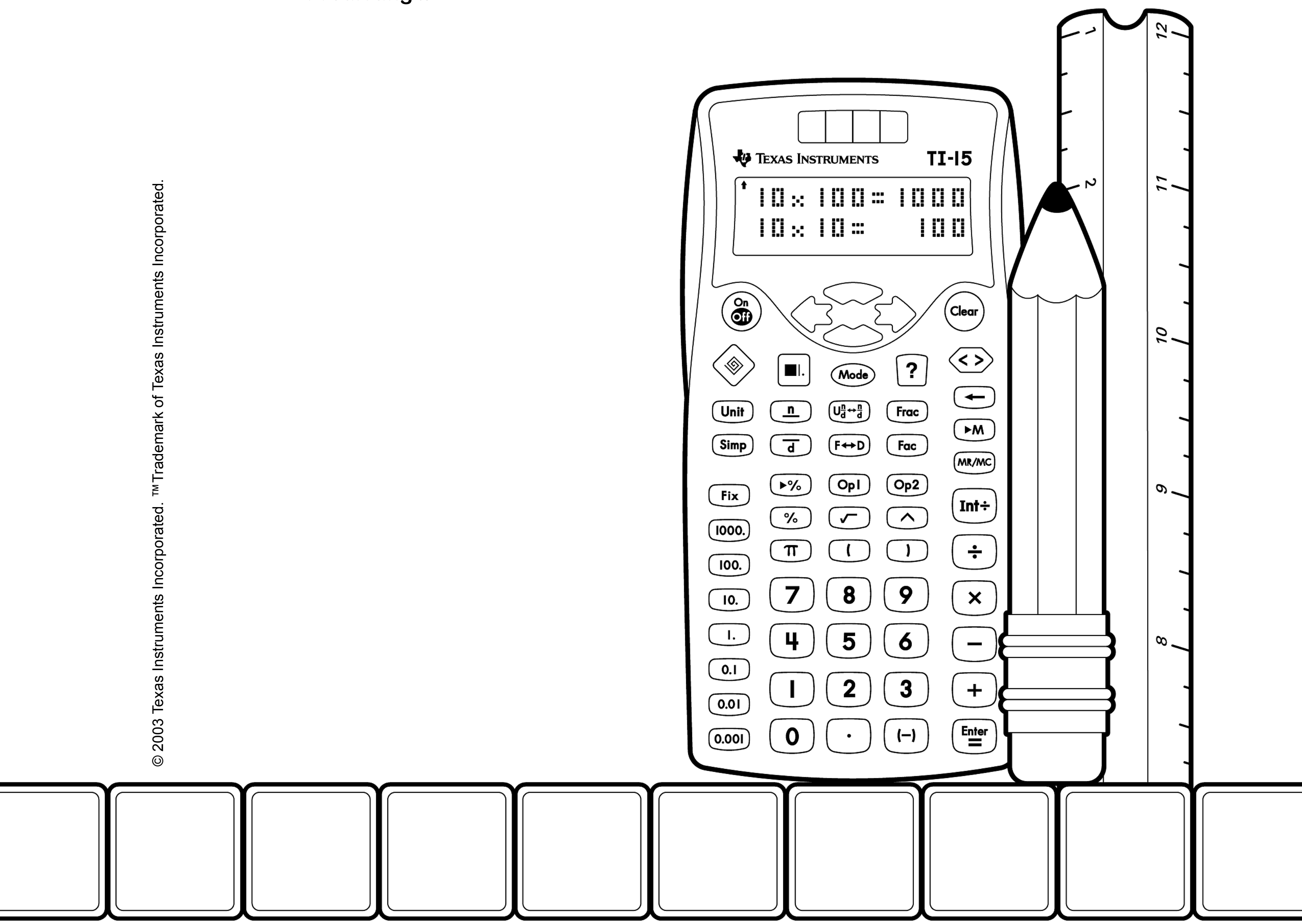
Activities:

- Map It!
- Only Half There?
- No More Peas, Please!
- Do Centimeters Make Me Taller?
- What's My Ratio?
- Ratios in Regular Polygons
- Predicting π



Map It!

Math Concepts	Overview
• whole numbers • ratio • addition • relations and functions • linear units of measure **Materials** • TI-10, TI-15 Explorer™ • **Map It!** recording sheets • linear measuring tools (rulers, tape measures, string, etc.) • pencils	Students will read a story, identify the locations of different places in the story, decide the distance between each set of places in the story, and create a map with a legend.

