SC.5.N.1.1 Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

LESSON 5

ESSENTIAL **QUESTION**

What Are Some Science Tools?

Engage Your Brain

Find the answer to the following question in this lesson and write it here.

This scientific equipment is filled with liquids. What tools can scientists use to measure the volume of a liquid?

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ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

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Compare and Contrast

Many ideas in this lesson are connected because they explain comparisons and contrasts—how things are alike and different. Active readers stay focused on comparisons and contrasts when they ask themselves, How are these things alike? How are they different?

Field Trips

If you like school field trips, you might want to become a field scientist. Field scientists travel around the world studying science in the wild. They pack their tools and take them along.

ACTIVE READING As you read these two pages, box the names of all the science tools.

Field scientists go "on location" to investigate the natural world. Their investigations are often in the form of repeated observations. They use tools to increase the power of their senses. Their choices of tools depend on the questions they ask.

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Collecting Net

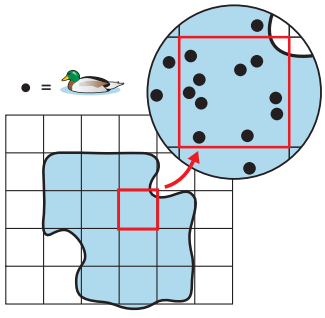
What kinds of animals swim near the shore of a pond? A scientist might use a collecting net and an observation pan to answer this question. By carefully pulling the net through the water, they can catch small animals without harming them.

Hand Lens

How does an ant move? How does it use its mouthparts? A hand lens might help answer these questions. Hold the hand lens near your eye. Then move your other hand to bring the object into view. Move the object back and forth until it is in sharp focus.

DO THE MATH

Estimate by Sampling



Scientists photograph ducks from a plane and then draw a grid over the photo. How many ducks do you estimate are on the whole lake?

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Why might your estimate differ from the actual number of ducks?

_____

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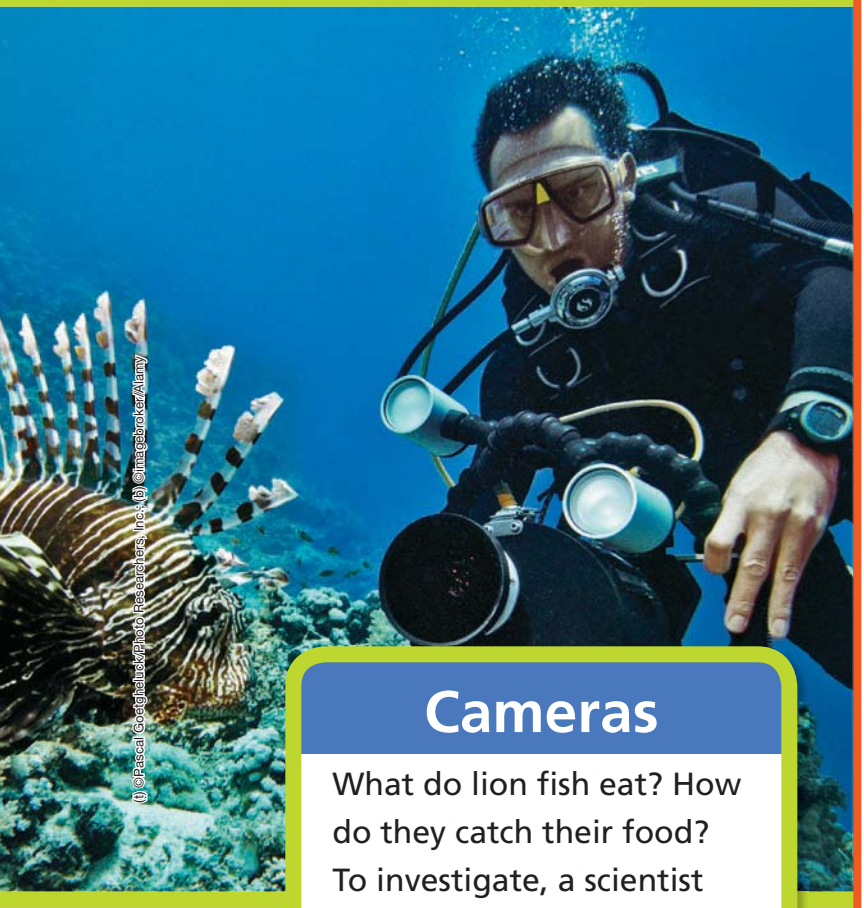

