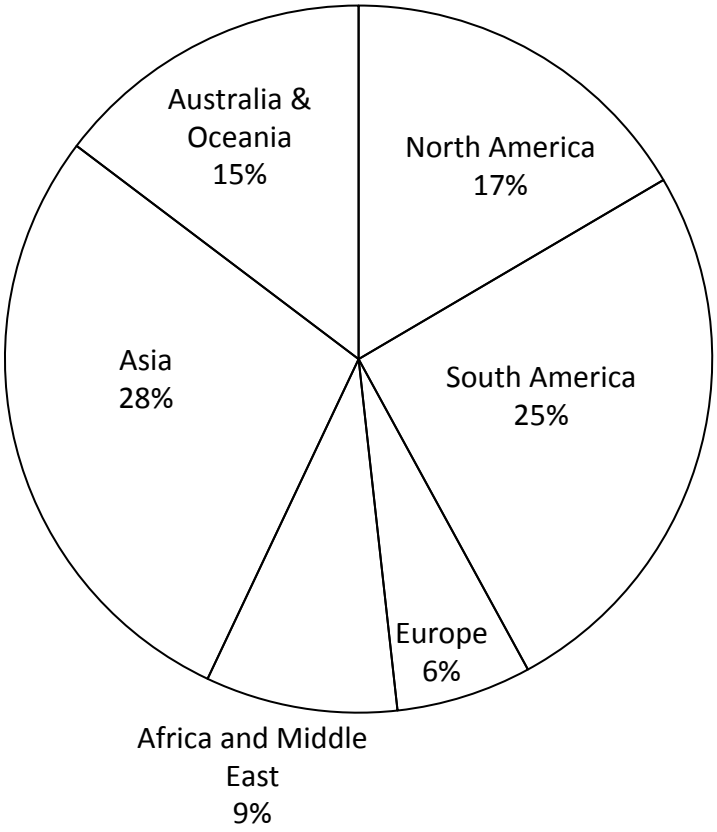
1. In which region is river water the most abundant?

2. What percentage of river water is distributed in North America?

3. Which region has more river water, Asia or South America?

4. Which region has the least amount of river water in the world?

The circle graph below shows how river water is distributed in the world.



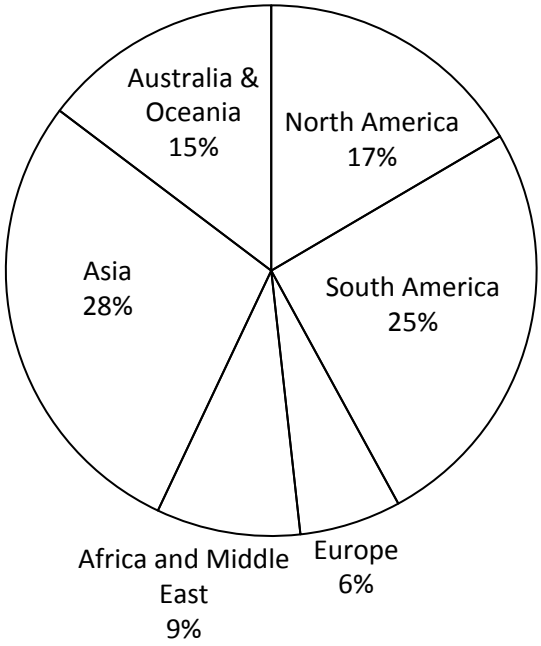
1. Which region has the third largest amount of river water in the world?

2. When the river water in South America and Asia is combined, is it larger than one-half of the total river water in the world?

3. Which region has one-quarter of the river water in the world?

4. . Which region has the equal amount of river water to Europe and Africa and Middle East combined?

The circle graph below shows how river water is distributed in the world.



1. Fill in the blanks.

	Percentage	Decimal	Fraction
North America	%		
South America	%		
Europe	%		
Africa and Middle East	%		
Asia	%		
Australia and Oceania	%		

2. List all regions whose share is larger than $\frac{1}{5}$ of the total.

3. When the river water in South America, Europe and Africa and Middle East is combined, which of the following is equivalent to the portion?

A. 0.3 B. $\frac{2}{5}$ C. 45% D. $\frac{3}{10}$

PROBLEM 18

Number & Operations

G2 G3 Number comparison (3-4 digits)

G4 G5 Addition & subtraction (3-4 digits)

Data Analysis

G4 G5 Bar graphs (3-4 digits)

Circle graphs

HOW IS OUR WATER USED?

PURPOSE

Through this activity, **2nd – 3rd grade** students will

- Practice number comparison (3 & 4-digit numbers)—**PROBLEM A**
- Understand how much water is used for what purposes
- Develop awareness of water quality

Through this activity, **4th – 5th grade** students will

- Add and subtract 3 & 4-digit numbers —**PROBLEM B** & **D**
- Interpret bar graphs (3 & 4-digit numbers)—**PROBLEM C**
- Interpret circle graphs —**PROBLEM D**
- Understand how much water is used for what purposes
- Develop awareness of water quality

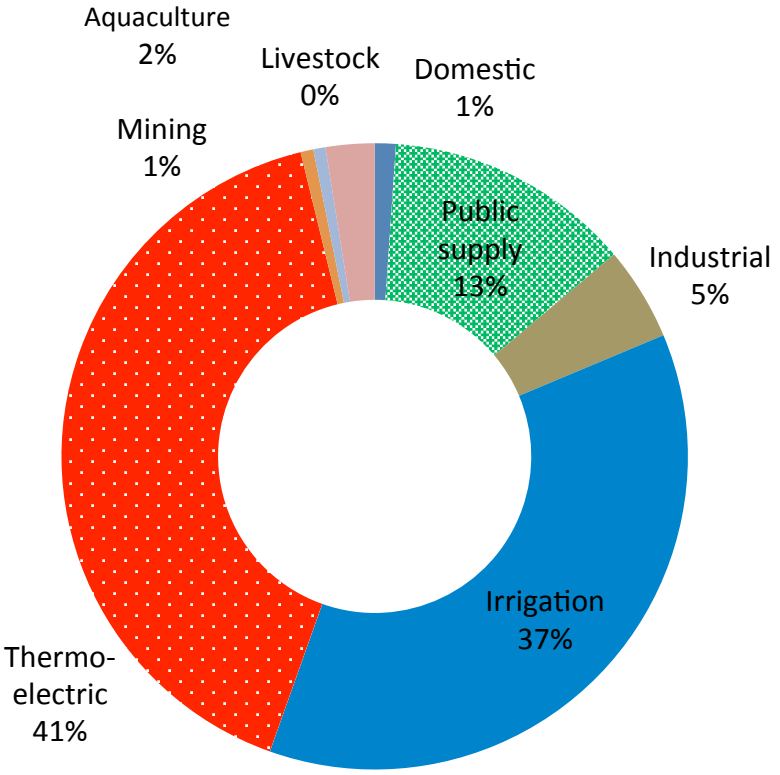
BACKGROUND FOR THE TEACHER

Our country consumes about 350 billion gallons of freshwater every day to meet our demands. This amount is equivalent to about 530,000 Olympic sized-swimming pools. Water is either extracted from surface water such as rivers or pumped from underground.

Where does the Extracted Water go?

Most freshwater, about 80%, is used for irrigation and electricity generation purposes. Water used for public supply and industrial purposes make up 13% and 5% respectively.

Water used for domestic, mining, livestock, and aquaculture purposes altogether account for only 4% of the total water consumption.



Domestic Water Use

Domestic water is water used for household purposes both indoor and outdoor.

Public-supply Water Use

Public supply refers to water extracted by governments or privately-run facilities that deliver water to our homes, businesses, and schools.

Industrial Water Use

Industrial water indicates water used in the industry sector for manufacturing purposes.

Irrigation Water Use

Irrigation water is used for growing fruits, grains, and vegetables.

Thermoelectric Power Water Use

Thermoelectric power water is used in the process of generating electricity through steam-driven turbine generators.

Mining Water Use

Mining water is water used for extraction of minerals .

Livestock Water Use

Livestock water is water used for farm needs.

Aquaculture Water Use

Aquaculture water is used for raising water creatures such as fish and shellfish.

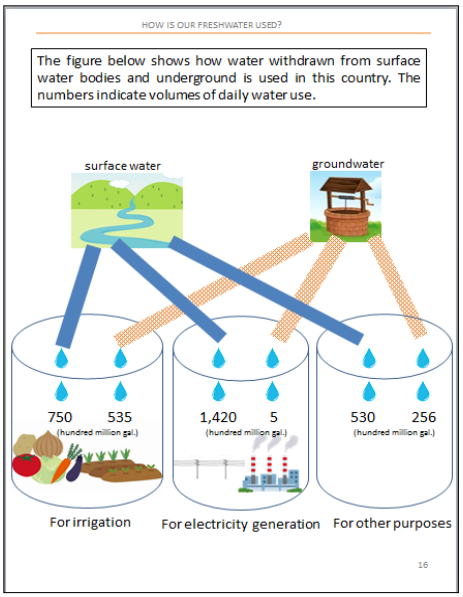
TEACHER GUIDE

The purpose of this activity is to enhance students' skills in addition and subtraction and reading graphs, while improving their understanding of how our freshwater is used in our nation. This activity was created based on data obtained from the U.S. Geological Survey.

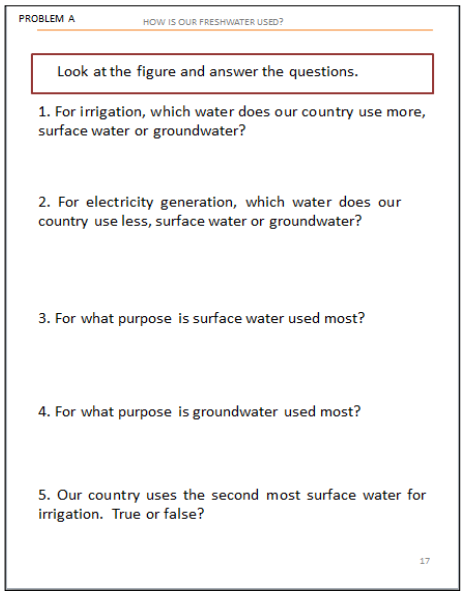
PROBLEM A

- *Number comparison (3 & 4 digits)*

Using the figure which shows how much and for what purposes surface water and groundwater are used for irrigation and electricity generation purposes in our country, students are asked to compare 3 digit-numbers.



P 132—Student Sheet

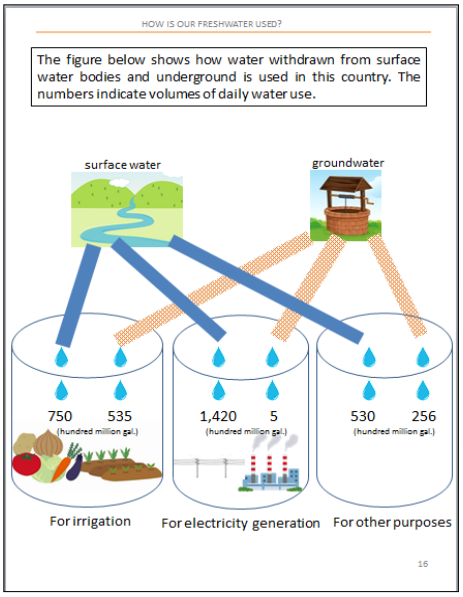


P 133—Student Sheet

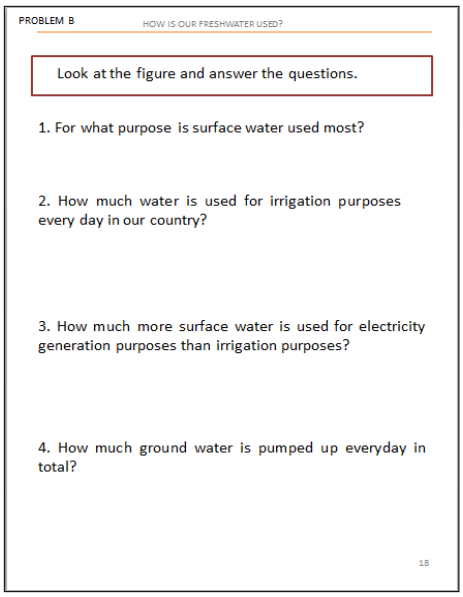
PROBLEM B

- *Addition (3 & 4 digits)*
- *Subtraction (3 & 4 digits)*

Using the figure which shows how much and for what purposes surface water and groundwater are used for irrigation and electricity generation, students complete questions by adding and subtracting three and four digit- numbers.



P 132—Student Sheet

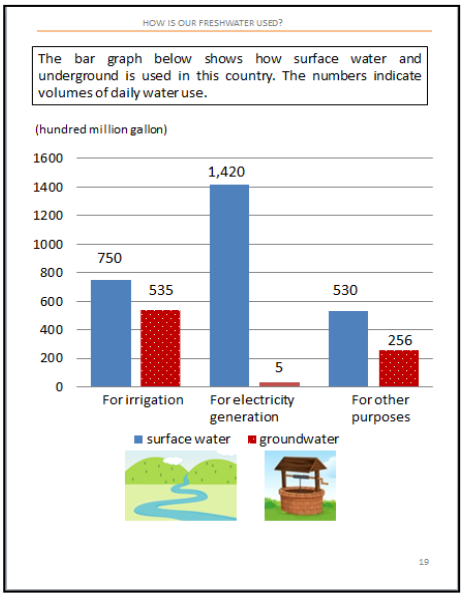


P 134—Student Sheet

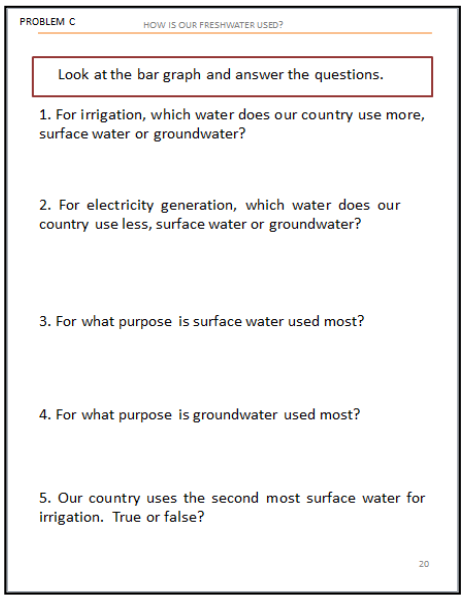
PROBLEM C

- *Interpreting bar graphs (3 & 4 digit numbers)*

Using a bar graph which shows how much surface water and groundwater are used for irrigation and electricity generation purposes in our country, students are asked to read the bar graph.