Introduction

1. Collect a variety of books that have plots in which characters move from place to place.

   Examples:
   Possibilities include some of the Laura Ingalls Wilder's "Little House" books or *The Wizard of Oz* by Frank Baum.

2. With the class, choose a book and then read the story or a section of it to the class.
   a. Make a transparency, which will be an imaginary map of the action in the story.
   b. Create a legend with a scale for distances.
   c. Identify at least three different locations from the story. **Examples:** In Judith Viorst's *Alexander and the Terrible, Horrible, No Good, Very Bad Day,* locations could include home, Dad's office, the dentist's office, and the shoe store.
   d. Put the places in the story in logical locations on the map.
   e. Use the legend to determine the distances between those places on the map.

3. Have students select a different story and work in pairs to develop a map with a legend to illustrate the primary action in the plot of the new story.

4. Ask students to write about the process they used to make their maps and any mistakes or discoveries they made.

Map It! *(continued)*

Collecting and Organizing Data

While students are developing their maps and measuring and recording their information, ask questions such as:

- Which locations did you choose from your story? How did you decide the distances between the locations? How do the distances between places in the story relate to the distances between places on your map? How does your legend reflect this?
- What measuring tool are you using? Why? How are you using it? Why is it important to use it in that way?
- What unit of measure are you using? What makes it the most useful for this purpose?

How are you using the calculator to help you find the distances on land and on your map?

What operations are you using on the calculator to help you find the distances?

How can you decide if the answer you are getting on the calculator is reasonable or not?

Analyzing Data and Drawing Conclusions

After students have recorded their information, have them work as a whole group to analyze their recording sheets. Ask questions such as:

- What information did you include in your legend? How did you use that information to create your map?
- Did you choose any distances you were unable to show on your map? Why?
- How could you describe the way you found the distances on the map?
- How did you use estimation?
- Did you have any difficulties making your map? What discoveries did you make?

How did you use the calculator to help you in making the legend for your map?

Continuing the Investigation

Have students select another story, make up a "map" of the action in the story, create a legend for the map, and repeat the process of locating points and determining the distances each character in the story will travel between two points.

Name:

Map It!

Recording Sheet

Collecting and Organizing Data

Legend: ____

Locations	Distance on Map	Distance on Land
From ____________________ To ____________________		
From ____________________ To ____________________		
From ____________________ To ____________________		

Use your legend and the information above to draw your map below or on the back of this sheet.

Analyzing Data and Drawing Conclusions

From this activity, we discovered:

Only Half There?

Math Concepts

- fractions
- ratio
- division
- proportion
- linear measure

Materials

- TI-10, TI-15 Explorer™
- **Only Half There?** recording sheets
- linear measuring tools (rulers, tape measures, string, etc.)
- pencils or markers
- butcher paper
- scissors

Overview

Students will use measuring tools and calculators to make half-sized drawings of themselves.

Introduction

1. Read selected portions from *Gulliver's Travels* by A. Benduce, *The Littles* by J. Peterson, or *The Borrowers* by M. Norton. Discuss what the little people might look like.

2. Have students work in pairs. Have one partner lie down on a piece of butcher paper while the other traces around his or her partner's body. Then have the partners trade places.

3. When everyone has a body tracing, have students cut out the tracings and fold them in half from top to bottom. Then give each student another sheet of paper that is half the length of his or her body.

4. Challenge students to draw a half-sized version of themselves. Have students discuss what ideas need to be considered. Have them record their measurements in the table on their recording sheets.

   Examples:
   What measurements need to be taken? How would those measurements be translated into the half-sized version?

5. Encourage students to use details in their drawings; for example, their facial features, clothing, etc.

Collecting and Organizing Data

While students are working on drawing the half-sized versions of themselves, ask questions such as:

- What measurements are you taking? Why did you choose those?
- What measuring tools are you using? Why did you choose those?

How are you using the calculator to help you with this problem?

Only Half There? *(continued)*

Collecting and Organizing Data (continued)

- How do your actual measurements relate to the measurements in your half-sized picture?
- Are there any features that come out looking strange? Why do you think that is happening?

Note: Many students will try to draw their waist using the measurement of half of the circumference. This makes their waist in the picture appear disproportionately large. Using calipers or shadows projected on a sheet of paper can help solve this problem.

How could you use [Int÷] on the TI-15 Explorer™ or [÷] on the TI-10 to help you with this problem?

