

# Exploring Angles Using Tangrams



Turn  
On  
3

## Program Overview

Students identify angles on Tangram pieces and create figures that have specific angle requirements.

## Mathematics Instructional Materials

SAS#3.1 (one per student)

SAS#3.2 (one per student)

SAS#3.3 (one per student)

TIS#3.1 (Journal prompt)

Tangrams

Student journals

## NCTM Standards Addressed

### Standard: Geometry

*Analyze characteristics and properties of two- and three-dimensional shapes and develop mathematical arguments about geometric relationships:*

#### Grades 3–5

- make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.

#### Grades 6–8

- precisely describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties;
- create and critique inductive and deductive arguments concerning geometric ideas and relationships, such as congruence, similarity, and the Pythagorean relationship.

*Use visualization, spatial reasoning, and geometric modeling to solve problems:*

#### Grades 3–5

- build and draw geometric objects.

#### Grades 6–8

- draw geometric objects with specified properties, such as side lengths or angle measures;
- recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life.

### Standard: Measurement

*Apply appropriate techniques, tools, and formulas to determine measurements:*

#### Grades 3–5

- select and use benchmarks to estimate measurements.

#### Grades 6–8

- use common benchmarks to select appropriate methods for estimating measurements.

*Instructional programs from prekindergarten through grade 12 should enable all students to:*

### Standard: Problem Solving

- build new mathematical knowledge through problem solving.

### Standard: Communication

- communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

### Standard: Connections

- recognize and use connections among mathematical ideas.

## California Standards Addressed

### Measurement & Geometry

#### Grade 5

**2.0** *Students identify, describe, and classify the properties of, and the relationships between, plane figures:*

**2.1** Measure, identify and draw angles, perpendicular and parallel lines, rectangles, and triangles, using appropriate tools.

**2.2** Know that the sum of the angles of any triangle is  $180^\circ$  and the sum of the angles of any quadrilateral is  $360^\circ$  and use the information to solve problems.

### Mathematical Reasoning

#### Grade 5

**3.0** *Students move beyond a particular problem by generalizing to other situations:*

**3.3** develop generalizations of the result obtained and apply them in other circumstances.

#### Grade 6

**2.0** *Students identify and describe the properties of two-dimensional figures:*

**2.3** Draw quadrilaterals and triangles from given information about them.

# Exploring Angles Using Tangrams



Turn  
On  
3

## Program Outline

### Pre-Viewing Activities

Have students sitting with partners in groups of four.

Distribute Tangrams, one set to each student (make sure each person in the group gets a different color).

Read or tell the story of the Tangram, see page 5.

Review terms: *right angle*, *acute angle*, *obtuse angle*.

Post charts identifying polygons and types of angles (optional).

### Program Viewing

Welcome	Introductions and teaser
Focus	Students explore angle measurement of Tangram pieces, then create geometric designs.
<b>Activity #1</b>	<b>Tangram Angles</b>
DLI	Discusses angle measurements and introduces and demonstrates the activity <i>YOUR TIME</i>
CT	Facilitates activity
S	Measure angles of each Tangram piece using the right angle Tangram Share measurement data
<b>Activity #2</b>	<b>Build a Shape</b>
DLI	Introduces and models the task <i>YOUR TIME</i>
CT	Facilitates activity, has students share their solutions on the overhead
S	Create shapes to fulfill the requirements on SAS#3.2 Share these shapes with partners for verification FAX in some of the shapes
<b>Activity #3</b>	<b>More Shapes</b>
DLI	Introduces the activity <i>YOUR TIME</i>
CT	Facilitates activity
S	Create specifications for new shapes, send these to a partner for completion
<b>Journal Writing</b>	Write about your favorite shape.

<b>KEY</b>	<i>DLI: Distance Learning Instructor</i>	<i>CT: Classroom Teacher</i>	<i>S: Students</i>
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# Exploring Angles Using Tangrams



Turn  
On  
3

## Instructions for Program Viewing

### Activity #1: Tangram Angles

#### Description

Students measure the angles of each Tangram piece.

#### Advance Preparation

Duplicate SAS#3.1 (one per student)

#### Materials

SAS#3.1  
Protractor  
Tangrams (one set per student)

#### Lesson Implementation

The Distance Learning Instructor introduces the activity. The Classroom Teacher facilitates by circulating and encouraging students to estimate before using the protractor.

Students select Tangram pieces to measure.

#### Teacher Note: Answer Key to SAS#3.1

Tangram	Acute	Obtuse	Right
Square	0	0	4-90°
Large Triangle	2-45°	0	1-90°
Medium Triangle	2-45°	0	1-90°
Small Triangle	2-45°	0	1-90°
Parallelogram	2-45°	2-135°	0

### Activity #2: Build a Shape

#### Description

Students use specified Tangrams to create shapes.

#### Advance Preparation

SAS#3.2 (one per student)  
SAS#3.3 (one per student)

#### Materials

SAS#3.2  
SAS#3.3  
Tangrams (one set per student)

#### Lesson Implementation

The Distance Learning Instructor demonstrates the activity. The Classroom Teacher facilitates by observing the group as they work, encouraging groups to find as many solutions as possible, and having students describe solutions. If time permits, Classroom Teacher asks students to share their shape on the overhead.

Students create a shape(s) that fills the angle measure requirements listed on the page. They trace their shapes on the worksheet.

