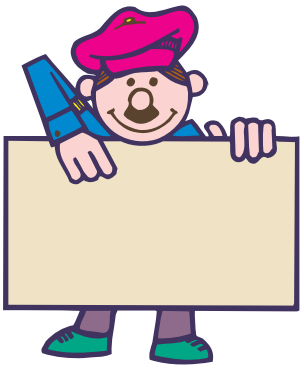
The learner will select and use appropriate tools to measure two- and three- dimensional figures.

2

Notes and textbook references

2.01 Estimate and measure length, perimeter, area, angles, weight, and mass of two- and three-dimensional figures, using appropriate tools.



A. **Space Ship Storage** (Blackline Master II - 1)
Students explore various shapes of rectangles to maximize area.

B. **Index Card Activity**
Materials needed: 3 x 5 index cards and scissors.
Students are instructed to mark a point anywhere along the side of a 3 x 5 card. They will draw a segment from this point to both corners of the opposite edge to form a triangle. Students should calculate the area of the triangle and the area of the entire card. The triangle is cut out. Students should use the pieces cut away from the triangle to verify that the area of the triangle is half the area of the entire card.

C. **Geoboard Activity**
Materials needed: Geoboard, rubber bands, grid paper.
Students will form a triangle on the geoboard with rubber bands. They will then form a rectangle around the triangle so that the heights and bases are the same. Students can count squares to determine the area of the rectangle and to estimate the area of the triangle. Each figure should be recorded on the grid paper. Do the students see a pattern? Even when estimating, do they find the area of the triangle to be about half the area of the rectangle?

Notes and textbook references

D. Apple Statistics Have students explore apple statistics at the web site shown here: http://www.michiganapples.com/quickfacts.html. Have students look under the following topics for apple statistics: Newsroom – apple facts, or Industry - current crop. Have students use these statistics to create and solve problems related to measurement. Can one group create a problem that will stump the others?

E. Measurement Tasks in the Real World Divide students into groups and give each group a topic of interest such as automobiles, pet care, amusement park rides, medical care, aviation, etc. Challenge the group to think of ways in which measurements must be made in each of these areas. They should attempt to include measurements involving length, weight, perimeter, area, angles, and mass. Have the students discuss tools used, precision of commonly used tools, when estimates might be used, results of overestimation, and results of underestimation.

F. Estimation Problem Discussion Cards (Blackline Master II - 6) Divide students into groups to discuss each of the situations presented on the cards. After the group has analyzed each situation, have groups share with each other their ideas on estimation.

G. Hubble Telescope (Blackline Master II - 7)
Sixth grade students are studying the solar system and technology used to explore space. This activity on the Hubble Telescope asks students to use their knowledge of geometry and measurement to become better acquainted with the Hubble.

Notes and textbook references

H. **Available Tools** The North Carolina manipulative kit contains tape measures and rulers which are marked with millimeters on the metric side and sixteenths of an inch on the customary measurement scale and a trundle wheel. Many science classrooms contain graduated cylinders and math teachers can borrow them to illustrate precision in measurement. Most classrooms have access to containers such as cups, pints, quarts,and liters. The manipulative kits also have balances that can be used to measure to the nearest gram.

I. **Make Your Own Graduated Cylinders** (Blackline Master II - 8)

Materials: cylinders of various sizes such as olive jars, medicine bottles, perfume vials; markers that will mark on plastic or glass, paper with equally spaced lines, such as graph paper or notebook paper. A copy machine may be used to reduce the lined paper if closer lines are needed.

Students follow the directions on the blackline master to make their own set of graduated cylinders using common objects and graph paper.

J. **Precisely!** (Blackline Master II - 9)

Students discuss answers to situations involving the concept of precision. Students should learn that the precision required of a measurement determines the tool that should be used to measure it.