Analyzing Data and Drawing Conclusions

After students have drawn their half-sized pictures, have them discuss their results as a whole group. Ask questions such as:

- What measuring tools did you use? Why did you choose them?
- What patterns, if any, do you see in your pairs of measurements in the table on the recording sheet?
- Why do you think those patterns are occurring?
- Did any parts of your body look distorted? If so, why do you think that happened?
- In a half-sized picture of yourself, is there only half of a full-sized picture? Support your response.

How can you use [÷] on the TI-15 Explorer™ to help you with this problem?

Continuing the Investigation

Have students:

- Draw one-third-sized versions of themselves and discuss their strategies for solving the problem.
- Try to fit drawings of themselves on 5- by 8-inch index cards.

Name:

Only Half There?

Recording Sheet

Collecting and Organizing Data

Body Part	Measurement	$\frac{1}{2}$ Measurement

Analyzing Data and Drawing Conclusions

To make a half-sized drawing of myself, I:

Questions we thought of while we were doing this activity (write on the back of this page):

No More Peas, Please!

Math Concepts / Materials	Overview
Math Concepts • whole numbers • ratio • multiplication • proportion • capacity measure **Materials** • TI-10, TI-15 Explorer™ • **No More Peas, Please** recording sheets • measuring tools (string, tape measures, rulers, containers, cubes, dice, marbles, counters, balances, etc.) • pencils or markers	**Overview** Students will use nonstandard units of volume and calculators to estimate the number of peas it would take to fill a room.

Introduction

1. Read to the class the book *Counting on Frank* by Rod Clement. Discuss the different examples of measurement in the story.

   Examples: The length of the ball point pen's line is linear measure; the number of Franks it takes to fill the bedroom is volume.

2. Start two lists on a transparency:
   - Situations in which units of length are helpful.
   - Situations in which units of volume are helpful.

3. Divide the class into small groups of students. Ask students to suggest ways to determine the number of peas the artist drew in the illustration.

4. Have students use the number of peas in the illustration to predict the number of peas it would take to fill their classroom.

5. Challenge students to develop a method to find out the number of peas it would take to fill the classroom.

6. Ask students to write a detailed plan for finding the number of peas it would take to fill the classroom.

   Note: To use the activity with younger children, have them estimate the number of peas needed to cover the desktop (surface area) rather than to fill the room (volume).

Collecting and Organizing Data

While students are working on their project, ask questions such as:

- What measurements are you taking? Why did you choose those?

How are you using the calculator to help solve this problem?

No More Peas, Please! *(continued)*

Collecting and Organizing Data (continued)

- What measuring tools are you using? Why did you choose those?
- Are there any measurement tools on the supply table you think would not be helpful in solving this problem? Why?

How will you decide if the answer you come up with is reasonable?

Analyzing Data and Drawing Conclusions

After students have described the method they would use to find the number of peas it would take to fill the room, have them discuss their results as a whole group. Ask questions such as:

- Was the illustration in the book helpful in designing a way of finding the number of peas it will take to fill this room? Why or why not?
- What measuring tools did you use? Why did you choose them?
- What measuring tools would not be helpful? Why?
- What do all of the helpful measuring tools seem to have in common?
- What was the most difficult part of this problem? Why?
- If we were to choose one method of solving this problem from among all of those suggested, which would it be? Be prepared to support your suggestion with sound, logical reasons.
- What is the difference between two-dimensional measuring tools and three-dimensional measuring tools?

What problems did you experience using the calculator in this problem? How did you solve those problems?

Continuing the Investigation

Have students:

- Test the plan they designed for finding the number of peas.
- Make up other measurement problems using the story *Counting on Frank*. Have students write each problem on one side of a card and write one method of solving it on the reverse side.
- Students can write their results on the board and the class can discuss the range of answers.

Name:

No More Peas, Please!

Recording Sheet

Collecting and Organizing Data

Materials we will need:

To find out how many peas it will take to fill this room, we will:

Analyzing Data and Drawing Conclusions

The method we chose will work because:

Questions we thought of while we were doing this activity:

Do Centimeters Make Me Taller?

Math Concepts

- fractions
- linear measure
- decimals
- ratio
- division
- proportion

Materials

- TI-15 Explorer™
- **Do Centimeters Make Me Taller?** recording sheets
- linear measuring tools (rulers, tape measures, string, etc.)
- non-standard measuring objects (pencils, paper clips, etc.)
- pencils and large paper

Overview

Students will use measuring tools and calculators to find pairs of measurements and form ratios. Then they will compare the ratios and make conclusions about using different units to measure lengths.