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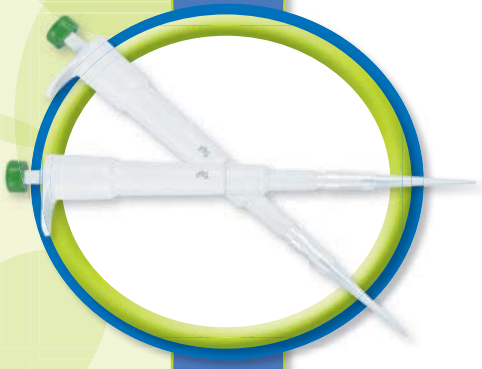
Cameras

What do lion fish eat? How do they catch their food? To investigate, a scientist might use an underwater video camera. Cameras help scientists record events.



Into the Lab

What's living in a drop of pond water? Lots of tiny critters! Some behave like animals. Others are like plants. All are too small to be seen with only a hand lens.

ACTIVE READING As you read these two pages, draw lines connecting the pairs of tools being compared to each other.

Science tools can be heavy and expensive. If you want to observe the tiniest pond life, you'll need science tools that are too big or too delicate to be carried into the field. For example, scientists use computers to record and analyze data, construct models, and communicate with other scientists.

Use Numbers

Some tools help scientists count things. Some scientists estimate, while others perform complex mathematical calculations. All scientists must be comfortable **using numbers**.

▶ **To find the magnification of a light microscope, multiply the power of the eyepiece lens by the power of the objective lens. The letter X stands for how many times bigger objects appear.**

Eyepiece Magnification	Objective Magnification	Total Magnification
10X	40X	
15X	60X	
8X	100X	

Light Microscope

The tiny living things in pond water are **microscopic**, or too small to see with just your eyes. A light microscope magnifies things, or makes them look bigger. The object to be viewed is placed on a clear slide. Light passes through the object and two lenses. You look through the eyepiece and turn knobs to focus an image.

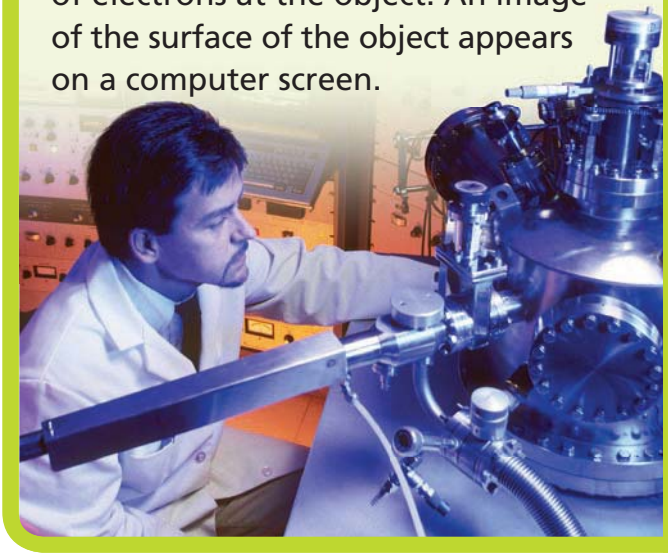
(bl) ©Tom Tracy Photography/Alamy

Dropper

A dropper is a tube with a rubber bulb on one end. Squeeze the bulb and then dip the tip into a liquid. Release the bulb, and the liquid will be sucked up the tube. When you slowly squeeze the bulb, the liquid drops out.