P 135—Student Sheet

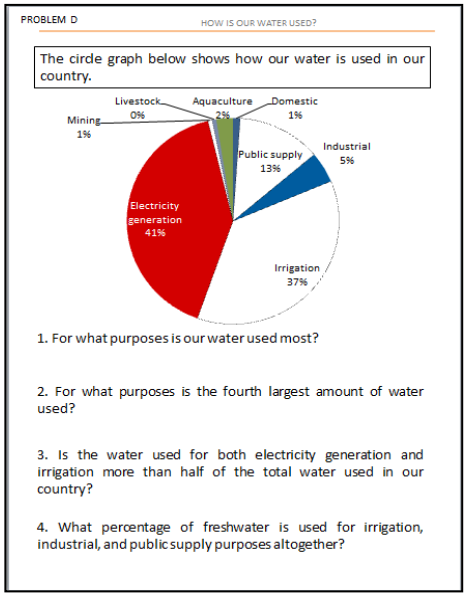


P 136—Student Sheet

PROBLEM D

- *Interpreting circle graphs*

Using a bar graph which shows how much and for what purposes freshwater is used in our country, students are asked to read the circle graph.



P 137—Student Sheet

The figure below shows how surface and groundwater are used in this country. The numbers indicate volumes of daily water use.

surface water

groundwater

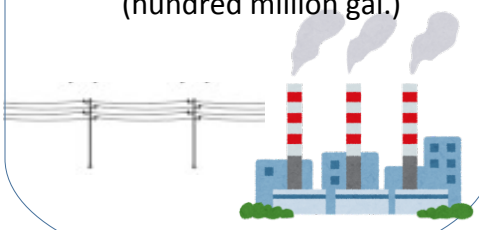
750 535

(hundred million gal.)

For irrigation

1,420 5

(hundred million gal.)



For electricity generation

530 256

(hundred million gal.)

For other purposes

Look at the figure and answer the questions.

1. For irrigation, which water does our country use more, surface water or groundwater?

2. For electricity generation, which type of water does our country use less, surface water or groundwater?

3. For what purpose is surface water used most?

4. For what purpose is groundwater used most?

5. True of false: Our country uses the second most surface water for irrigation.

Look at the figure and answer the questions.

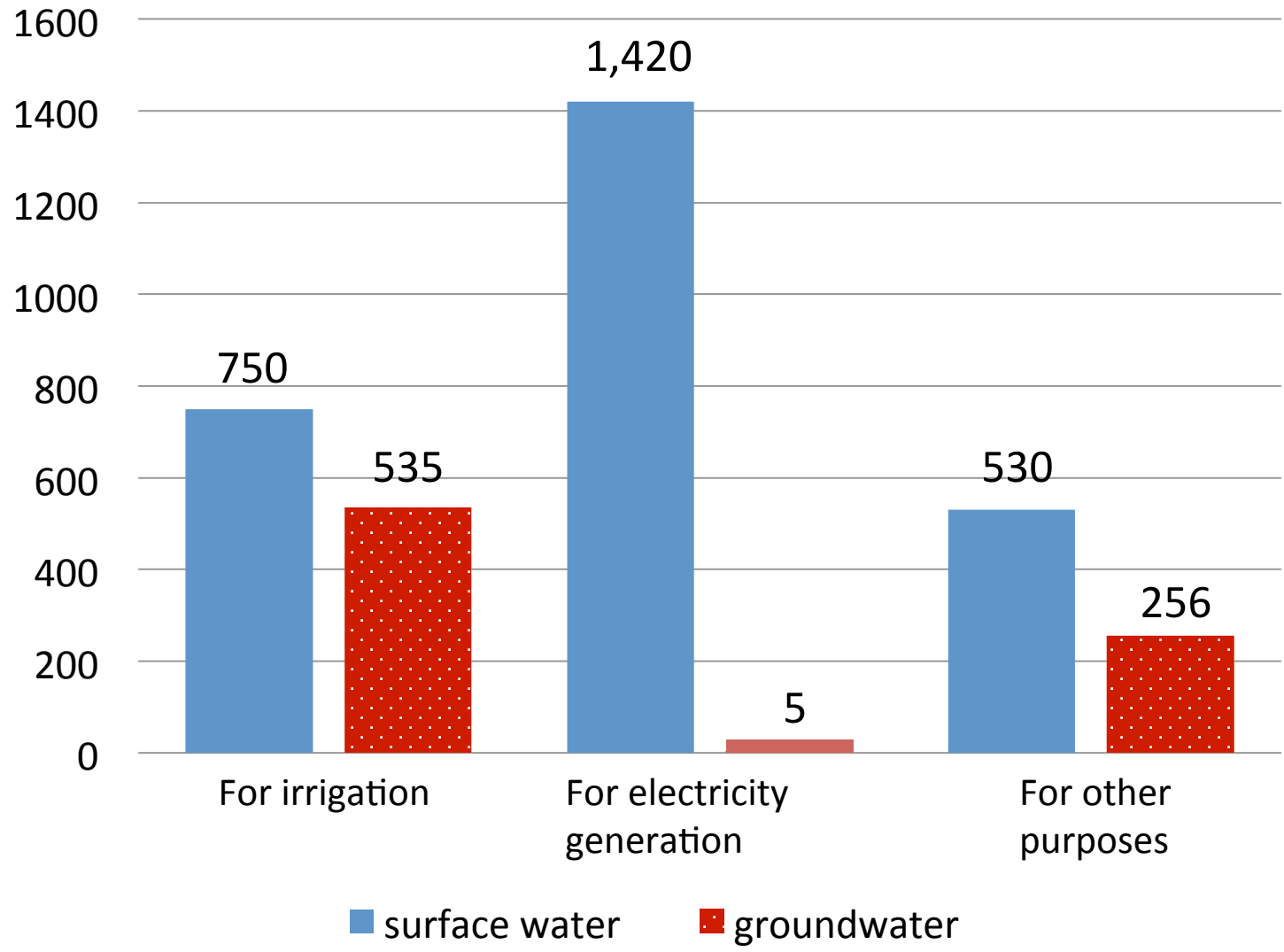
1. For what purpose is surface water used most?

2. How much water is used for irrigation purposes every day in our country?

3. How much more surface water is used for electricity generation purposes than irrigation purposes?

4. How much ground water is pumped up every day in total?

The bar graph below shows how surface and underground water are used in this country. The numbers indicate volumes of daily water use.



Look at the figure and answer the questions.

1. For irrigation, which type of water does our country use more, surface water or groundwater?

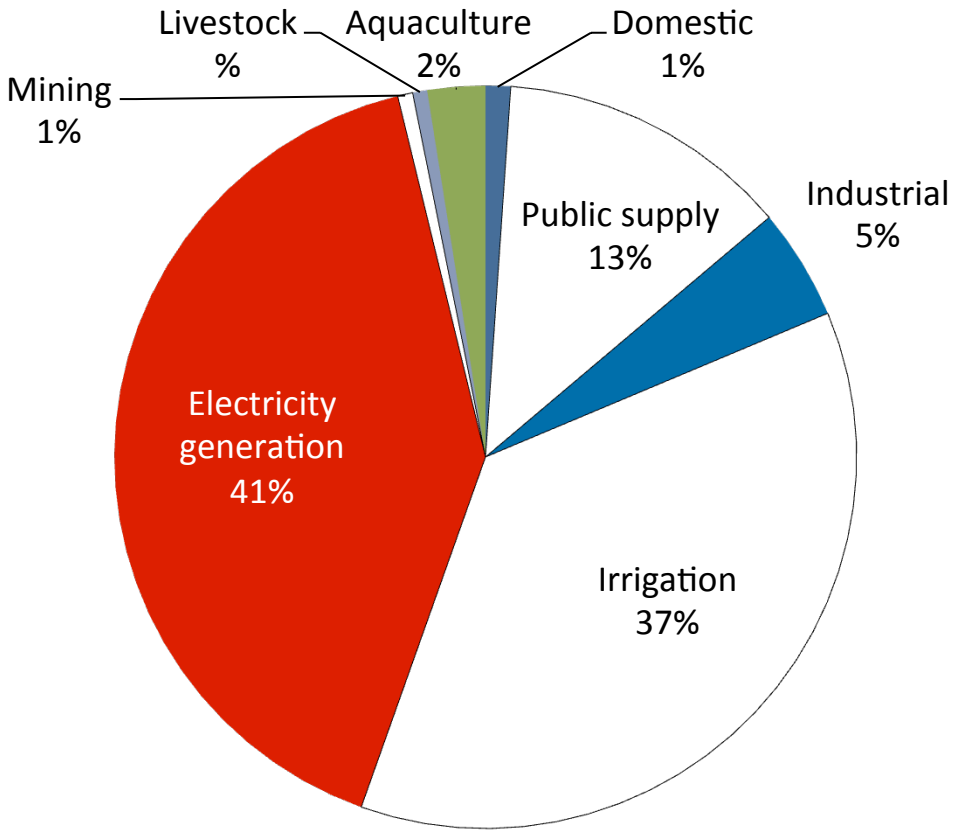
2. For electricity generation, which type of water does our country use less, surface water or groundwater?

3. For what purpose is surface water used most?

4. For what purpose is groundwater used most?

5. True of false: Our country uses the second most surface water for irrigation.

The circle graph below shows how our water is used in our country.



1. For what purposes is our water used most?

2. For what purposes is the fourth largest amount of water used?

3. Is the water used for both electricity generation and irrigation more than half of the total water used in our country?

4. What percentage of freshwater is used for irrigation, industrial, and public supply purposes altogether?

PROBLEM 19

Data Analysis

G3 G4 Bar graphs (up to 100)

G4 G5 Finding the mean, median & range

DO YOU THINK WE USE LOTS OF WATER?

PURPOSE

Through this activity, **3rd – 4th grade** students will

- Create bar graphs (up to 100)—**PROBLEM A**
- Interpret bar graphs (up to 100)—**PROBLEM A**
- Develop awareness of water use

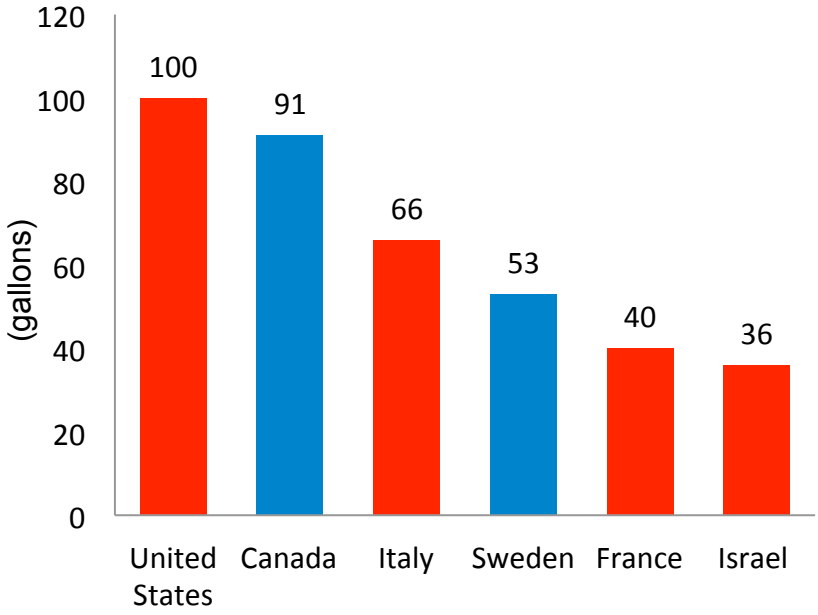
Through this activity, **4th – 5th grade** students will

- Find the mean, median & range —**PROBLEM B**
- Develop awareness of water quality

BACKGROUND FOR THE TEACHER

People in our country are one of the largest water consumers in the world. Average water use per person is about 100 gallons a day in the United States. This amount is about three times larger than that in Israel.

This figure compares average daily domestic water use per capita in some countries. As shown here, per capita water use is relatively high in the United States and Canada.



Source: Government of Canada

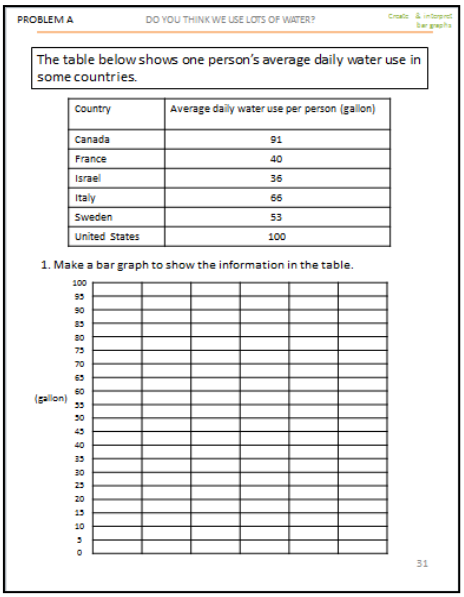
TEACHER GUIDE

The purpose of this activity is to enhance students' skills in data analysis. This worksheet was created based on data about per capita water use in some countries, including the United States, Canada, Italy, Sweden, France, and Israel. The data was obtained from the Government of Canada.

PROBLEM A

- *Creating and interpreting bar graphs*

Using the table which shows per capita average water use in 6 countries, students are asked to create a bar graph. They also use 2 digit multiplication for the questions to interpret the table and the bar graph.


PROBLEM A DO YOU THINK WE USE LOTS OF WATER?

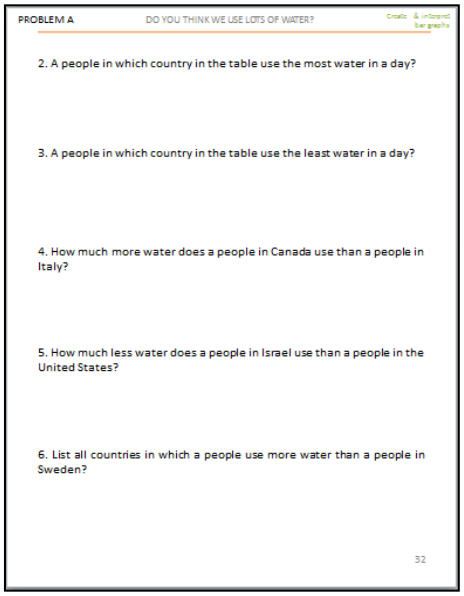
The table below shows one person's average daily water use in some countries.

Country	Average daily water use per person (gallon)
Canada	91
France	40
Israel	36
Italy	66
Sweden	53
United States	100

1. Make a bar graph to show the information in the table.

(gallon)

P 141—Student Sheet


PROBLEM A DO YOU THINK WE USE LOTS OF WATER?