Introduction

1. Have each student lie down on the floor or on a sheet of paper, and mark the length of his or her height.
2. Then have each student mark the length of his or her foot, use the length of the foot to measure his or her height, and record the measurement on the chart provided on the recording sheet.
3. Next, have each student measure his or her height and the length of his or her foot, using a standard unit of measure (inches or centimeters), and record the results on the chart.
4. Discuss the idea of ratio as a number that describes the comparison of two quantities. This number can be expressed as a fraction or a decimal.

   Example:
   If your foot is 20 cm long and your height is 120 cm, the ratio of your foot measurement to your height is 20 cm/120 cm or 1/6.
5. Have students use the $\boxed{\div}$ key to change their foot/height ratios from fraction form to decimal form. Have students compare their two ratios and discuss how they are alike and how they are different.
6. Have students select another nonstandard unit of measure (hand, pencil, eraser, etc.), use it to measure both their foot and height, and record their measurements on the chart.
7. Have each student measure his or her foot and height with some other standard unit of measure and record the measurements on the chart.

Do Centimeters Make Me Taller? *(continued)*

Introduction (continued)

8. Have students find the ratios of these pairs of measurements and compare their values.

9. Have students repeat this process with one more nonstandard unit and one more standard unit of measure and then discuss their results.

Example:

Unit of Measure	1st Measure	2nd Measure	Ratio of 1st to 2nd	Ratio in Decimal Form
Nonstandard Unit: my foot	My foot is: 1 foot (Nonstandard Units)	My height is: 6 feet (Nonstandard Units)	$\frac{1 \text{ foot}}{6 \text{ feet}}$	0.1666667
Standard Unit: cm	My foot is: 25 cm (Standard Units)	My height is: 140 cm (Standard Units)	$\frac{25 \text{ cm}}{140 \text{ cm}}$	0.1785714
Nonstandard Unit: pencil	My foot is: 2 pencils (Nonstandard Units)	My height is: 13 pencils (Nonstandard Units)	$\frac{2 \text{ pencils}}{13 \text{ pencils}}$	0.1538462
Standard Unit: in.	My foot is: 10 in. (Standard Units)	My height is: 64 in. (Standard Units)	$\frac{10 \text{ in.}}{64 \text{ in.}}$	0.15625

Collecting and Organizing Data

While students take measurements to generate the chosen ratios, ask questions such as:

- What kinds of units are you using to make your measurements?
- How do your ratios of measurements with nonstandard units compare to your ratios with standard units?
- How close do you want your ratios to be to accept them as the "same" ratio? What does this mean about the units you are using?

How are you using the calculator to help you with this problem?

How can you use $\boxed{\div}$ to help you look at ratios?

How can you use $\boxed{\text{⎕}}$ to help you look at ratios?

How can you use $\boxed{\text{F}\leftrightarrow\text{D}}$ to help you look at ratios?

How can you use $\boxed{\text{Fix}}$ to help you decide if your ratios are "close"?

Do Centimeters Make Me Taller? *(continued)*

Analyzing Data and Drawing Conclusions

After students have found several pairs of measurements, have them discuss their results as a whole group. Ask questions such as:

- What measuring tools did you use? Why did you choose them?
- What patterns, if any, do you see in your pairs of measurements?
- Why do you think those patterns occur?
- How close did you decide the ratios had to be in order to be the "same"?
- Why was it necessary to allow the ratios to be "close" rather than exactly equal?
- If someone else made your same pairs of measurements, would their data come out exactly the same as yours? Why or why not? What would be different, if anything?
- Does measuring your height in centimeters make you taller than measuring your height in inches? Why or why not?

Continuing the Investigation

Have students:

- Pick a ratio and try to find pairs of measurements that will form ratios close to the one they picked.
- Trade recording sheets, redo the pairs of measurements on the recording sheet, and see how closely these results match the first results.
- Use nonstandard and standard units to measure pairs of objects other than their feet and heights to see if the same pattern occurs in the ratios.

How did you use $\boxed{\text{Fix}}$ in this problem?

How could you use $\boxed{\underline{\text{n}}}$ in this problem?

How could you use $\boxed{\text{F}\leftrightarrow\text{D}}$ in this problem?

How could you use $\boxed{\div}$ in this problem?

Would you want to use $\boxed{\text{Int}\div}$ in this problem? Why or why not?

Name:

Do Centimeters Make Me Taller?