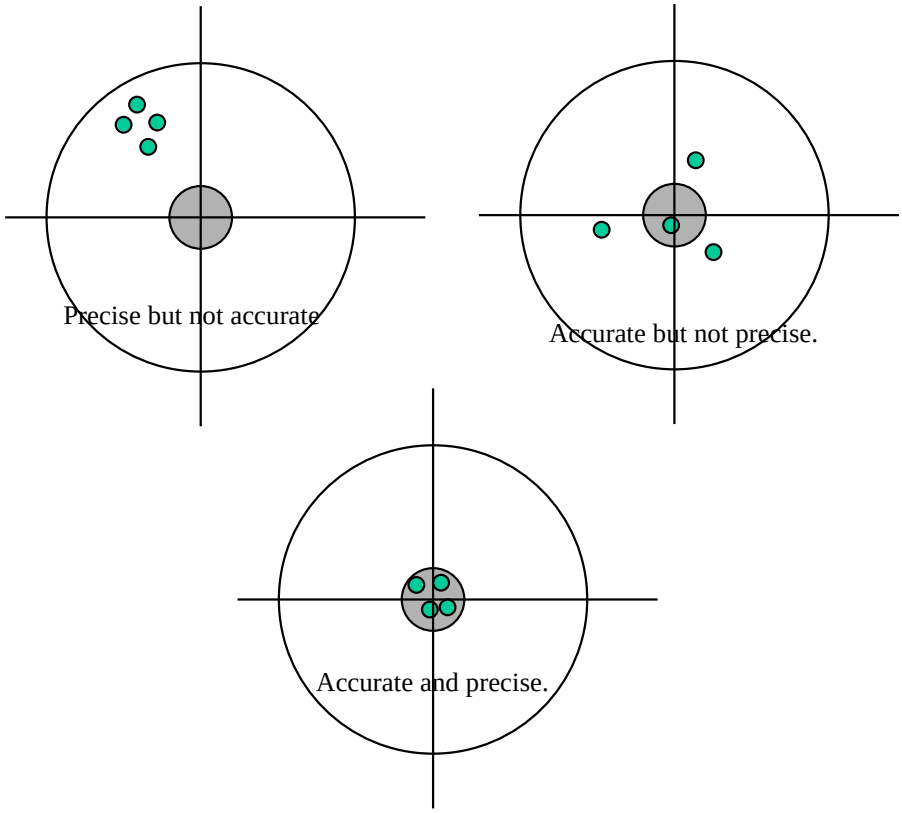
Students should also learn that the precision of measured values limits the precision of calculations made with those measurements. For example, if a student uses an inch ruler to cut a strip 8 inches long and carefully divides the strip into thirds, will each third be exactly 2.6666666666666666 inches long? We can hardly think so. If we can't measure the sides to the nearest tenth, then we can't assume calculations based on that measurement are even more precise than that.

Notes and textbook references

K. Explanation of Precision In teaching and learning pure mathematics, we often ignore precision. We consider that 2.1 is the same as 2.10 or 2.100 or 2.1000. That is very true if our only concern is number equivalence. However, in the real world, numbers used in calculations are very often measurements, and when considering measurements, the numbers listed above do not mean the same thing. 2.1 means you measured something and the instrument was only reliable to the nearest tenth. However, 2.1000 means the instrument could be used to measure to the nearest ten thousandth and 2.1000 is a reflection of that measured value.

Precision in the writing of numbers has to do with how many decimals you can write down. For example, 9.13 is less precise than 9.134.

Precision is commonly confused with accuracy. They are not the same. Consider the diagram below. These are targets left after marksmen engaged in target practice. Accuracy has to do with how close to the bullseye they came. Precision has to do with how close each trial was to the others.



The most important concept to consider is that when we use measured values to do calculations, the precision of the calculated answer is limited by the precision of the measured numbers in the calculation.

Example: I want to measure the distance from my home to school. I measure the distance from my front door to my car with a yardstick and measure to the nearest inch. Then I drive from home to school and measure that distance with the car's odometer. When I get to school, I measure the distance from the car to school with a yardstick.

House door to car: 120 feet 3 inches = 120.25 feet
Home to School on the road: 5.2 miles = 27,456 feet
Parking lot to School: 250 feet 4 inches = 250.333 feet

Total distance? Is it 27,826.583 feet? Can we really trust this answer to the nearest thousandth of an inch? Of course not! The answer cannot be more precise than the least precise measurement. Even the 27,456 feet is questionable. How can I measure something to the nearest foot with a machine that can only measure to the nearest tenth of a mile?

We can let students gauge the best unit to use for a particular measurement. For example, medicine doses should be measured in milliliters while punch recipes use liters. We can insist that when measured values are used in calculations, the measured values should be taken from instruments with similar precision. We should expect students to recognize errors in calculations such as the one illustrated above.