# Exploring Angles Using Tangrams



Turn  
On  
3

## Activity #3: More Shapes

### Description

The Distance Learning Instructor introduces the activity. Students write specifications for new shapes and send these to their partner for completion.

### Materials

Tangrams

### Lesson Implementation

The Distance Learning Instructor introduces the activity. The Classroom Teacher facilitates the activity by clarifying any questions students might have.

Students write specifications, verify that this shape can be built using Tangrams, then send the specifications to their partner to see if it can be built.

## Teacher Background

Tangrams have been the companion of millions of children through the centuries. We can read the history of the puzzle within the more than 300 designs it hides from all but those who see beyond the square. Perhaps we can suppose it likes best to be a gift to those with imagination.

### The Story of the Tangram

About 4,000 years ago in China, there lived a man called Tan. Tan had, as his greatest possession, a fine ceramic tile. One day while he was carrying it to show the emperor, he tripped and the tile fell to the floor and smashed into seven pieces. Tan spent the rest of his life trying to put the tile back together again. Even though he was unsuccessful in putting it together, he did succeed in creating many different geometric shapes and pictures.

He inadvertently pictured his cat with the seven pieces, and a pagoda which resembled the one he visited often for meditation.

Tan enjoyed his life and his friends who often came to visit with him and share in the delights of his pictures. Thus Tan amused himself and his friends into the “sunset years” of his life and even until death.

However, Tan’s puzzle did not die with him. It was passed on from one generation to the next and from country to country. Some people say that it helped ease the restless pacing of Napoleon while he was imprisoned on the island of St. Helena.

The three different polygons found in Tangram shapes are right triangles, a square, and a parallelogram. Angles of the Tangram pieces are right angles ( $90^\circ$ ), acute angles (less than  $90^\circ$ ) and obtuse angles (greater than  $90^\circ$ ). The total number of degrees in any triangle is  $180^\circ$ , and the total number of degrees in any quadrilateral is  $360^\circ$ . One way to measure angles is with a protractor. Another is to compare unknown angles with angles whose measurement is known. Provide ample time to discover solutions.

## Post-Viewing Activity

Complete Activity #3 (More Shapes) and send student worksheet to be shared on the program or on the TEAMS home page.

# Exploring Angles Using Tangrams



**Turn  
On  
3**

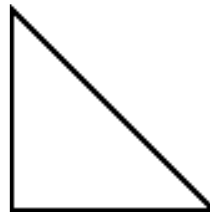
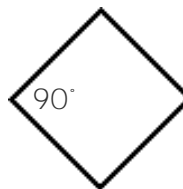
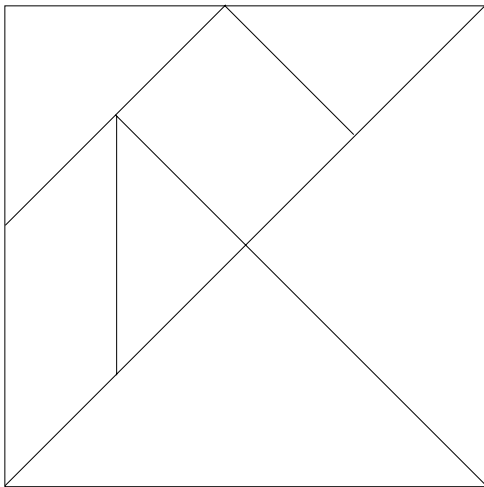
SAS#3.1

## Tangram Angles

Name \_\_\_\_\_

Date \_\_\_\_\_

Use one set of Tangram pieces. Record the angle measurements of each shape below.



Record angle measurements on this chart:

Tangram	Acute	Obtuse	Right
Square	_____	_____	_____
Large Triangle	_____	_____	_____
Medium Triangle	_____	_____	_____
Small Triangle	_____	_____	_____
Parallelogram	_____	_____	_____

Explain how you determined the measurements: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# Exploring Angles Using Tangrams



Turn  
On  
3

SAS#3.2

## Build a Shape

Student Name

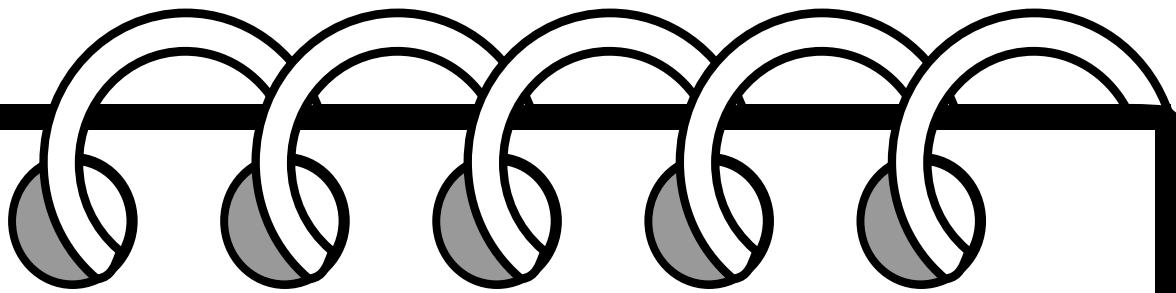
Use the Tangram square and 2 small triangles, to make each polygon described below. Trace, record, label each angle, and name the polygon.

- 1) 4 right angles  
0 acute angles  
0 obtuse angles

- 2) 0 right angles  
2 acute angles  
2 obtuse angles

- 3) 1 right angle  
2 acute angles  
0 obtuse angles





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Journal Writing

Write about  
your  
favorite  
shape.