Recording Sheet

Collecting and Organizing Data

Unit of Measure	1st Measure	2nd Measure	Ratio of 1st to 2nd	Ratio in Decimal Form
Nonstandard Unit: ________	____________ is: ______ (Nonstandard Units)	____________ is: ______ (Nonstandard Units)		
Standard Unit: ________	____________ is: ______ (Standard Units)	____________ is: ______ (Standard Units)		
Nonstandard Unit: ________	____________ is: ______ (Nonstandard Units)	____________ is: ______ (Nonstandard Units)		
Standard Unit: ________	____________ is: ______ (Standard Units)	____________ is: ______ (Standard Units)		
Nonstandard Unit: ________	____________ is: ______ (Nonstandard Units)	____________ is: ______ (Nonstandard Units)		
Standard Unit: ________	____________ is: ______ (Standard Units)	____________ is: ______ (Standard Units)		

Analyzing Data and Drawing Conclusions

What we noticed about our pairs of ratios:

What this means:

Questions we thought of while we were doing this activity:

What's My Ratio?

Math Concepts

- fractions
- ratio
- decimals
- proportion
- division
- similarity
- linear measure

Materials

- TI-15 Explorer™
- **What's My Ratio?** recording sheets
- centimeter grid paper
- rulers or other linear measuring tools
- pencils
- pictures with enlarged or reduced copies

Overview

Students will use linear measurement and calculators to investigate proportionality and determine the constant ratio between similar figures.

Introduction

1. Read appropriate sections of *Goosebumps—Monster Blood III* (Chapters 15 and 16) by R.L. Stine or *The Shrinking of Treehorn* by F. Heide. Have students discuss what would happen to a picture in the pocket of someone who is shrunk or "blown up."

2. Have students draw a simple picture on centimeter grid paper (or use the centimeter grid provided on page 94). Have them decide to either increase or decrease the size of the picture, predict what they think the dimensions will be in the increased or decreased version, and discuss their reasoning.

3. Have students draw the increased or decreased picture on grid paper, keeping the picture's original shape, to test their predictions.

4. Discuss the use of ratio (comparing the measurements of corresponding parts) to describe how the picture has been increased or decreased.

   Example:
   If a line in the first picture is 3 cm and the corresponding line in the second picture is 6 cm, the ratio of the first picture to the second picture is 3 to 6 or three-sixths (or one-half, in simplest form).

5. Divide students into groups. Give each group an interesting picture (or use those provided on page 93) and a reduced or enlarged copy of the same picture. Ask each group to measure several pairs of corresponding parts on the two pictures, record their data on the recording sheet, and make some conclusions about copies of pictures.

What's My Ratio? *(continued)*

Collecting and Organizing Data

While students take measurements to generate data for comparing the ratios, ask questions such as:

- How are you going to compare these two pictures?
- What is your estimate of the change in size?
- Does that estimate make sense? Why or why not?
- How would you express the change as a comparison between the two pictures?
- What kinds of attributes could you compare?
- Is it important to compare the same things in the two pictures? Why or why not?
- What have you done previously in mathematics that might apply to this problem?
- How will you explain your strategy to the rest of the class?
- Would your strategy work for any picture? If so, why? If not, why not?
- What patterns, if any, do you see in the data?
- What conjectures have you made from the patterns in the data?

How are you using the calculator to help you with this problem?

How can you use $\boxed{F \leftrightarrow D}$ to help you look for patterns?

How can you use the calculator to compare fraction and decimal representations of ratios?

Analyzing Data and Drawing Conclusions

After students have taken several measurements and compared several ratios in their pictures, have them discuss their results as a whole group. Ask questions such as:

- Did your results match your estimates? Why or why not?
- How did you determine the ratio between the two figures?
- How did you use measuring tools to help find the ratios?
- What problems did you encounter, and how did you solve them?
- What mathematics did you use to find the ratios?

How could you use $\boxed{\frac{n}{\;}}$ in this problem?

How could you use $\boxed{F \leftrightarrow D}$ in this problem?

How could you use $\boxed{\div}$ in this problem?

Would you want to use $\boxed{\text{Int}\div}$ in this problem? Why or why not?

What's My Ratio? *(continued)*

Analyzing Data and Drawing Conclusions (continued)

- What patterns did you find in the ratios?
- Why do you think those patterns exist?
- What do you think would happen if you changed the values of any of the ratios between corresponding parts in a pair of pictures? Why do you think that would happen?

Continuing the Investigation

Have students:

- Create their own drawings, trade drawings with other students, and increase or decrease the drawings by a given ratio.
- Investigate the ratio between the areas of the two pictures. Is it the same as the ratio between the linear dimensions? Why or why not?