2. A people in which country in the table use the most water in a day?

3. A people in which country in the table use the least water in a day?

4. How much more water does a people in Canada use than a people in Italy?

5. How much less water does a people in Israel use than a people in the United States?

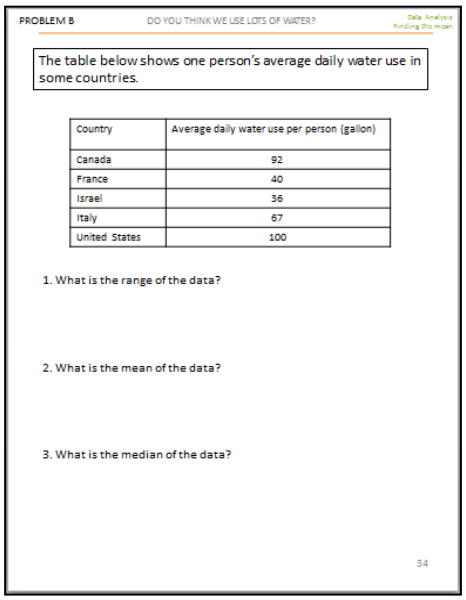
6. List all countries in which a people use more water than a people in Sweden?

P 142—Student Sheet

PROBLEM B

- *Finding the mean, median & range*

Using the table which lists per capita water use in five countries, students are asked to find the mean, median, and range. The numbers for Canada and Italy were modified to fit this activity.



PROBLEM B DO YOU THINK WE USE LOTS OF WATER? Data Analysis: Finding the mean

The table below shows one person's average daily water use in some countries.

Country	Average daily water use per person (gallon)
Canada	92
France	40
Israel	36
Italy	67
United States	100

1. What is the range of the data?

2. What is the mean of the data?

3. What is the median of the data?

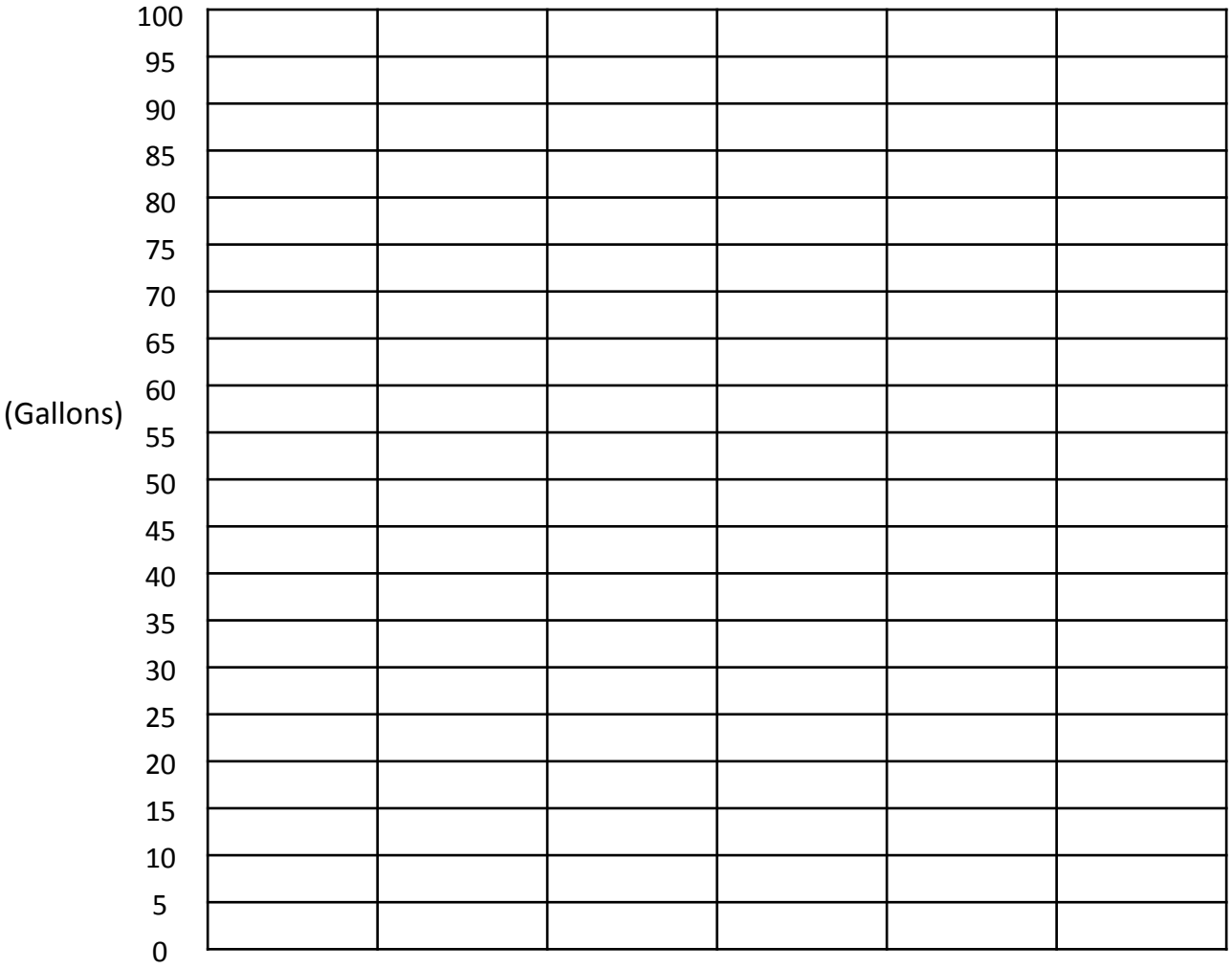
34

P 143—Student Sheet

The table below shows one person's average daily water use in six countries.

Country	Average daily water use per person (gallons)
Canada	91
France	40
Israel	36
Italy	66
Sweden	53
United States	100

1. Make a bar graph to represent the information in the table.



2. People in which country in the table use the most water in a day?

3. People in which country in the table use the least water in a day?

4. How much more water does a person in Canada use than a person in Italy?

5. How much less water does a person in Israel use than a person in the United States?

6. List all countries in which people use more water than people in Sweden?

The table below shows one person's average daily water use in five countries.

Country	Average daily water use per person (gallons)
Canada	92
France	40
Israel	36
Italy	67
United States	100

1. What is the range of the data?

2. What is the mean of the data?

3. What is the median of the data?

PROBLEM 20

Number & Operations

	Addition & subtraction (large numbers)
G4 G5	Addition & subtraction (decimals)
	Multiplication & division (large numbers)
	Multiplication & division (decimals)

WATER TANKS IN EVANSVILLE

PURPOSE

Through this activity, **4th – 5th grade** students will

- Add and subtract large numbers—**PROBLEM A**
- Add and subtract decimal numbers—**PROBLEM A**
- Multiply and divide large numbers—**PROBLEM B**
- Multiply and divide decimal numbers—**PROBLEM B**
- Understand how water is managed in Evansville
- Develop awareness of water conservation

BACKGROUND FOR THE TEACHER

The City of Evansville's Water Department extracts water from the Ohio River to meet demands in and around the City. To ensure drinking water quality, the Water Department monitors for nearly 100 contaminants, including bacteria, metals, and pesticides at its water filtration plant. At the plant, water is treated with several chemicals, including aluminum sulfate, caustic, fluoride, carbon, chlorine dioxide, and ammonia, to remove contaminants and improve the water quality. The method that applies chlorine dioxide for treatment of drinking water was invented at the Evansville Filtration Plant in 1989.

In total, the Evansville Water Department has 8 storage tanks and 1,000 miles of water mains in the system. The Department treats, on overage, about 25 million gallons of water per day. Evansville's drinking water meets or exceeds all state and federal regulations so that it can be drunk without any home filters.

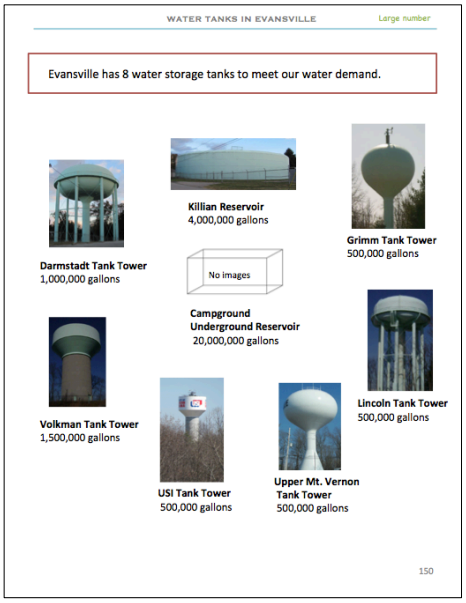
Our Sewer System

The Evansville Sewer Department manages the sewage system in the area that consists of 504 miles of sanitary sewer system (for human waste) and 318 miles of combined sewer system (for human waste and storm sewer). The sewage system begins with connecting pipes from residential and commercial buildings to larger underground trunk mains, which convey wastewater to two wastewater treatment facilities—the West Wastewater Treatment Plant and East Wastewater Treatment Plant. The West Wastewater Treatment Plant has the capacity to treat 30.6 million gallons of wastewater from the western basins of Evansville per day, while the East Wastewater Treatment Plant has the capacity to treat 22.5 million gallons of wastewater from the eastern basins.

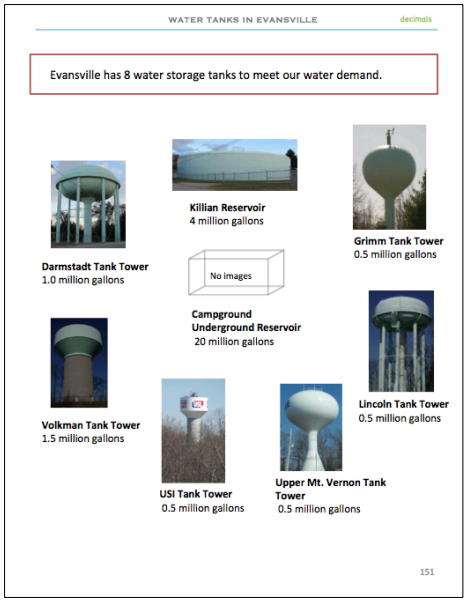
West Wastewater Treatment Plant

TEACHER GUIDE

The purpose of this activity is to enhance students' skills in addition, subtraction, multiplication, and division of large numbers. This worksheet uses data from 8 water storage tanks in Evansville. It provides two patterns to express the size of the tanks: One is expressed as 500,000 gallons (page 150) and the other is expressed as 0.5 million gallons (page 151), for example. Teachers can choose either one, depending on the skills they are focusing on in the class. The data was obtained from the Evansville Water Department.



P 150—Student Sheet

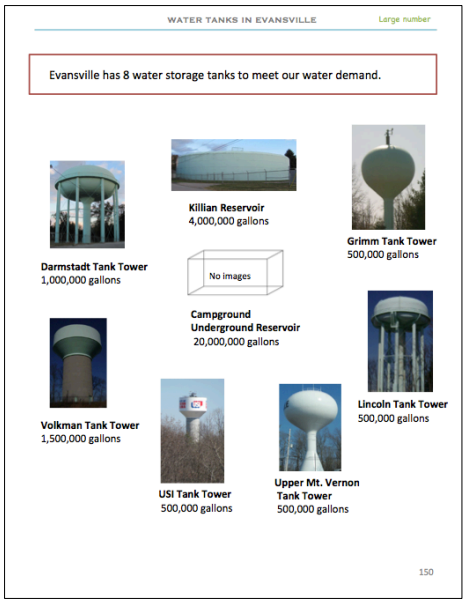


P 151—Student Sheet

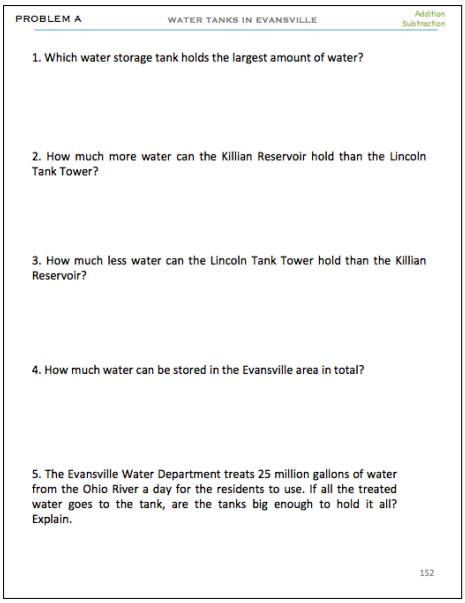
PROBLEM A

- *Addition & Subtraction (large numbers or decimals)*

Using data from 8 water storage tanks in Evansville, students are asked to answer questions that use addition and subtraction, inducing the size difference between two tanks and the total water storage capacity in Evansville. Use a worksheet on page 150 or 151, depending on the skills you are focusing on in the class.



P 150 or 151—Student Sheet

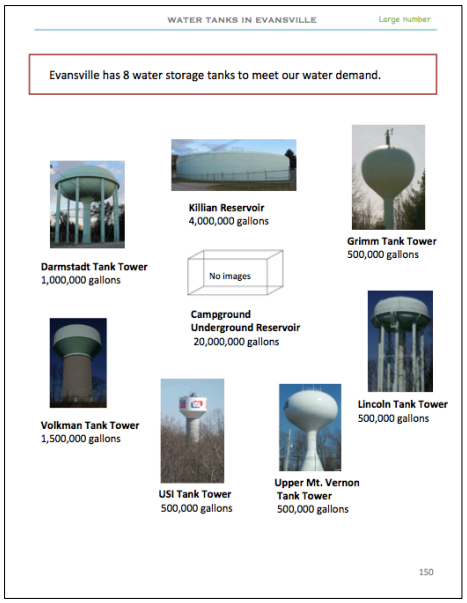


P 152—Student Sheet

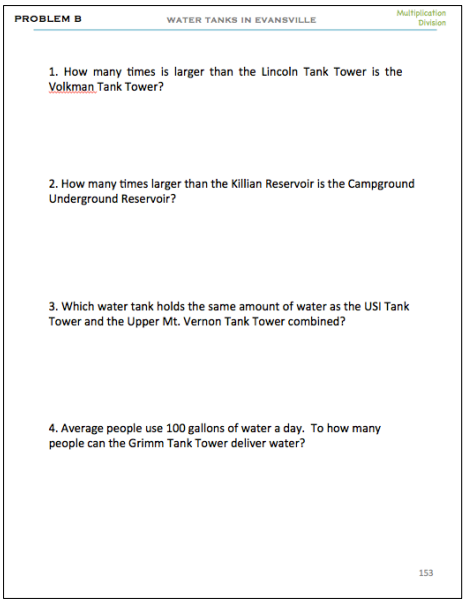
PROBLEM B

- *Multiplication & Division (large numbers or decimals)*

Using data from 8 water storage tanks in Evansville, students are asked to answer questions that use multiplication and division, inducing "how many times is A larger than B ?" Use a worksheet on page 150 or 151, depending on the skills you are focusing on in the class.