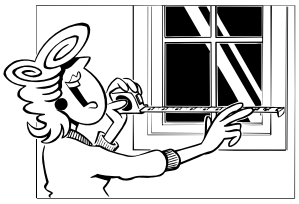
Notes and textbook references

Notes and textbook references

2.02 Solve problems involving perimeter/ circumference and area of plane figures.

A. Kepler's Laws (Blackline Masters II - 2 and II - 3)
Sixth grade students are studying the solar system. Kepler's Laws relate area and time in the orbit of a comet or planet. Students will estimate irregular areas on a grid to solve the problems in this activity.

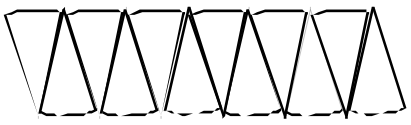
B. Circumference Stumpers (Blackline Master II - 4)
These diagrams show how unusual shapes can be the combination of circles and other basic geometric shapes. Students can use their knowledge of circles to find perimeters of these shaded shapes.



C. Eyes on Space (Blackline Master II - 5)
Sixth grade students are studying the solar system and technology of space exploration. In this activity, students are given information about various large telescopes in use. They use this information to determine radius and circumference and to arrange the sizes in order.

D. Mini Review – Area (Blackline Masters II - 23 and II - 24)
This mini review covers most of the area skills from this unit. Allow students to work in pairs to share strategies and skills.

E. Slicing π (Blackline Master II - 10)
Materials needed: Scissors.
Students cut the segments of a circle apart and rearrange them to form a "rectangle" as shown. The base of this "rectangle" is half the circumference of the circle, that is half of 2π x radius. The height of the "rectangle" is the radius. The area is π x radius squared.



Notes and textbook references

F. Bean π (Blackline Master II - 11)

Materials needed: Scissors, dried beans.

Students fill the circle with a layer of beans to cover it as completely as possible without overlapping. These beans are set aside to use in the next step. Then the squares are cut apart. Students should note that the area of each square is the radius squared. The squares are placed end to end to form a long rectangle. Now the beans are used to cover the squares that form the rectangle from one end to the other. It should be observed that the beans will cover slightly more than three of the rectangles. This provides evidence that the area of the circle is ~3.14 times the radius squared.

G. Nearly π (Blackline Master II - 12)

Students compare the area of a circle with the area of a polygon of nearly the same size. In the diagram, if the diameter of the circle is d, then the side length of each small square is $^1/_3$ the diameter, or $^2/_3$ the radius. The area of each small square is $4r^2/9$. The area of the polygon is equivalent to the area of seven of the small squares or $28r^2/9$. This value is $3.11r^2$, which is very close to πr^2.

H. Shape Exploration (Blackline Masters II - 13 and II - 14)

Materials needed: scissors, recording paper.

Procedure: Students are asked to cut out the shapes provided and find the area and perimeter of each one. Then the students should use the shapes in combinations to form parallelograms and larger triangles. The area of each of these can be found by adding the areas of the parts. These examples can be used to help generalize formulas for areas of triangles and parallelograms and even trapezoids.

I. Pick-Up Area (Blackline Masters II - 15 through II - 21)

Materials needed: Deck of area cards, spinner.

Procedure: The cards are shuffled and placed in a draw pile, face down. On a student's turn, he may turn over one card and place it face up in the center of the table. He then spins the spinner. If he can pick up a card with the area shown on the spinner, he collects that card and may keep spinning. When he can no longer pick up a card with the correct area, play passes to the next player. Cards not picked up remain face up in the play area. Play continues until all cards have been picked up. The student with the most cards in his possession is the winner.

Notes and textbook references

J. Area of a Polygon

Materials needed: Scissors, rulers. Have students use rulers to construct polygons with five, six, and seven sides respectively.
Have the students estimate the area of each polygon by overlaying it with centimeter grid paper. (Blackline Master II - 14) Then have students dissect each polygon into triangles and measure the base and height for each one. They can then calculate the areas of the triangles and add to get the calculated area of each polygon. They should compare the estimated area to the calculated area and discuss possible errors in deriving the area in each of these ways.

K. Finding Area (Blackline Master II - 22)

Students use their knowledge of the area of squares and triangles to find the area of the space station figure shown.