  Note: Investigate with simple squares to form a conjecture.

Name:

What's My Ratio?

Recording Sheet

Collecting and Organizing Data

We measured a picture of a ____

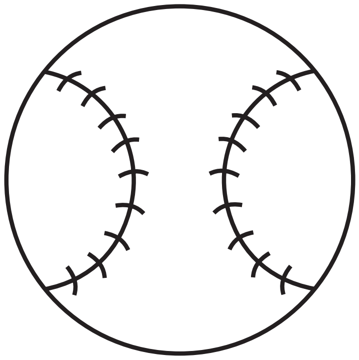
Part of the Picture That We Measured	Measurement in 1st Picture	Measurement in 2nd Picture	Ratio in Fraction Form	Ratio in Decimal Form

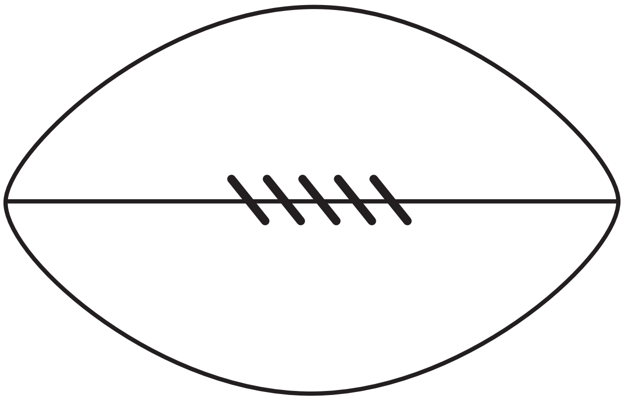
Analyzing Data and Drawing Conclusions

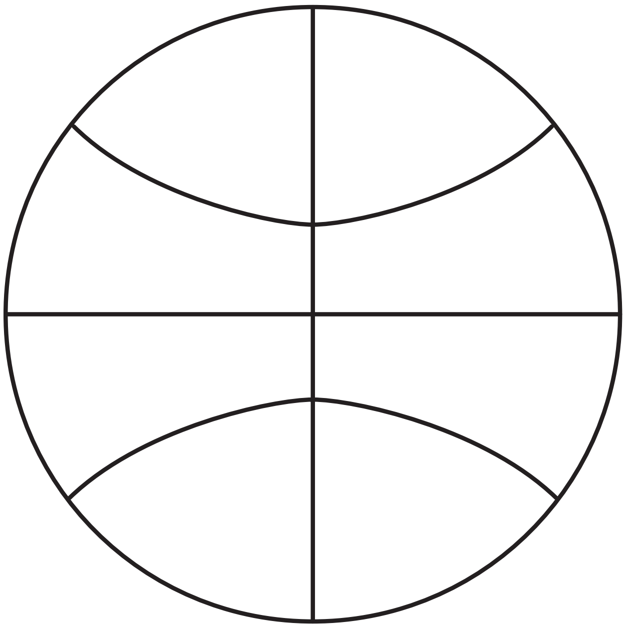
Questions we thought of while we were doing this activity:

What's My Ratio?

Sample Pictures to Shrink or Enlarge







Ratios in Regular Polygons

Math Concepts

- fractions
- segments
- decimals
- polygons
- linear measure
- congruence
- ratio
- similarity
- proportion

Materials

- TI-15 Explorer™
- **Ratios in Regular Polygons** recording sheets
- rulers and pencils
- protractors

Overview

Students will use linear measurement and calculators to investigate the ratios between corresponding parts of regular polygons.

Introduction

1. Have students draw several triangles, compare their triangles with those of other students, and look for any similarities among all the triangles.

   Note: There should be very few similarities.

2. Next, have students draw several equilateral triangles, compare their triangles with those of other students, and look for similarities.

   Note: They are all the same shape but different sizes.

3. Have students do the same experiment with rectangles, and then squares.

   Note: The rectangles come in all shapes; the squares are all the same shape but different sizes.

4. Introduce the term *similar figures* to mean "having the same shape but not necessarily the same size."

5. Give students the picture of several different-sized squares (see page 98). Have students measure the length of the diagonal and the perimeter of each square, record their findings on the recording sheet, and look for patterns.

6. Have students record the same data for other regular polygons of several different sizes and look for patterns. Regular hexagons, pentagons, and octagons are on page 98.