Electron Microscope

Light microscopes have been around for 500 years. But technology, or people's use of tools, has improved. Today a scanning electron microscope (SEM) can magnify an object up to one million times. The SEM shoots a beam of electrons at the object. An image of the surface of the object appears on a computer screen.



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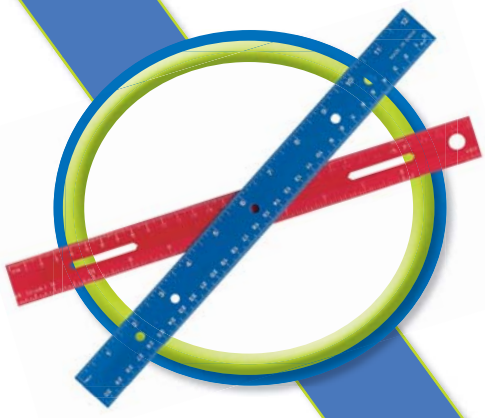
Pipette

A pipette is a tool like a dropper, but it's more exact. It is used to add or remove very small amounts of liquids. Pipettes often have marks on the side to measure volume. One kind of pipette makes drops so tiny that they can only be seen with a scanning electron microscope!

Measuring Up



What do a digit, a palm, a hand, a dram, a peck, a rod, and a stone have in common? They all are, or were at one time, units of measurement!

ACTIVE READING As you read the next four pages, circle all the units of measurement.

When you **measure**, you make observations involving numbers and units. Today most countries use the International System (SI) units in daily life. If you were to visit these countries, you'd purchase fruit or cheese by the *kilogram*. In the United States, most everyday measurements use units from the time when English colonists lived in America. However, scientists around the world—including those in the United States—use the SI, or metric system.

The metric system is based on multiples of 10. In the metric system, base units are divided into smaller units using prefixes such as *milli-*, *centi-*, and *deci-*. Base units are changed to bigger units using prefixes such as *deca-* and *kilo-*.

Measuring Length

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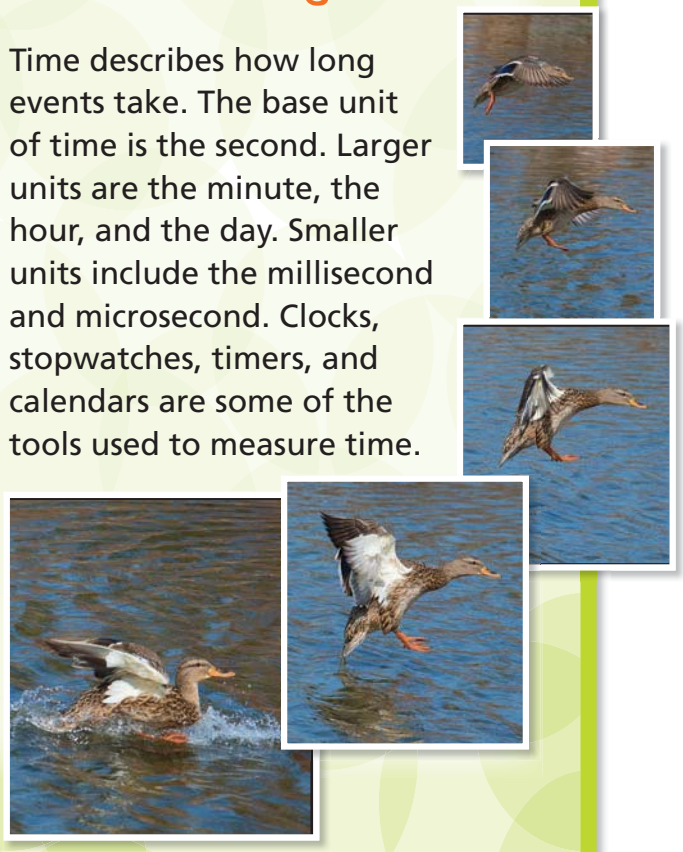
Length is the distance between two points. The base metric unit of length is the *meter*. Rulers, metersticks, and tape measures are tools used to measure length.