P 150 or 151—Student Sheet



P 153—Student Sheet

Water Conservation in Evansville

Masker Park Zoo & Botanic Garden

Rain Garden Project

Mesker Park Zoo planted a rain garden to reduce silt and pollutants in runoff water coming from their gift shop roof. Native plants were used in this rain garden because they don't require fertilizer and are more tolerant of the local climate, soil, and water conditions. These plants also have deep root systems which help replenish groundwater.

The Zoo also created buffer strips, grassed waterway, and pasture in what was the Asian Wild Horse exhibit. The project allows more sediment and water to be absorbed and filtered, resulting in reducing water pollution and preventing rain from causing the manure to run off.

Toyota Motor Manufacturing, Indiana

Water Monitoring

Toyota Motor Manufacturing, Indiana (TMMI), partnering with World Water Monitoring Challenge* (WWMC), offers a water monitoring program to about 2,200 6th grade students in Southwest Indiana every year. The program begins with classroom training that focuses on the importance of clean water to ecosystems, sources of water pollution, and basic sampling techniques.

Then the students are taken to one of the 100 different local watersheds to conduct sampling to collect and analyze water. All monitoring data is uploaded to the WWMC database.

**World Water Monitoring Challenge is an international education and outreach program that builds public awareness and involvement in protecting water resources around the world by engaging citizens to conduct basic monitoring of their local water bodies.*

Evansville Sewer Department

Reduction of Combined Sewer Overflows

Open graded stone being installed around the Old Courthouse

Combined sewer overflow (CSO) occurs when the volume of precipitation exceeds the capacity of waste water treatment plants and some untreated sewage / stormwater is discharged without treatment. To reduce the frequency of CSOs, the Evansville Sewer Department conducted a pilot project and created "green" infrastructure below eight city blocks of sidewalks that captures, stores, and infiltrates* stormwater in the downtown Evansville area. The pilot project that cost $235,000 has the potential to remove over 1.2 million gallons of stormwater from the Evansville's combined sewer system annually.

*Infiltration systems allow runoff water to percolate into the subsoil, which reduces stormwater runoff (see an infiltration system of University Evansville on page 149).

NRCS (Natural Resource Conservation Service)

Pigeon Creek Logjam Removal Project

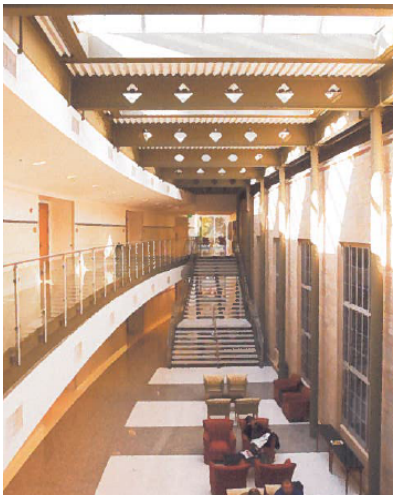
NRCS provides America's farmers and ranchers with financial and technical assistance to voluntarily put conservation on the ground not only helping the environment but agricultural operations, too. NRCS removed the Pigeon Creek logjam with a partnership between the State DNR, County Commissioners, local landowners, and area contractors. This project saved thousands of tons of soil and water contamination of Pigeon Creek.

University of Evansville

Stormwater Infiltration/ Detention System

The Schroeder Family School of Business Administration Building at University of Evansville, designed by Hafer Associates, is equipped with a stormwater infiltration / detention system, which is installed underground. The system allows water to percolate into the soil and prevents flash flooding and CSO (see page 148) as a result.

The system also allows bacteria to consume oil, antifreeze, and other waste products in the water before it enters the soil, playing a critical role in preventing water from contamination.



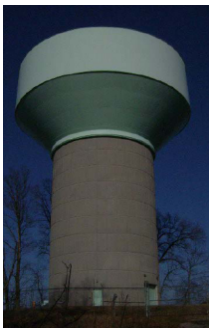
Evansville has 8 water storage tanks to meet our water demand.

Darmstadt Tank Tower
1,000,000 gallons

Killian Reservoir
4,000,000 gallons

Grimm Tank Tower
500,000 gallons

Campground Underground Reservoir
20,000,000 gallons



Volkman Tank Tower
1,500,000 gallons

Lincoln Tank Tower
500,000 gallons

USI Tank Tower
500,000 gallons

Upper Mt. Vernon Tank Tower
500,000 gallons

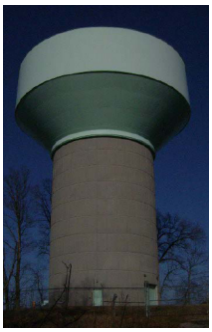
Evansville has 8 water storage tanks to meet our water demand.

Darmstadt Tank Tower
1.0 million gallons

Killian Reservoir
4 million gallons

Grimm Tank Tower
0.5 million gallons

Campground Underground Reservoir
20 million gallons



Volkman Tank Tower
1.5 million gallons

Lincoln Tank Tower
0.5 million gallons

USI Tank Tower
0.5 million gallons

Upper Mt. Vernon Tank Tower
0.5 million gallons

1. Which water storage tank holds the largest amount of water?

2. How much more water can the Killian Reservoir hold than the Lincoln Tank Tower?

3. How much less water can the Lincoln Tank Tower hold than the Killian Reservoir?

4. How much water can be stored in the Evansville area in total?

5. The Evansville Water Department treats 25 million gallons of water from the Ohio River a day for the residents to use. If all the treated water goes to the tank, are the tanks big enough to hold it all? Explain.

1. How many times is larger than the Lincoln Tank Tower is the Volkman Tank Tower?

2. How many times larger than the Killian Reservoir is the Campground Underground Reservoir?

3. Which water tank holds the same amount of water as the USI Tank Tower and the Upper Mt. Vernon Tank Tower combined?

4. Average people use 100 gallons of water a day. To how many people can the Grimm Tank Tower deliver water?

PROBLEM 21

Number & Operations

Number comparison (3-4 digits)

G3 Place Value

G4 Addition & subtraction (3-4 digits)

Rounding

Data Analysis

G3 G4 Bar graphs (3-4 digits)

HOW LONG IS OUR OHIO RIVER?

PURPOSE

Through this activity, **3rd – 4th grade** students will

- Practice number comparison (3-4 digits)—**PROBLEM A**
- Practice place value problems (3-4 digits)—**PROBLEM B**
- Add and subtract 3 &4-digit numbers—**PROBLEM C**
- Practice rounding (nearest 100)—**PROBLEM D**
- Create bar graphs (3-4 digits)—**PROBLEM E**
- Develop awareness of our main water resource, the Ohio River

BACKGROUND FOR THE TEACHER

The majority of drinking water for the residents of Southwest Indiana comes from the Ohio River. According to the U.S. Geological Survey, the Ohio River is about 1,310 miles long and the largest river, by volume, that flows into the Mississippi River—the chief river of the largest drainage system in North America. It flows through or borders 6 states—Pennsylvania, West Virginia, Ohio, Indiana, Kentucky, and Illinois.

Prior to European conquest, the Ohio River was important in the history of Native Americans who created successful cultures along the valley. Angel Mounds, located in Vanderburgh and Warrick counties, is one of the numerous civilized towns that were formed by the prehistoric Native Americans who used the River for travel and trade.

Now, the Ohio River is a vital water source for more than three million people, and over 25 million people, almost 10% of the U.S. population, live within the Ohio River Basin. In the City of Evansville, for example, about 24 million gallons of water are extracted from the Ohio River everyday through the City of Evansville's Water Department and distributed to about 600,000 customers. Evansville's drinking water is treated at the Evansville filtration plant and its quality meets or exceeds all state and federal regulations.

Ohio River History

- For thousands of years, Native Americans used the Ohio River as a major transportation and trading route.
- The River's name came from *ohi:yo:h* that means "good river" as the River was a prime route that went through the lower Mississippi during the pre-Colombian era.
- The River was the southern boundary of the Northwest Territory during the 19th century.
- Thomas Jefferson described in his *Notes on the State of Virginia*, in 1781 : "The Ohio is the most beautiful river on earth. Its current gentle, waters clear, and bosom smooth and unbroken by rocks and rapids, a single instance only excepted."

TEACHER GUIDE

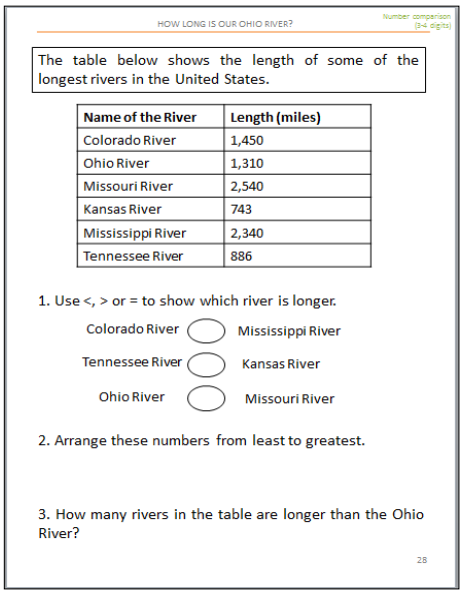
The purpose of this activity is to enhance students' skills in number and operations, including number comparison, place value, addition and subtraction, and rounding, and creation of bar graphs, while promoting their understanding of our main source of water—the Ohio River. This activity is created based on the length of some of the largest rivers in the United States, such as the Missouri River and Mississippi River. The data was obtained from the U.S. Geological Survey.

Name of the River	Length (miles)
Missouri River	2,540
Mississippi River	2,340
Colorado River	1,450
Ohio River	1,310
Tennessee River	886
Kansas River	743

PROBLEM A

- *Number comparison (3-4 digits)*

Using the table that shows the length of six rivers, students are asked to compare 3- and 4- digit numbers. They also use the symbols <, >, = to compare the numbers.



HOW LONG IS OUR OHIO RIVER?

Number comparison (3-4 digits)

The table below shows the length of some of the longest rivers in the United States.

Name of the River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

1. Use <, > or = to show which river is longer.

Colorado River ◯ Mississippi River

Tennessee River ◯ Kansas River

Ohio River ◯ Missouri River

2. Arrange these numbers from least to greatest.

3. How many rivers in the table are longer than the Ohio River?

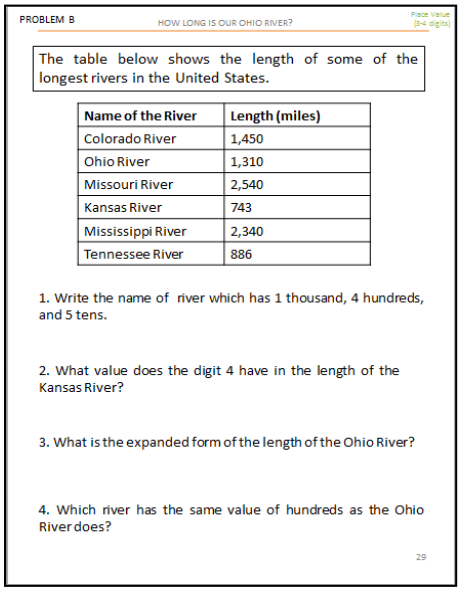
28

P 159—Student Sheet

PROBLEM B

- *Place value (3-4 digits)*

Using the table that shows the length of six rivers, students complete questions related to the place value.



PROBLEM B HOW LONG IS OUR OHIO RIVER? Place Value (3-4 digits)

The table below shows the length of some of the longest rivers in the United States.

Name of the River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

1. Write the name of river which has 1 thousand, 4 hundreds, and 5 tens.

2. What value does the digit 4 have in the length of the Kansas River?

3. What is the expanded form of the length of the Ohio River?

4. Which river has the same value of hundreds as the Ohio River does?

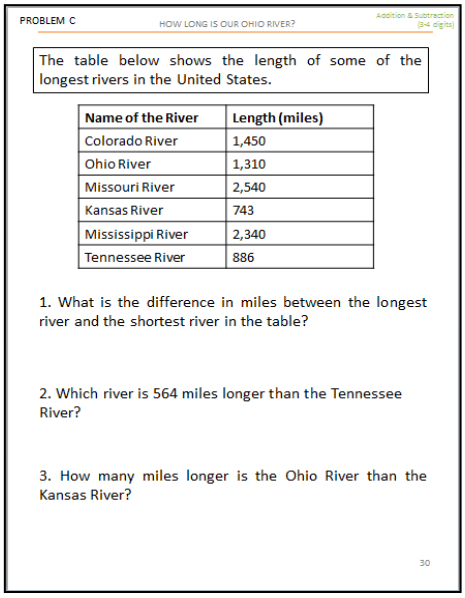
29

P 160—Student Sheet

PROBLEM C

- *Addition and subtraction (3-4 digits)*

Using the table that shows the length of six rivers, students complete questions by adding and subtracting three and four digit-numbers.



PROBLEM C HOW LONG IS OUR OHIO RIVER? Addition & Subtraction (3-4 digits)

The table below shows the length of some of the longest rivers in the United States.

Name of the River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

1. What is the difference in miles between the longest river and the shortest river in the table?

2. Which river is 564 miles longer than the Tennessee River?

3. How many miles longer is the Ohio River than the Kansas River?

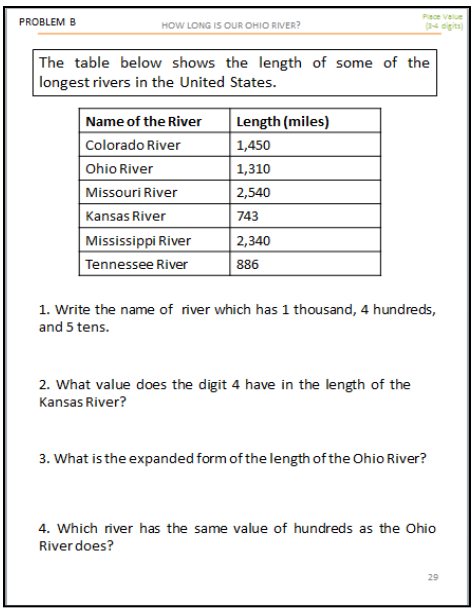
30

P 161—Student Sheet

PROBLEM D

- *Rounding (3-4 digits)*

Using the table that shows the length of six rivers, students are asked to round these numbers to the nearest hundred.



PROBLEM B — HOW LONG IS OUR OHIO RIVER? — Place Value (3-4 digits)

The table below shows the length of some of the longest rivers in the United States.

Name of the River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

1. Write the name of river which has 1 thousand, 4 hundreds, and 5 tens.

2. What value does the digit 4 have in the length of the Kansas River?

3. What is the expanded form of the length of the Ohio River?

4. Which river has the same value of hundreds as the Ohio River does?

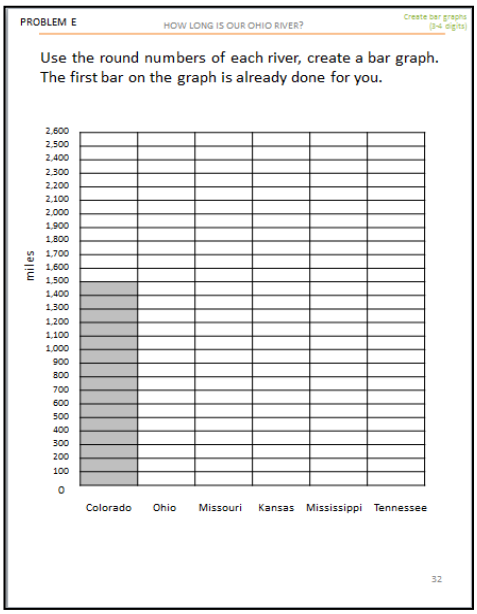
29

P 162—Student Sheet

PROBLEM E

- *Creating bar graphs*

Using the rounded numbers that students arrived at in **PROBLEM D**, students are asked to create a bar graph that compares the length of 6 rivers in the United States, including the Ohio River.



P 163—Student Sheet

The table below shows the length of some of the longest rivers in the United States.

Name of River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

1. Use <, > or = to show which river is longer.

Colorado River ◯ Mississippi River

Tennessee River ◯ Kansas River

Ohio River ◯ Missouri River

2. Arrange these numbers from least to greatest.

3. How many rivers in the table are longer than the Ohio River?

The table below shows the length of some of the longest rivers in the United States.

Name of River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

1. Write the name of river which has 1 thousand, 4 hundreds, and 5 tens.

2. What value does the digit 4 have in the length of the Kansas River?

3. What is the expanded form of the length of the Ohio River?

4. Which river has the same value of hundreds as the Ohio River does?

The table below shows the length of some of the longest rivers in the United States.

Name of River	Length (miles)
Colorado River	1,450
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Missouri River	2,540
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Mississippi River	2,340
Tennessee River	886

1. What is the difference in miles between the longest river and the shortest river in the table?

2. Which river is 564 miles longer than the Tennessee River?

3. How many miles longer is the Ohio River than the Kansas River?

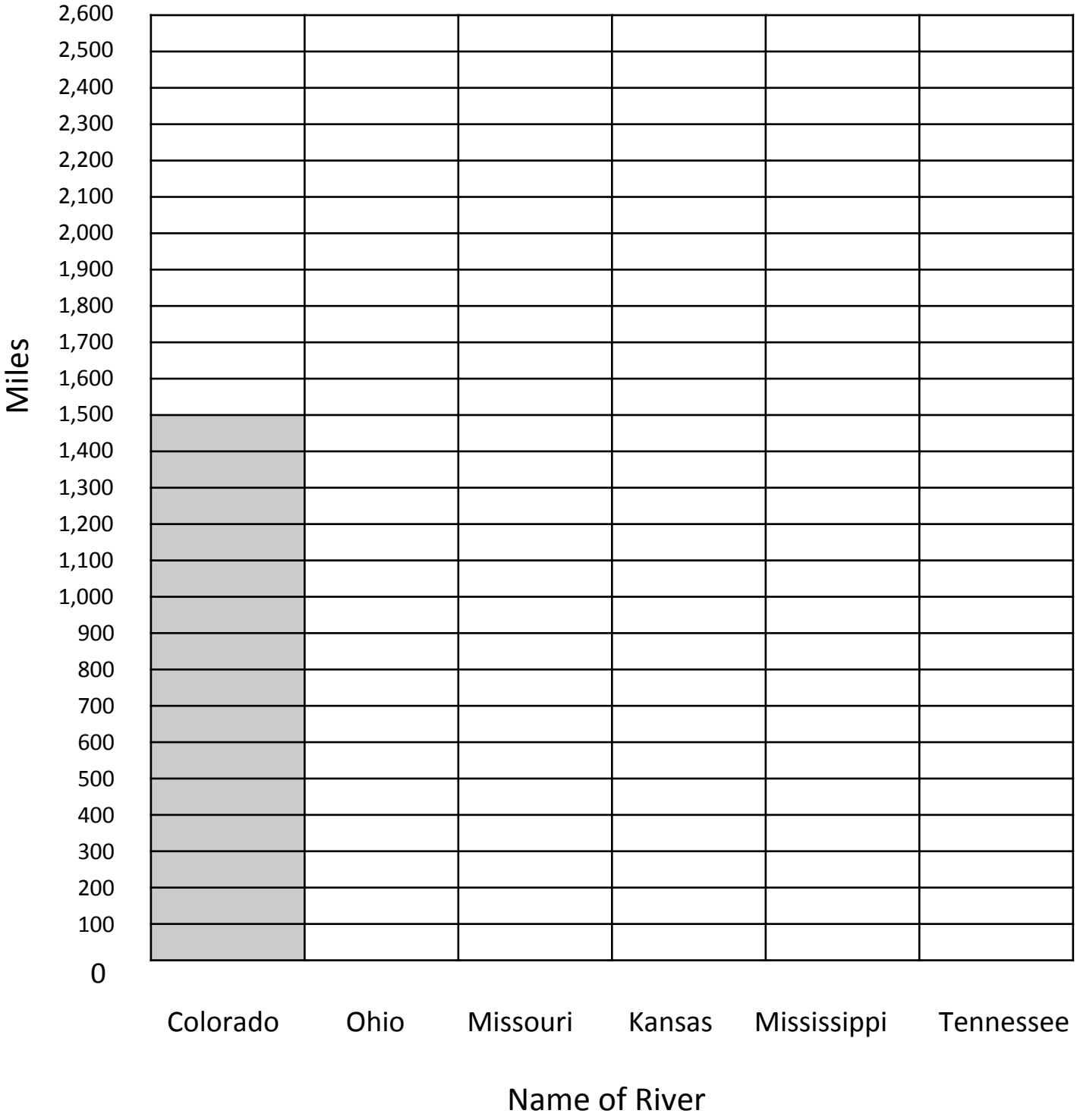
The table below shows the length of some of the longest rivers in the United States.

Name of River	Length (miles)
Colorado River	1,450
Ohio River	1,310
Missouri River	2,540
Kansas River	743
Mississippi River	2,340
Tennessee River	886

Round the length of the rivers to the nearest hundred.

Name of River	Length (miles)
Colorado River	
Ohio River	
Missouri River	
Kansas River	
Mississippi River	
Tennessee River	

Using the round numbers of each river's length, create a bar graph. The first bar on the graph is already done for you.



PROBLEM 22

Number & Operations

G2 G3	Addition & subtraction (2 digits)
G3 G4 G5	Addition & Subtraction (3 digits)
G3 G4 G5	Multiplication (2 digits x 1 digit)

APPLE *vs.* HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE?

PURPOSE

Through this activity, **2nd – 3rd grade** students will

- Add and subtract 2-digit numbers—**PROBLEM A**
- Understand how much water is required to produce food
- Develop awareness of water conservation

Through this activity, **3rd – 5th grade** students will

- Add and subtract 3-digit numbers—**PROBLEM B & C**
- Multiply 2 digits by 1 digit—**CHALLENGE**
- Understand how much water is required to produce food
- Develop awareness of water conservation

BACKGROUND FOR THE TEACHER

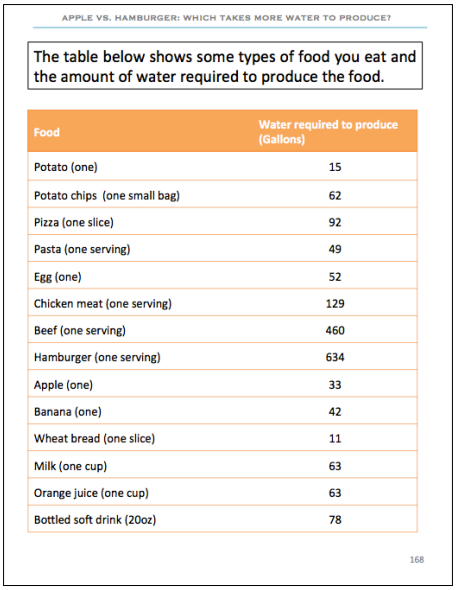
It is estimated that it takes 530 to 1,320 gallons of water to produce one person's daily food. Demand for food production have been increasing as global population grows, and has demand for water. In particular, the increase of meat consumption has become one of the dominant pressures on our water resources because livestock production requires additional crop production as feed.

Beef and its Giant Water Footprint

Increasing demands for livestock production and animal feed are one of the dominant pressures on water resources these days. Meat production takes about 10 times more water than grain production because livestock production requires additional crop production as feed. It is expected that the global average of meat consumption will increase from 82 pounds per person per year in 1999/2001 to 115 pounds in 2050 (United Nations, 2012). After all, global water consumption for agriculture is expected to increase by 19% by 2050 (United Nations).

TEACHER GUIDE

The table on the right shows how much water is required to produce some of the foods we eat quite often, such as apples and pizzas. The table is created based on data obtained from the Water Footprint and the World watch Institute.



APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE?

The table below shows some types of food you eat and the amount of water required to produce the food.

Food	Water required to produce (Gallons)
Potato (one)	15
Potato chips (one small bag)	62
Pizza (one slice)	92
Pasta (one serving)	49
Egg (one)	52
Chicken meat (one serving)	129
Beef (one serving)	460
Hamburger (one serving)	634
Apple (one)	33
Banana (one)	42
Wheat bread (one slice)	11
Milk (one cup)	63
Orange juice (one cup)	63
Bottled soft drink (20oz)	78

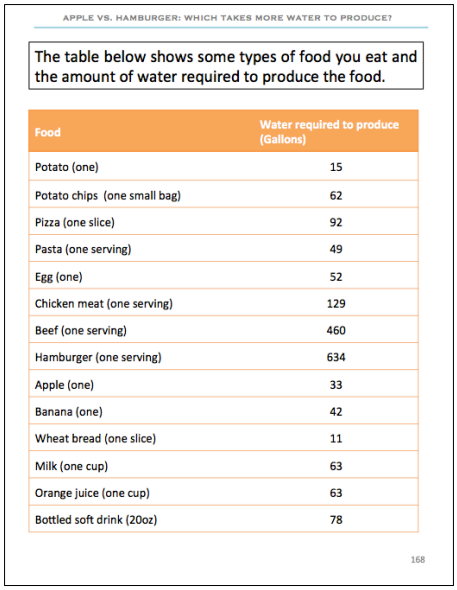
168

P 168 -Table

PROBLEM A

- *Addition & subtraction (2 digits)*

Using the table on page 168, students are asked to compare two types of food to figure out which one requires more/less water to produce. Questions in problem A include "How much more water does it take to produce a bottled soft drink than a cup of milk?"



APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE?

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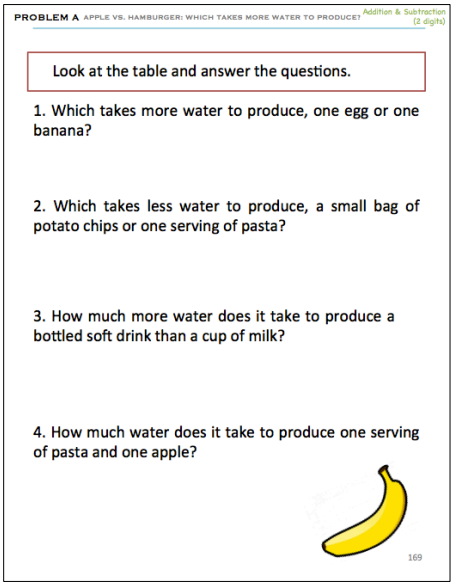
Egg (one)	52
Chicken meat (one serving)	129
Beef (one serving)	460
Hamburger (one serving)	634
Apple (one)	33
Banana (one)	42
Wheat bread (one slice)	11
Milk (one cup)	63
Orange juice (one cup)	63
Bottled soft drink (20oz)	78

168

P 168 -Table



PROBLEM A APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE? Addition & Subtraction (2 digits)

Look at the table and answer the questions.

1. Which takes more water to produce, one egg or one banana?

2. Which takes less water to produce, a small bag of potato chips or one serving of pasta?

3. How much more water does it take to produce a bottled soft drink than a cup of milk?

4. How much water does it take to produce one serving of pasta and one apple?

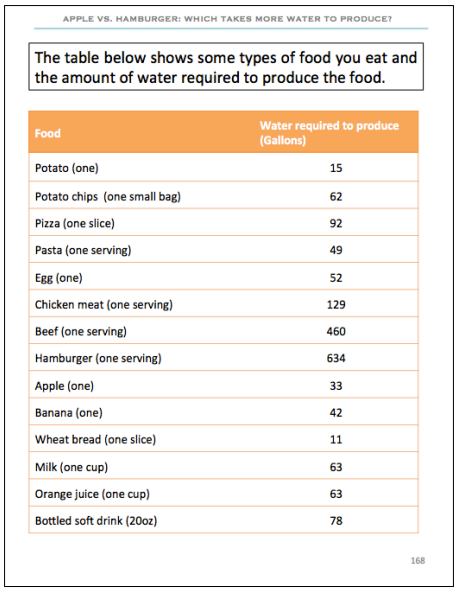
169

P 169—Student Sheet

PROBLEM B

- *Addition & subtraction (3 digits)*

Using the table on page 168, students are asked to compare two items to figure out which one requires more/less water to produce. Questions in the problem B include "How much more water does it take to produce one serving of hamburger than one serving of chicken meat?"



APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE?

The table below shows some types of food you eat and the amount of water required to produce the food.

Food	Water required to produce (Gallons)
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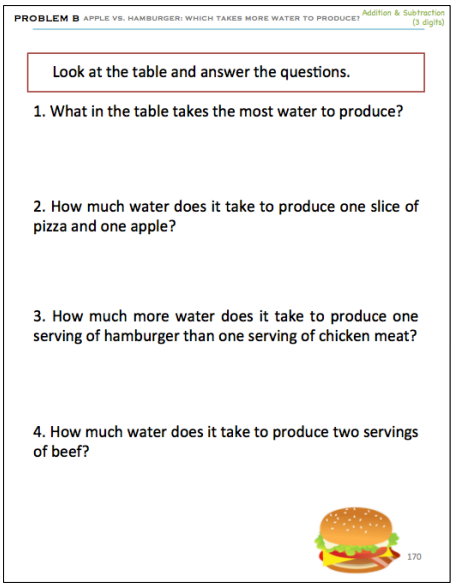
Pizza (one slice)	92
Pasta (one serving)	49
Egg (one)	52
Chicken meat (one serving)	129
Beef (one serving)	460
Hamburger (one serving)	634
Apple (one)	33
Banana (one)	42
Wheat bread (one slice)	11
Milk (one cup)	63
Orange juice (one cup)	63
Bottled soft drink (20oz)	78

168

P 168 -Table



PROBLEM B APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE? Addition & Subtraction (3 digits)

Look at the table and answer the questions.

1. What in the table takes the most water to produce?

2. How much water does it take to produce one slice of pizza and one apple?

3. How much more water does it take to produce one serving of hamburger than one serving of chicken meat?

4. How much water does it take to produce two servings of beef?

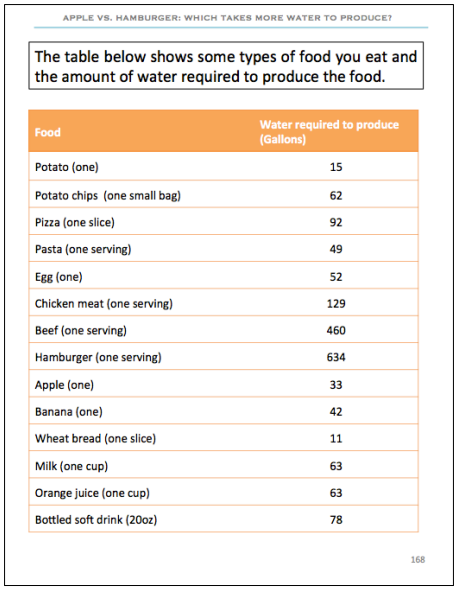
170

P 170—Student Sheet

PROBLEM C

- *Addition & subtraction (3 digits)*

Using the table on page 168, students are asked to find out how much water is required to produce your meal that consists of at least three items from the table. Students complete questions by adding or subtracting multiple numbers.



APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE?

The table below shows some types of food you eat and the amount of water required to produce the food.

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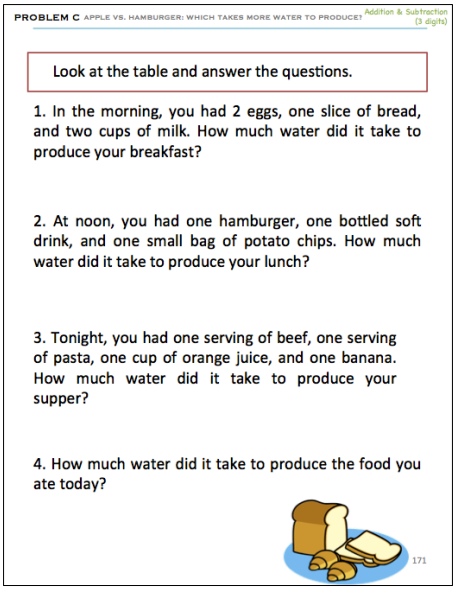
Pasta (one serving)	49
Egg (one)	52
Chicken meat (one serving)	129
Beef (one serving)	460
Hamburger (one serving)	634
Apple (one)	33
Banana (one)	42
Wheat bread (one slice)	11
Milk (one cup)	63
Orange juice (one cup)	63
Bottled soft drink (20oz)	78

168

P 168 -Table



PROBLEM C APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE? Addition & Subtraction (3 digits)

Look at the table and answer the questions.

1. In the morning, you had 2 eggs, one slice of bread, and two cups of milk. How much water did it take to produce your breakfast?

2. At noon, you had one hamburger, one bottled soft drink, and one small bag of potato chips. How much water did it take to produce your lunch?

3. Tonight, you had one serving of beef, one serving of pasta, one cup of orange juice, and one banana. How much water did it take to produce your supper?

4. How much water did it take to produce the food you ate today?

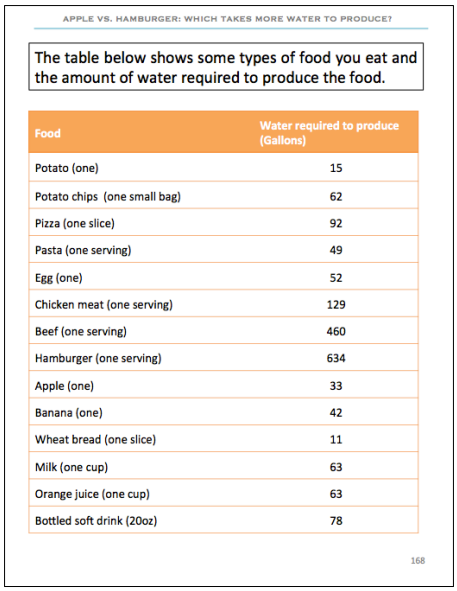
171

P 171—Student Sheet

CHALLENGE

- *Multiplication (2 digits x 1 digit)*

This page is provided for those who are capable of solving more challenging problems after completing problem C. The problem asks which supper requires more/ less water to produce. It requires 3-digit addition and subtraction skills.



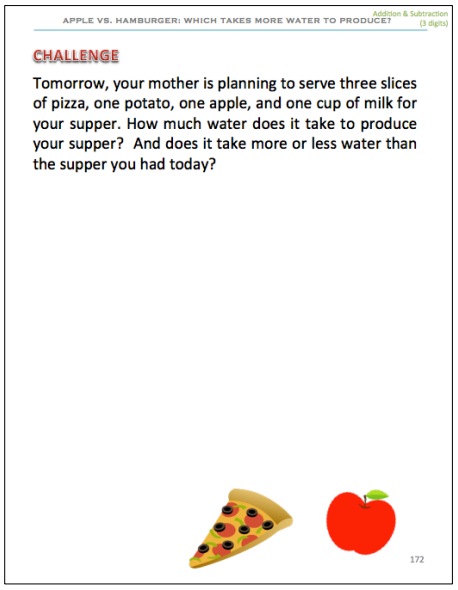
APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE?

The table below shows some types of food you eat and the amount of water required to produce the food.

Food	Water required to produce (Gallons)
Potato (one)	15
Potato chips (one small bag)	62
Pizza (one slice)	92
Pasta (one serving)	49
Egg (one)	52
Chicken meat (one serving)	129
Beef (one serving)	460
Hamburger (one serving)	634
Apple (one)	33
Banana (one)	42
Wheat bread (one slice)	11
Milk (one cup)	63
Orange juice (one cup)	63
Bottled soft drink (20oz)	78

168

P 168 -Table



APPLE VS. HAMBURGER: WHICH TAKES MORE WATER TO PRODUCE? Addition & Subtraction (3 digits)

CHALLENGE

Tomorrow, your mother is planning to serve three slices of pizza, one potato, one apple, and one cup of milk for your supper. How much water does it take to produce your supper? And does it take more or less water than the supper you had today?

172

P 172—Student Sheet

The table below shows some types of food you eat and the amount of water required to produce the food.

Food	Water required to produce (Gallons)
Potato (one)	15
Potato chips (one small bag)	62
Pizza (one slice)	92
Pasta (one serving)	49
Egg (one)	52
Chicken meat (one serving)	129
Beef (one serving)	460
Hamburger (one serving)	634
Apple (one)	33
Banana (one)	42
Wheat bread (one slice)	11
Milk (one cup)	63
Orange juice (one cup)	63
Bottled soft drink (20oz)	78

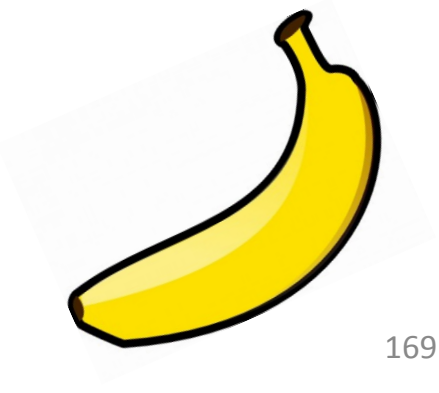
Look at the table and answer the questions.

1. Which takes more water to produce, one egg or one banana?

2. Which takes less water to produce, a small bag of potato chips or one serving of pasta?

3. How much more water does it take to produce a bottled soft drink than a cup of milk?

4. How much water does it take to produce one serving of pasta and one apple?



Look at the table and answer the questions.

1. What in the table takes the most water to produce?

2. How much water does it take to produce one slice of pizza and one apple?

3. How much more water does it take to produce one serving of hamburger than one serving of chicken meat?

4. How much water does it take to produce two servings of beef?

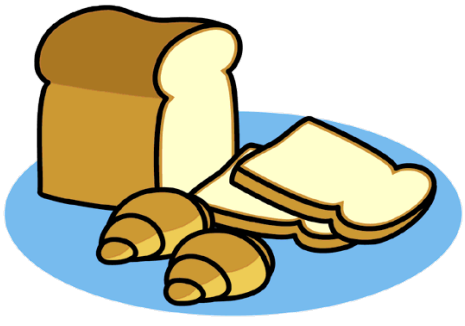
Look at the table and answer the questions.

1. In the morning, you had 2 eggs, one slice of bread, and two cups of milk. How much water did it take to produce your breakfast?

2. At noon, you had one hamburger, one bottled soft drink, and one small bag of potato chips. How much water did it take to produce your lunch?

3. Tonight, you had one serving of beef, one serving of pasta, one cup of orange juice, and one banana. How much water did it take to produce your supper?

4. How much water did it take to produce the food you ate today?



CHALLENGE

Tomorrow, your mother is planning to serve three slices of pizza, one potato, one apple, and one cup of milk for your supper. How much water does it take to produce your supper? And does it take more or less water than the supper you had today?

PROBLEM 23

Number & Operations

G1	Number comparison (1-digit number)
G1	Addition (1-digit number)
G2 G3	Multiplication (1 digit x 1 digit)
G3 G4 G5	Multiplication (2 digits x 1 digit)

HOW MUCH WATER DO I USE??

PURPOSE

Through this activity, **1st grade** students will

- Compare numbers—**PROBLEM A**
- Add 1-digit numbers—**PROBLEM A**
- Understand how much water is consumed for daily activities
- Develop awareness of water conservation

Through this activity, **2nd- 3rd grade** students will

- Multiple 1-digit numbers—**PROBLEM B**
- Understand how much water is consumed for daily activities
- Develop awareness of water conservation

Through this activity, **3rd – 5th grade** students will

- Multiply 2-digit number by 1-digit number—**PROBLEM C**
- Solve challenging 1 digit x 1 digit problems—**PROBLEM C**
- Understand how much water is consumed for daily activities
- Develop awareness of water conservation

BACKGROUND FOR THE TEACHER

The average person uses 120 gallons of water every day. Washing hands requires about 2 gallons of water and taking a shower for ten minutes requires 38 gallons of water, for example. Most of the water we use every day comes from the Ohio River. River water is precious because it accounts for only 0.00015% of the total water on the earth (see page 112). To raise awareness of water conservation, it is important for your students to realize how much water they consume every day.

TEACHER GUIDE

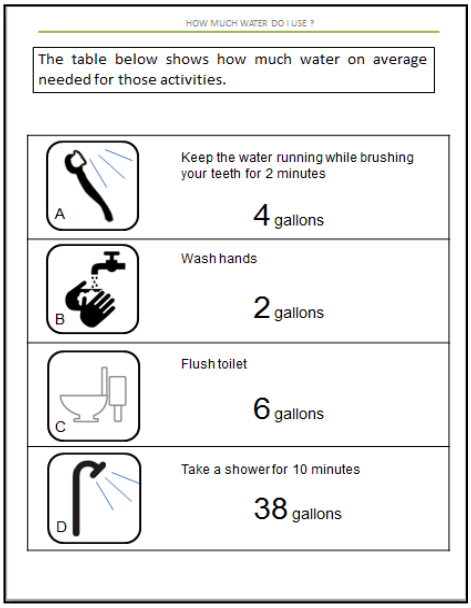
The table on page 176 shows how much water on average is required to conduct daily activities, including brushing teeth, flushing toilets, and taking a shower.

Activity	Water use (gallons)
Keep the water running while brushing your teeth for 2 minutes twice a day	8
Wash hands	2
Flush toilet	6
Take a shower for 10 minutes	38

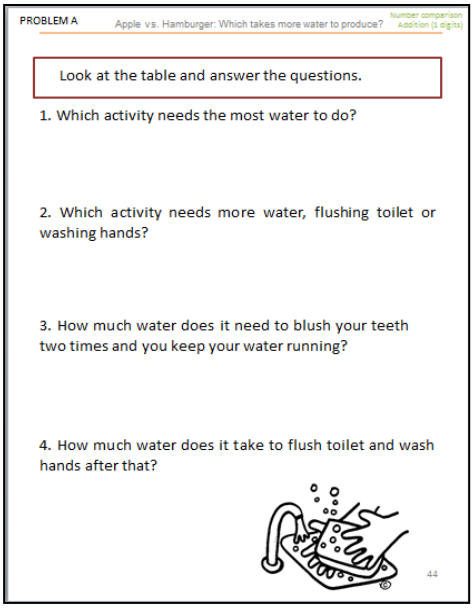
PROBLEM A

- *Number comparison (1 digit)*
- *Addition (1 digit)*

Using the table on page 176, students are asked to compare two activities to figure out which activity requires more/less water to do. Students are also asked to add two 1-digit numbers to find out how much water is consumed to do those activities.



P 176-Table

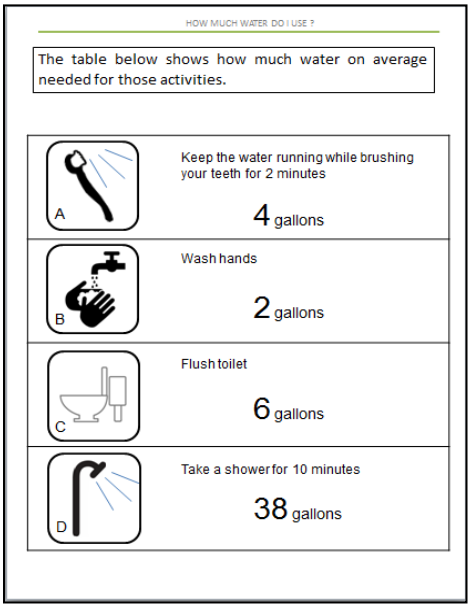


P 177—Student Sheet

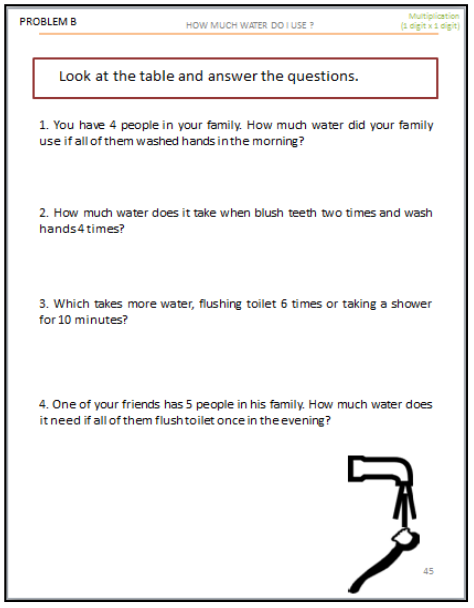
PROBLEM B

- *Multiplication (1 digit x 1 digit)*

Using the table on page 176, students are asked to complete questions by using 1 digit x 1 digit multiplication.



P 176-Table

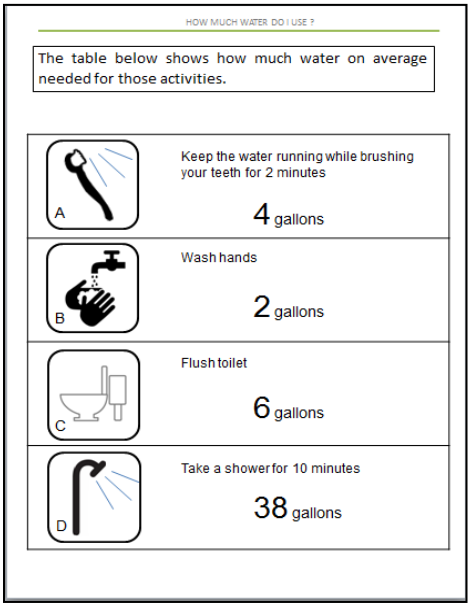


P 178—Student Sheet

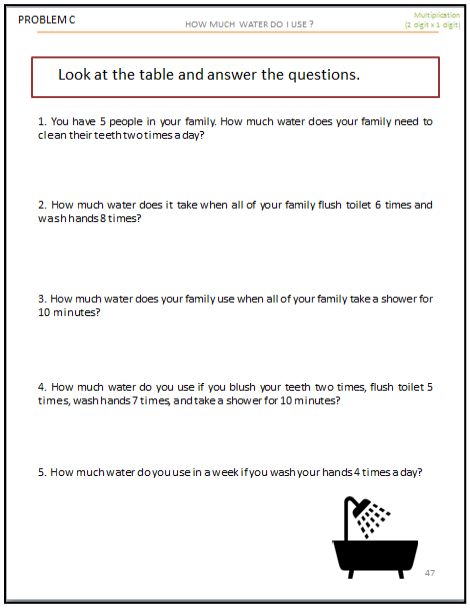
PROBLEM C

- *Multiplication (2 digits x 1 digit)*

Using the table on page 176 students are asked to complete questions by using 2 digits x 1 digit multiplication. They are also asked to solve challenging problems that use 1 digit x 1 digit operations.

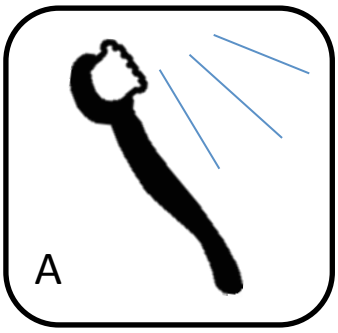
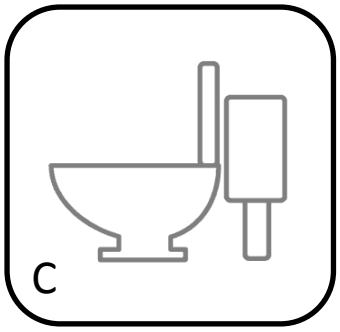
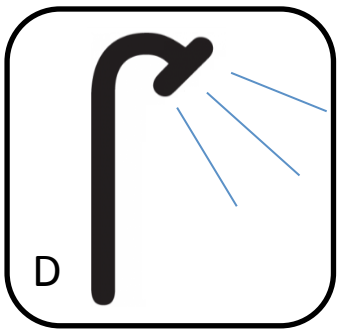


P 176-Table



P 179—Student Sheet

The table below shows how much water on average needed for these activities.

 A	Keep the water running while brushing your teeth for 2 minutes	4 gallons
 B	Wash hands	2 gallons
 C	Flush toilets	6 gallons
 D	Take a shower for 10 minutes	38 gallons

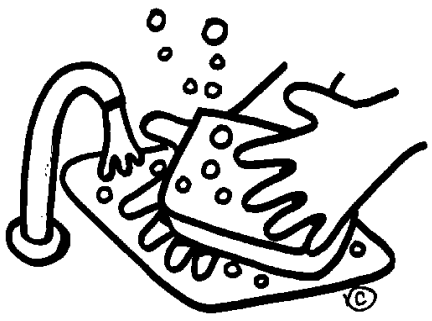
Look at the table and answer the questions.

1. Which activity needs the most water to do?

2. Which activity needs more water, flushing the toilet or washing your hands?

3. How much water does it take to brush your teeth two times with the water running?

4. How much water does it take to flush the toilet and wash your hands after?



Look at the table and answer the questions.

1. You have 4 people in your family. How much water did your family use if all of them washed their hands in the morning?

2. How much water does it take when your brush your teeth two times and wash your hands 4 times?

3. Which takes more water, flushing the toilet 6 times or taking a shower for 10 minutes?

4. One of your friends has 5 people in his family. How much water does it take if all of them flush the toilet once in the evening?

Look at the table and answer the questions.

1. You have 5 people in your family. How much water does your family need to brush their teeth two times a day?

2. How much water does it take when all of your family flushes the toilet 6 times and washes their hands 8 times?

3. How much water does your family use when all of your family takes a shower for 10 minutes?

4. How much water do you use if you brush your teeth two times, flush the toilet 5 times, wash your hands 7 times, and take a shower for 10 minutes?

5. How much water do you use in a week if you wash your hands 4 times a day?

Number & Operations

G2 Subtraction
G3 (2 digits)

Data Analysis

G4 Double bar
G5 graphs

HOW CAN I SAVE WATER?

PURPOSE

Through this activity, **2nd – 3rd grade** students will

- Subtract 2-digit numbers—**PROBLEM A**
- Learn how much water they can save when they do daily activities
- Raise awareness of their own water use
- Learn how small changes make a big difference

Through this activity, **4th – 5th grade** students will

- Create double bar graphs—**PROBLEM B**
- Interpret double bar graphs—**PROBLEM B**
- Learn how much water they can save when they do daily activities
- Raise awareness of their own water use
- Learn how small changes make a big difference

BACKGROUND FOR THE TEACHER

Replacing older showerheads, toilets, and faucets with low-flow ones is considered one of the most effective ways to reduce water use.

However, there are many other opportunities for saving water even for elementary school children. For example, stopping flushing trash saves 6 gallons of water and turning off the water when putting shampoo and body soap saves as much as 38 gallons of water.

WaterSense, a partnership program by the U.S. EPA, offers people a way to use less water by certifying water-efficient products and services. Products and services that have earned the WaterSense label are at least 20 percent more efficient than average products in that category.

TEACHER GUIDE

Page X shows how much water you can save by changing the way you do some daily activities. Activities include turning off the water while brushing teeth, drinking juice from a reusable mug, throwing trash away in a trash bin instead of the toilet, limiting the use of running water while washing dishes, and turning off water when putting shampoo and body soap when you take a shower.

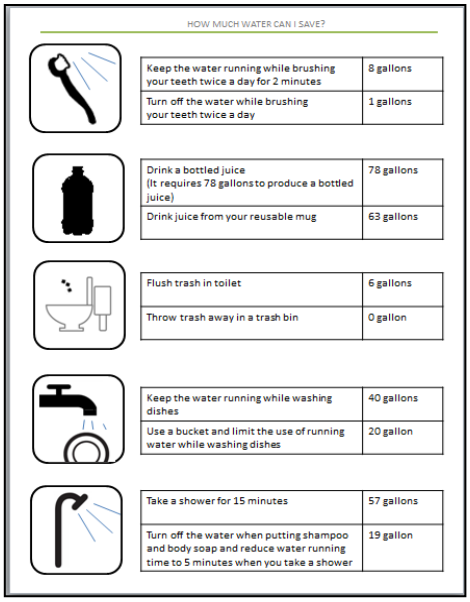
USEFUL SOURCES

WaterSense for Kids, U.S. EPA
http://www.epa.gov/watersense/kids/index.html

PROBLEM A

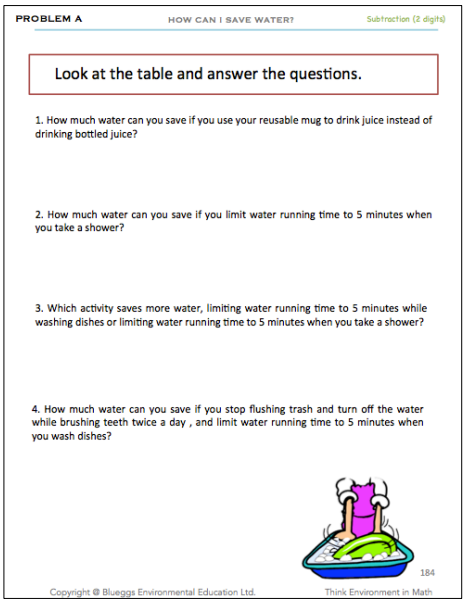
- *Subtraction (2 digits)*

Using the table on page 183, students are asked to use subtraction to find the difference between two numbers.


HOW MUCH WATER CAN I SAVE?

Keep the water running while brushing your teeth twice a day for 2 minutes	8 gallons
Turn off the water while brushing your teeth twice a day	1 gallons
Drink a bottled juice (It requires 78 gallons to produce a bottled juice)	78 gallons
Drink juice from your reusable mug	63 gallons
Flush trash in toilet	6 gallons
Throw trash away in a trash bin	0 gallon
Keep the water running while washing dishes	40 gallons
Use a bucket and limit the use of running water while washing dishes	20 gallon
Take a shower for 15 minutes	57 gallons
Turn off the water when putting shampoo and body soap and reduce water running time to 5 minutes when you take a shower	19 gallon

P 183-Table


PROBLEM A HOW CAN I SAVE WATER? Subtraction (2 digits)

Look at the table and answer the questions.

1. How much water can you save if you use your reusable mug to drink juice instead of drinking bottled juice?

2. How much water can you save if you limit water running time to 5 minutes when you take a shower?

3. Which activity saves more water, limiting water running time to 5 minutes while washing dishes or limiting water running time to 5 minutes when you take a shower?

4. How much water can you save if you stop flushing trash and turn off the water while brushing teeth twice a day , and limit water running time to 5 minutes when you wash dishes?

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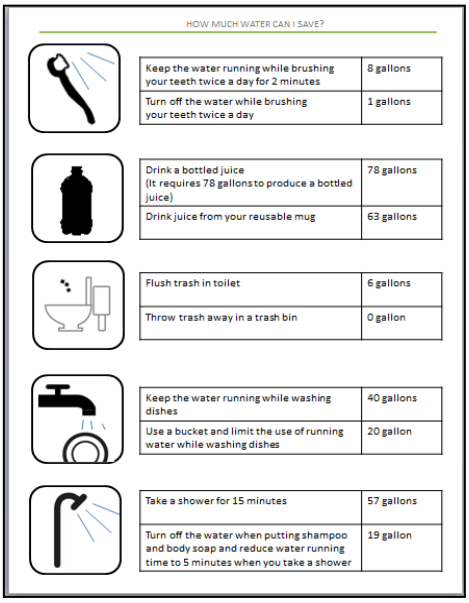
P 184—Student Sheet

PROBLEM B

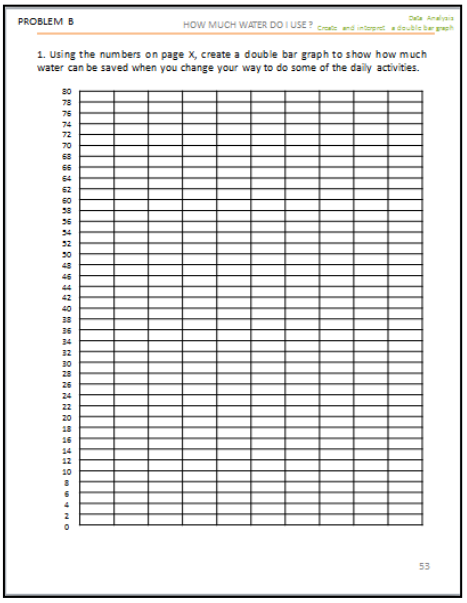
- *Creating double bar graphs*
- *Interpreting double bar graphs*

Using the table on page 183, students are asked to create a double bar graph to show how much water they can save if they change the way of doing some daily activities. Based on the bar graph created, they complete some questions.


HOW MUCH WATER CAN I SAVE?

Keep the water running while brushing your teeth twice a day for 2 minutes	8 gallons
Turn off the water while brushing your teeth twice a day	1 gallons
Drink a bottled juice (It requires 78 gallons to produce a bottled juice)	78 gallons
Drink juice from your reusable mug	63 gallons
Flush trash in toilet	6 gallons
Throw trash away in a trash bin	0 gallon
Keep the water running while washing dishes	40 gallons
Use a bucket and limit the use of running water while washing dishes	20 gallon
Take a shower for 15 minutes	57 gallons
Turn off the water when putting shampoo and body soap and reduce water running time to 5 minutes when you take a shower	19 gallon

P 183-Table


PROBLEM B

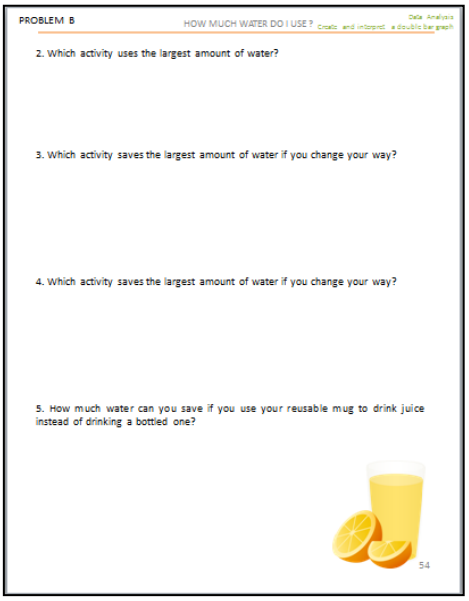
HOW MUCH WATER DO I USE ? Data Analysis Create and interpret a double bar graph

1. Using the numbers on page X, create a double bar graph to show how much water can be saved when you change your way to do some of the daily activities.

80 78 76 74 72 70 68 66 64 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0

53

P 185—Student Sheet


PROBLEM B

HOW MUCH WATER DO I USE ? Data Analysis Create and interpret a double bar graph

2. Which activity uses the largest amount of water?

3. Which activity saves the largest amount of water if you change your way?

4. Which activity saves the largest amount of water if you change your way?

5. How much water can you save if you use your reusable mug to drink juice instead of drinking a bottled one?

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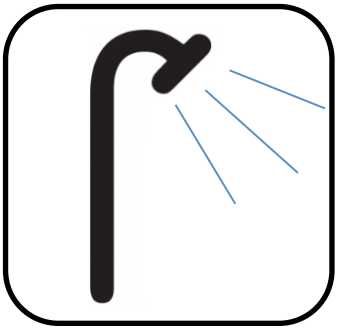
P 186—Student Sheet

Keeping the water running while brushing your teeth twice a day for 2 minutes	8 gallons
Turning off the water while brushing your teeth twice a day	1 gallon

Drinking a bottled juice (It requires 78 gallons to produce a bottled juice)	78 gallons
Drinking juice from your reusable mug	63 gallons

Flushing trash in toilet	6 gallons
Throwing trash away in a trash bin	0 gallon

Keeping the water running while washing dishes	40 gallons
Using a bucket and limiting the use of running water while washing dishes	20 gallons



Taking a shower for 15 minutes	57 gallons
Turning off the water when applying shampoo and body soap and reducing water running time to 5 minutes when you take a shower	19 gallons

Look at the table and answer the questions.

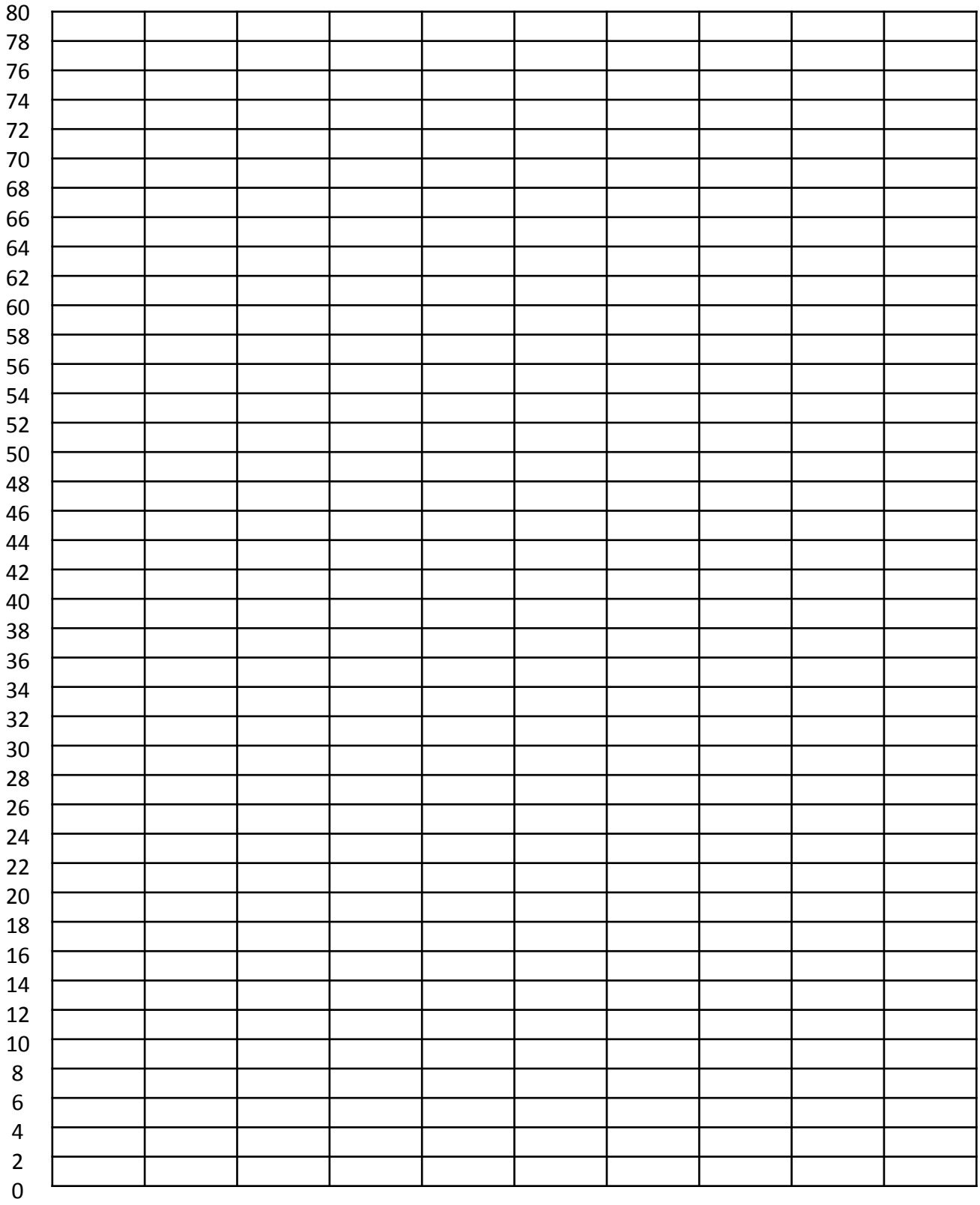
1. How much water can you save if you use your reusable mug to drink juice instead of drinking bottled juice?

2. How much water can you save if you limit water running time to 5 minutes when you take a shower?

3. Which activity saves more water, limiting water running time to 5 minutes while washing dishes or limiting water running time to 5 minutes when you take a shower?

4. How much water can you save if you stop flushing trash and turn off the water while brushing teeth twice a day , and limit water running time to 5 minutes when you wash dishes?

1. Using the numbers on page X, create a double bar graph to show how much water can be saved when you change your way of doing some of the daily activities.



2. Which activity uses the largest amount of water?

3. Which activity saves the largest amount of water if you change the way of doing it?

4. Which activity saves the largest amount of water if you change the way of doing it?

5. How much water can you save if you use your reusable mug to drink juice instead of drinking bottled juice?

PROBLEM 25

Geometry

G3 G4 Identifying three-dimensional objects

WHAT WILL YOU FIND IN THE OHIO RIVER?

PURPOSE

Through this activity, **3rd – 4th grade** students will

- Identify three-dimensional objects including rectangular prisms, spheres, and cylinders
- Develop awareness of air quality

BACKGROUND FOR THE TEACHER

The availability of our water resources is limited, therefore, it is critical to keep our water clean. However, our water sources are susceptible to water pollution.

According to surface water quality research conducted by the U.S. EPA, about 44 percent of assessed rivers and streams, 44 percent of assessed lakes, ponds, and reservoirs, and 30 percent of assessed bays and estuaries were classified as polluted (U.S. EPA, "The National Water Quality Inventory." 2009)

There are many causes of water pollution that are associated with human activities. Urban development, farming, industry, stormwater runoff, wastewater from septic tanks and sewers, ocean and marine dumping, oil spills, underground storage and tube leakage—these are just some of the sources of water quality degradation. Even fertilizer and pesticides from our lawns can be a cause of water pollution. Also, natural phenomena, including storms, volcanoes, algae blooms, and earthquakes, contribute to water contamination.

TEACHER GUIDE

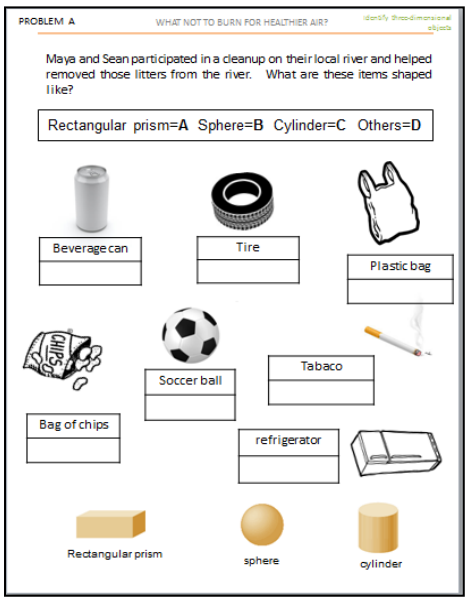
The purpose of this activity is to 1) identify three-dimensional objects and 2) raise awareness of water pollution.

Two problems are provided to match students' levels of understanding.

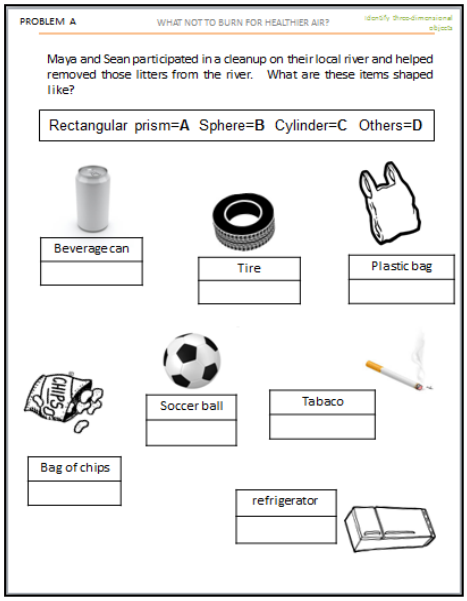
PROBLEM A

- *Identifying three-dimensional objects*

Students are asked to identify the shapes of the items by looking at the pictures of them. Shapes include rectangular prisms, spheres, and cylinders. Some items that do not fit in those categories are also included, such as plastic bags and potato chip bags. The first worksheet (Problem A-1: page 189) includes images of each solid and the other (Problem A-2: page 190) does not.



P 189—Student Sheet



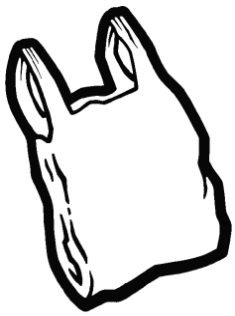
P 190—Student Sheet

Maya and Sean participated in a cleanup on the Ohio River and helped remove litter from the river. What are these items shaped like?

Rectangular prism=**A** Sphere=**B** Cylinder=**C** Others=**D**

Beverage can

Tire

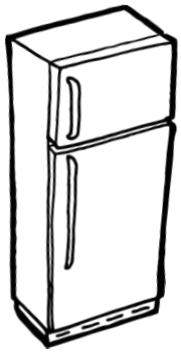


Plastic bag

Bag of chips

Soccer ball

Cigarette



Refrigerator

Rectangular prism

sphere

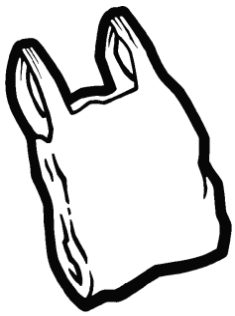
cylinder

Maya and Sean participated in a cleanup on the Ohio River and helped remove litter from the river. What are these items shaped like?

Rectangular prism=**A** Sphere=**B** Cylinder=**C** Others=**D**

Beverage can

Tire



Plastic bag

Soccer ball

Cigarette

Bag of chips

Refrigerator

PROBLEM 26

Number & Operations

G4 G5 Addition and subtraction (3 digits)

GLOBAL WATER SHORTAGE

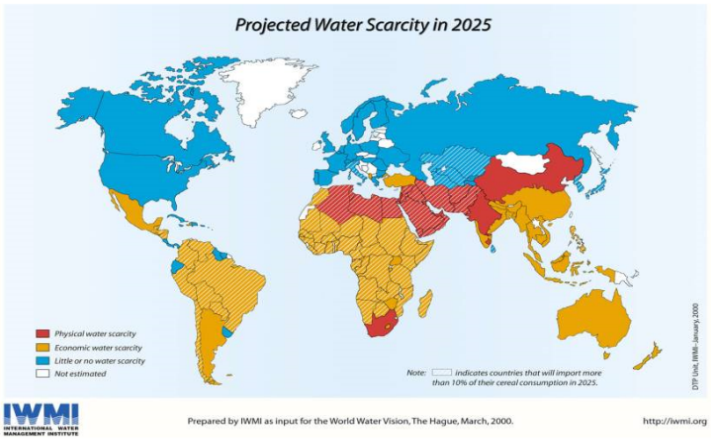
PURPOSE

Through this activity, **4th – 5th grade** students will

- Add and subtract 3-digit numbers
- Develop awareness of the global water shortage problem

BACKGROUND FOR THE TEACHER

Water consumption has been increasing at more than double the rate of population growth over the last century (UN), and is causing water shortage in many areas. The water scarcity problem is projected to worsen as the global population grows and demands for food production increase in the world. It Is estimated that about 769 million people lack access to safe water, of which 94% live either in Africa or Asia (Water.org). The United Nations projects that 47% of world's shortage stressed conditions by 2030.



It is estimated that 1.8 billion people will live in areas with absolute water scarcity, and two-thirds of people in the world will live in areas of high water shortage by 2025. Source: United Nations

Water Shortage Facts

- An estimated 80% of people who lack access to an adequate drinking water source live in either sub-Saharan Africa, Eastern Asia or Southern Asia. (Source: World Wide Fund for Nature (WWF)

- Sanitation coverage in developing countries is only half that of the developed world. (Source: WWF)

- The world's population increases by about 80 million people per year. This leads to an increased freshwater demand of about 17,000 billion gallons a year. (Source: United Nations)

- Since 1900, more than half of the wetlands in the world have disappeared. (Source: WWF)

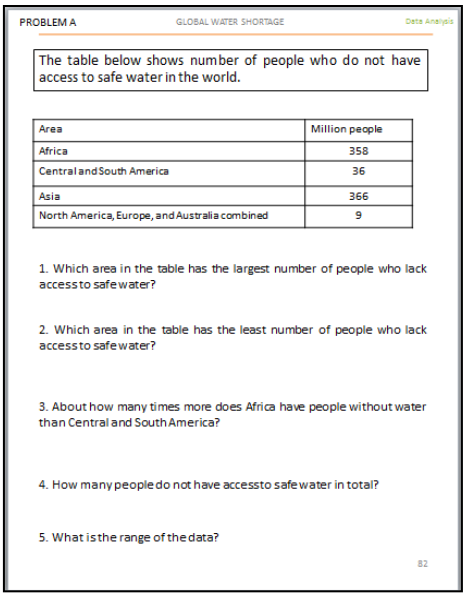
TEACHER GUIDE

The purpose of this activity is to enhance students' skills in data analysis. This worksheet was created based on data about people who lack access to safe water in the world. The data was obtained from water.org.

PROBLEM

- *Addition & subtraction (3digits)*

Using the table which shows the number of people who lack access to safe water in Africa, Asia, Central & South America, and North America, Europe, and Australia combined, students are asked to answer questions related to the table. They use 3-digit addition and subtraction to answer some of the questions.



PROBLEM A GLOBAL WATER SHORTAGE Data Analysis

The table below shows number of people who do not have access to safe water in the world.

Area	Million people
Africa	358
Central and South America	36
Asia	366
North America, Europe, and Australia combined	9

1. Which area in the table has the largest number of people who lack access to safe water?

2. Which area in the table has the least number of people who lack access to safe water?

3. About how many times more does Africa have people without water than Central and South America?

4. How many people do not have access to safe water in total?

5. What is the range of the data?

82

P 193—Student Sheet

The table below shows the number of people who do not have access to safe water in the world.

Area	Million people
Africa	358
Central and South America	36
Asia	366
North America, Europe, and Australia combined	9

1. Which area in the table has the largest number of people who lack access to safe water?

2. Which area in the table has the least number of people who lack access to safe water?

3. About how many times more people without water does Africa have than Central and South America?

4. How many people do not have access to safe water in total?

5. What is the range of the data?