Ratios in Regular Polygons *(continued)*

Collecting and Organizing Data

While students generate data for the different sets of similar figures, ask questions such as:

- How are all of these squares (or hexagons, pentagons, etc.) alike?
- How are you measuring the diagonals?
- How are you measuring the perimeters?
- How do you know your measurements are reasonable?
- Does it matter whether you measure in inches or centimeters? Why or why not?
- What patterns do you see? Why do you think those patterns are occurring?

How can you use division with the calculator to help you look for patterns?

How can you use F↔D to help you look for patterns?

How can you judge if what you see on your calculator is reasonable?

How can you use the calculator and the patterns you see to help you predict measurements?

Analyzing Data and Drawing Conclusions

After students have made and compared several sets of measurements, have them discuss their results as a whole group. Ask questions such as:

- Did your data turn out exactly like everyone else's? Why or why not?
- What patterns do you see in your data?
- How are the diagonals and the perimeters of squares related to each other? Of regular pentagons? Of regular hexagons? Of regular octagons?
- From the patterns in your data, what conjectures can you make about measurements in similar figures?

What operations or keys did you use on the calculator to help you find patterns in this activity? Why did you choose those operations or keys?

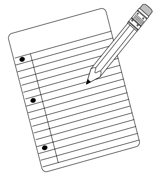
How did you determine if your calculator results were reasonable?

Continuing the Investigation

Have students:

- Look for relationships between measurements of other parts of similar figures; for example, perimeter and area.
- Investigate similar figures other than regular polygons; for example, different sizes of nonsquare rectangles that are the same shape, different sizes of scalene triangles that are the same shape, etc.

Name:



Ratios in Regular Polygons

Recording Sheet

Collecting and Organizing Data

Polygon investigated: ______________________________

Measurement of Perimeter	Measurement of Diagonal	Ratio of Perimeter to Diagonal	Ratio in Decimal Form