A caliper can be used to measure the distance between the two sides of an object.

Measuring Time

Time describes how long events take. The base unit of time is the second. Larger units are the minute, the hour, and the day. Smaller units include the millisecond and microsecond. Clocks, stopwatches, timers, and calendars are some of the tools used to measure time.



Measure Your Science Book

Use a metric tool and units to measure the length, width, and thickness of your science book.

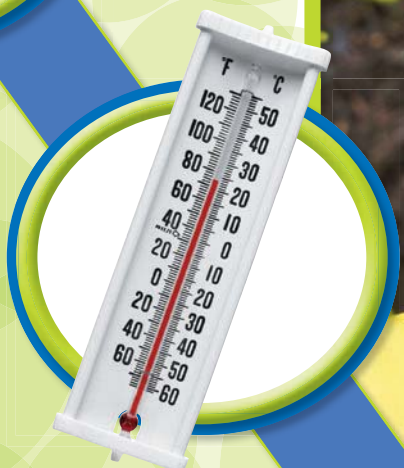
Length: _____

Width: _____

Thickness: _____

Measuring Temperature

Temperature describes how hot or cold something is. Thermometers are used to measure temperature. Scientists measure temperature in degrees Celsius. So do most other people around the world. In the United States, degrees Fahrenheit are used to report the weather, to measure body temperatures, and in cooking.



With this balance, you can directly compare the masses of two objects. Put one object in each pan. The pan that sinks lower contains the greater mass.

Pan Balance

A **balance** is a tool used to measure mass. *Mass* is the amount of matter in an object. The base unit of mass is the kilogram. One kilogram equals 1,000 grams.

To measure in grams, place an object in one pan.

Add gram masses to the other pan until the two pans are balanced. Then add the values of the gram masses to find the total mass.

Always carry a balance by holding its base.

This pan balance has drawers where the masses are stored.

Three Beams

A triple-beam balance measures mass more exactly than the pan balance. It has one pan and three beams. To find the number of grams, move the sliders until the beam balances.

Digital Mass

An electronic balance calculates the mass of an object for you. It displays an object's mass on a screen.

How Strong?

A **spring scale** is a tool used to measure force. Force is a push or a pull. When an object hangs down from the scale, the force of gravity, or weight, is measured. When the spring scale is used to pull an object, it measures the force needed to move the object. Either way, the base unit is called a newton.

▶ **Draw lines to match the tools to what they measure and the units.**

Tool	What It Measures	Units
	• force •	• seconds, minutes, hours, days, years, etc.
	• temperature •	• grams, milligrams, kilograms, etc.
	• length •	• newtons
	• mass •	• degrees Celsius, degrees Fahrenheit
	• time •	• meters, kilometers, millimeters, etc.

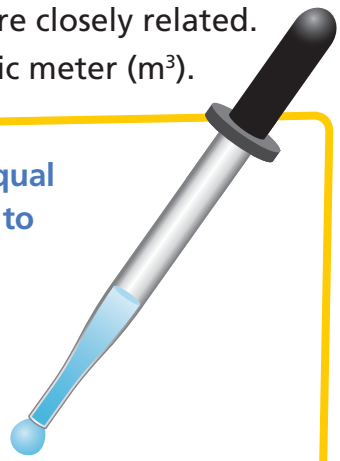
More Measuring

It's a hot day and you're thirsty. How much lemonade would you like? 1,000 milliliters or 1,000 cubic centimeters? Not sure? Read on!

ACTIVE READING As you read the next two pages, circle important words that are defined, and underline their definitions.

Units of Volume

Volume is the amount of space a solid, liquid, or gas takes up. There are two base metric units for measuring volume. A *cubic meter* is one meter long, one meter high, and one meter wide. The *liter* is the base unit often used for measuring the volume of liquids. You're probably familiar with liters because many drinks are sold in 1-liter or 2-liter bottles. These two metric units of volume are closely related. There are 1,000 liters (L) in one cubic meter (m^3).



▶ **One cubic centimeter (cm^3) is equal to 1 milliliter (mL). Both are equal to about 20 drops from a dropper. Which is greater—1,000 mL or 1,000 cm3?**

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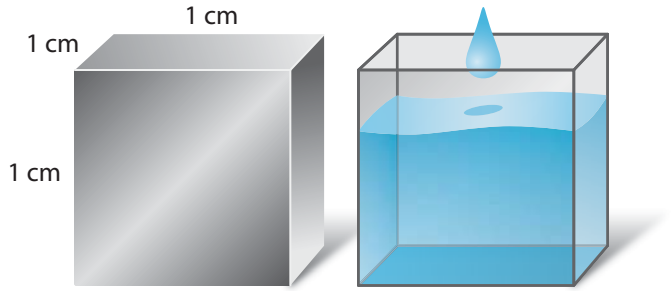
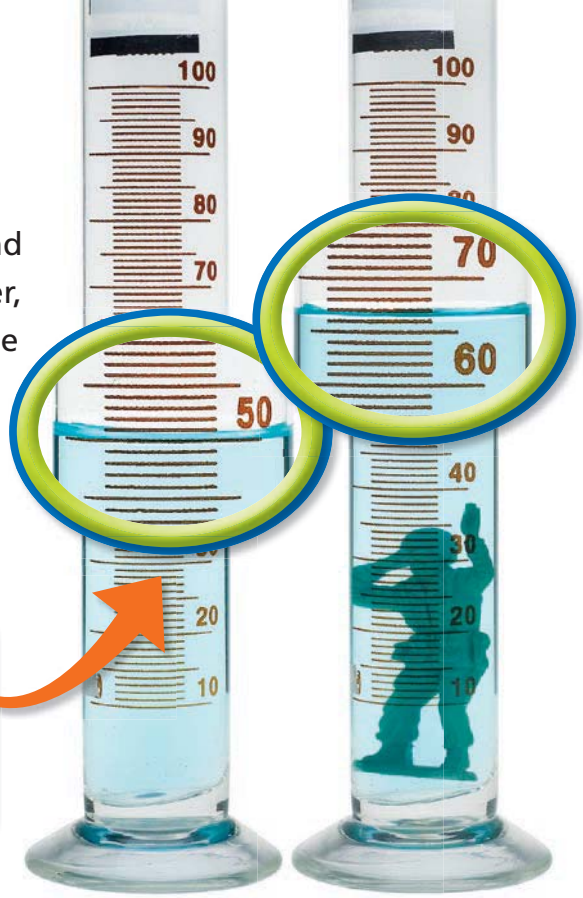


Finding Volume

You can find the volume of a rectangular prism by multiplying length times width times height. To find the volume of a liquid, use a measuring cup, beaker, or graduated cylinder. Use water to find the volume of an irregular solid. Put water in a graduated cylinder. Note the volume. Then drop the object in and note the new volume. Subtract the two numbers to find the volume of the object.



The surface of a liquid in a graduated cylinder is curved. This curve is called a *meniscus*. Always measure volume at the bottom of the meniscus.

Accurate Measurements

When a measurement is close to the true size, it is **accurate**. Try to measure as accurately as you can with the tools you have. Make sure a tool is not broken and that you know how to use it properly. Also pay attention to the units on the tools you use. Accurate measurements are important when doing science investigations, when baking, and when taking medicines.

Follow these tips to improve your accuracy:

- ☑ Handle each tool properly.
- ☑ Use each tool the same way every time. For example, read the measurement at eye level.
- ☑ Measure to the smallest place value the tool allows.
- ☑ Measure twice.
- ☑ Record your measurements carefully, including the units.

▶ **Write the math sentence for finding the volume of the toy.**

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