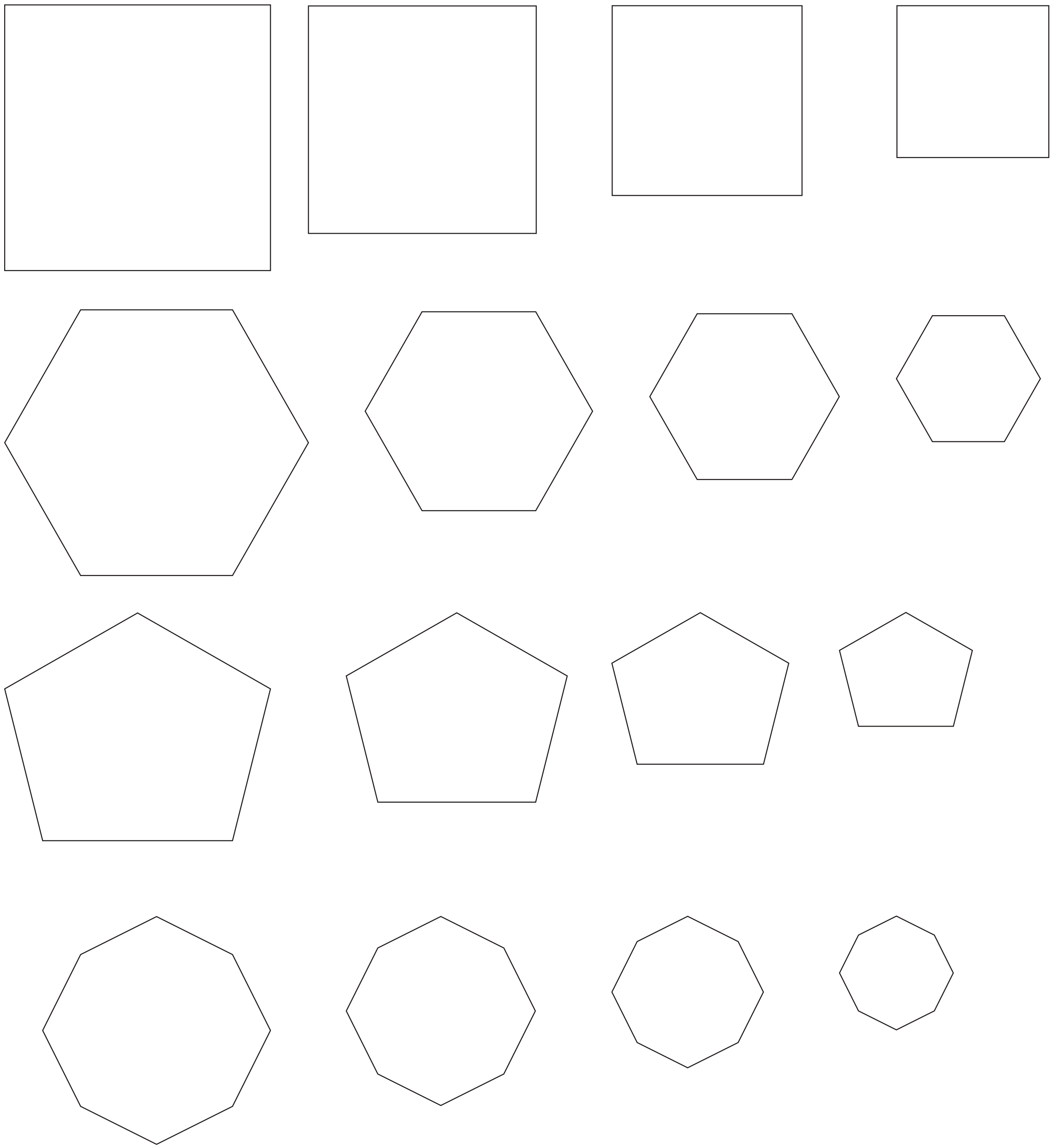
Analyzing Data and Drawing Conclusions

What we noticed about the ratios of the different-sized polygons:

Questions we thought of while we were doing this activity:

Ratios in Regular Polygons

Regular Polygons of Different Sizes



Predicting π

Math Concepts

- fractions
- circles
- decimals
- diameter
- linear measure
- circumference
- ratio
- similarity
- proportion

Materials

- TI-15 Explorer™
- **Predicting** π recording sheets
- rulers, meter sticks, string, compasses, calipers
- pencils

Overview

Students will use linear measurement and calculators to discover the existence of π, the constant ratio between the circumference and the diameter of a circle.

Introduction

It would be helpful to complete the **Ratios in Regular Polygons** activity on page 95 before beginning this activity.

1. Have students identify several circular objects in the classroom, on the school grounds, or at home.

   Note: You may wish to have students bring circular objects to class.

2. Have students select a tool to measure the circumference and diameter of each circle, and record these measurements on the recording sheet.

3. Have students use a compass to draw several different circles and record their circumferences and diameters on the recording sheet.

4. Have students look for patterns in their data and make conjectures about why the patterns might exist.

Predicting π *(continued)*

Collecting and Organizing Data

While students generate data for the circles, ask questions such as:

- How are all of the circles alike?
- How are you measuring the diameters?
- How are you measuring the circumferences?
- How are the measurements you are making with circles different from the measurements you made with the regular polygons (refer to **Ratios in Regular Polygons** on page 95)? How are they alike?
- Does it matter whether you measure in inches or centimeters? Why or why not? (see **Do Centimeters Make Me Taller?** on page 85).
- What patterns do you see?
- Why do you think those patterns are occurring?

How are you using the calculator to help you look for patterns?

How can you judge that what you see on your calculator is reasonable?

How can you use the calculator and the patterns you see to help you predict measurements of diameters or circumferences?

Analyzing Data and Drawing Conclusions

After students have made and compared several sets of measurements, have them discuss their results as a whole group. Ask questions such as:

- Is your data the same as everyone else's? Why or why not?
- What patterns do you see in your data?
- How are these patterns like the ones in the **Ratios in Regular Polygons** activity (page 95)? How are they different?
- How are the circumferences and the diameters of the circles related to each other?
- How is this relationship like the ones you found in the **Ratios in Regular Polygons** activity (page 95)?
- From the patterns in your data, what conclusions can you make about the number π, which represents the constant ratio between the circumference and diameter of a circle?

What operations or keys did you use on the calculator to help you find patterns in this activity? Why did you choose those operations or keys?

How did you determine whether your calculator results were reasonable?

Predicting π *(continued)*

Analyzing Data and Drawing Conclusions (continued)

- Why do you think this ratio was given the name “Pi”?
- How can the knowledge of this constant ratio π be used?
- Do you think the distance around a tennis ball container is greater than, about the same as, or less than its height? Why?

Continuing the Investigation

Have students research the history of the development of the numerical value of π.

Name:

Predicting π
Recording Sheet

Collecting and Organizing Data

Object	Measure of Circumference (C)	Measure of Diameter (D)	Ratio of C to D	Ratio in Decimal Form

Analyzing Data and Drawing Conclusions

If I know the length of the diameter of a circle, I can find its circumference by:

If I know the length of the circumference of a circle, I can find the length of its diameter by:

Questions we thought of while we were doing this activity: