› Read and share with your student.

TEXAS MATH SOLUTION

How to support your student as they learn about

Reasoning with Shapes

Mathematics is a connected set of ideas, and your student knows a lot. Encourage them to use the mathematics they already know when encountering new concepts in this module.

Module Introduction

In this module your student will reason algebraically—connecting what they know about lines on the coordinate plane to verify simple geometric theorems. There are 3 topics in this module: *Using a Rectangular Coordinate System, Rigid Motions on a Plane,* and *Congruence Through Transformations*. Your student will use what they already know about transforming shapes on a coordinate plane in this module.

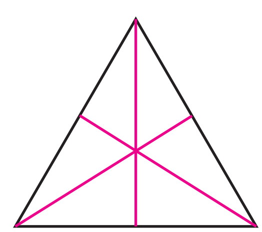
Academic Glossary

Each module will highlight an important term. Knowing and using these terms will help your student think, reason, and communicate their math ideas.

Term	Analyze
Definition	• To study or look closely for patterns. • To break a concept down into smaller parts to gain a better understanding of it.
Questions to Ask Your Student	• Do you see any patterns? • Have you seen something like this before? • What happens if the shape, model, or numbers change?
Related Phrases	• Examine • Evaluate • Determine • Observe • Consider • Investigate • What do you notice?

TABLE OF CONTENTS

This equilateral triangle has three lines of symmetry. **Analyze** the lines of symmetry. What do you notice?



ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS
https://www.carnegielearning.com/texas-help/students-caregivers/

Math Process Standards

Each module will focus on a process (or a pair of processes) that will help your student become a mathematical thinker. The "I can" statements listed below help your student to develop their mathematical learning and understanding.

Analyze mathematical relationships to connect and communicate mathematical ideas.

I can:

- identify important relationships in a problem situation.
- use what I know to solve new problems.
- analyze and organize information.
- look closely to identify patterns or structure.
- look for different ways to solve problems.

Look for examples of these processes in the Topic Summaries.

The Carnegie Learning Way

Our Instructional Approach

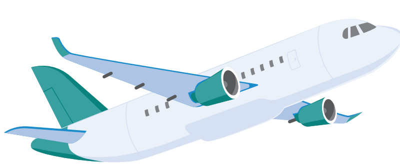
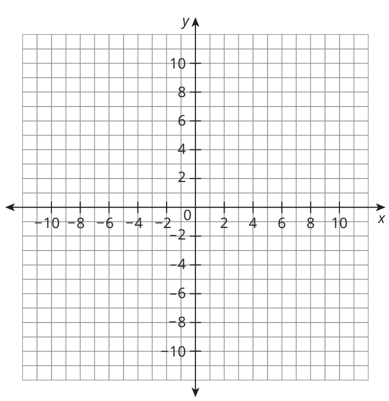
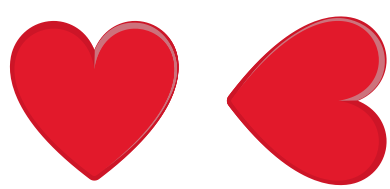
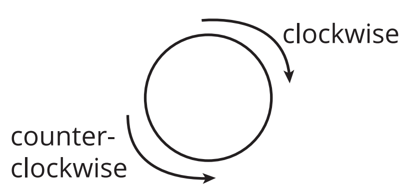
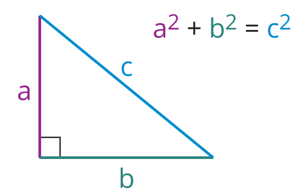
Carnegie Learning's instructional approach is based on how people learn and real-world understandings. It is based on three key components:

ENGAGE	DEVELOP	DEMONSTRATE
Purpose: Provide an introduction that creates curiosity and uses what students already know and have experienced. **Questions to Ask:** How does this problem look like something you did in class?	**Purpose:** Build a deep understanding of mathematics through different activities. **Questions to Ask:** Do you know another way to solve this problem? Does your answer make sense?	**Purpose:** Reflect on and evaluate what was learned. **Questions to Ask:** Is there anything you do not understand?

ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS

https://www.carnegielearning.com/texas-help/students-caregivers/

Module Overview

TOPIC 1	TOPIC 2	TOPIC 3
Using a Rectangular Coordinate System	**Rigid Motions on a Plane**	**Congruence Through Transformations**
19 Days	19 Days	12 Days
Your student will study the properties of squares and will learn strategies for determining the perimeters and areas of figures on the coordinate plane.	**Your student will study rigid motions with a transformation machine, then consider each as a function.**	**Your student will use formal reasoning to prove geometric theorems.**
Plane vs. Plane A plane can mean an airplane.  A plane can also be a flat surface. A **coordinate plane** is formed by the intersection of horizontal and vertical lines. 	What in the world? A **transformation machine** is like making a shake. You put in the ingredients (the input), you blend them together (the transformation), and the result is a delicious shake (the output). How has this image of a heart been transformed?  [*This heart shape has been rotated 90 degrees clockwise.*] 	What is a theorem? A **theorem** is a math rule that has been proven to be true.  A well-known example is the Pythagorean Theorem.

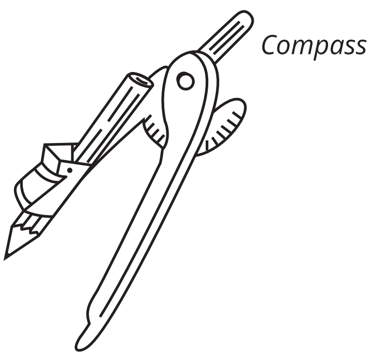
ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS
https://www.carnegielearning.com/texas-help/students-caregivers/

Topic 1: Using a Rectangular Coordinate System

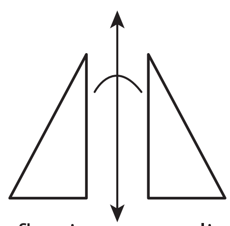
Key Terms

- sketch
- draw
- conjecture
- auxiliary line
- construct
- compass
- straightedge
- point
- line
- line segment
- midpoint
- segment bisector
- perpendicular bisector
- diagonal
- transformation
- rigid motion
- translation
- reflection
- rotation
- Distance Formula
- Midpoint Formula
- composite figure
- regular polygon

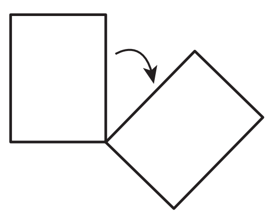
A **compass** is a tool used to create arcs and circles.



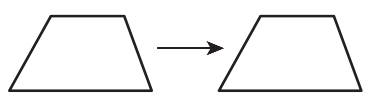
A **transformation** is an operation that maps, or moves, a figure, called the preimage, to form a new figure called the image. Three types of transformations are reflections, rotations, and translations.



reflection over a line



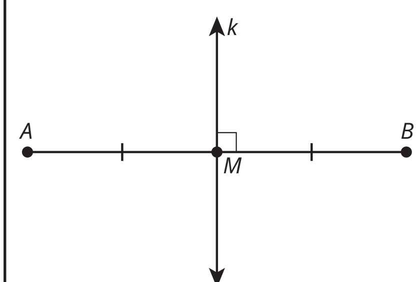
rotation about a point



translation

A **perpendicular bisector** is a line, line segment, or ray that intersects the midpoint of a line segment at a 90° angle.

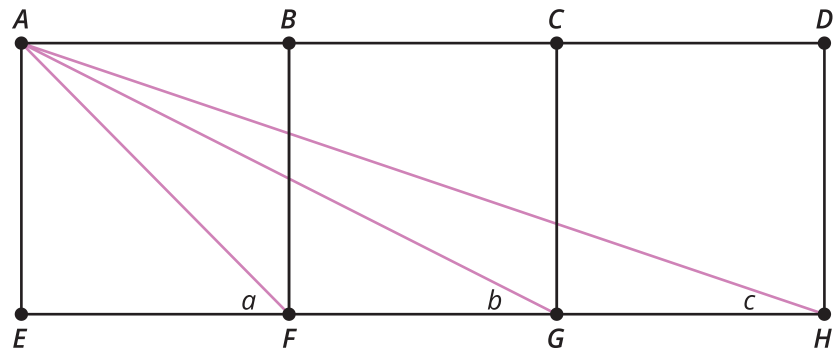
Line k is the perpendicular bisector of $\overline{AB}$. It is perpendicular to $\overline{AB}$, and intersects $\overline{AB}$ at midpoint M so that $AM = MB$.



Follow the link to access the Mathematics Glossary:
https://www.carnegielearning.com/texas-help/students-caregivers/

Three Angles

Students begin this topic by solving a geometry puzzle. Students measure and then prove that three angles in a diagram sum, or add, to 90°.

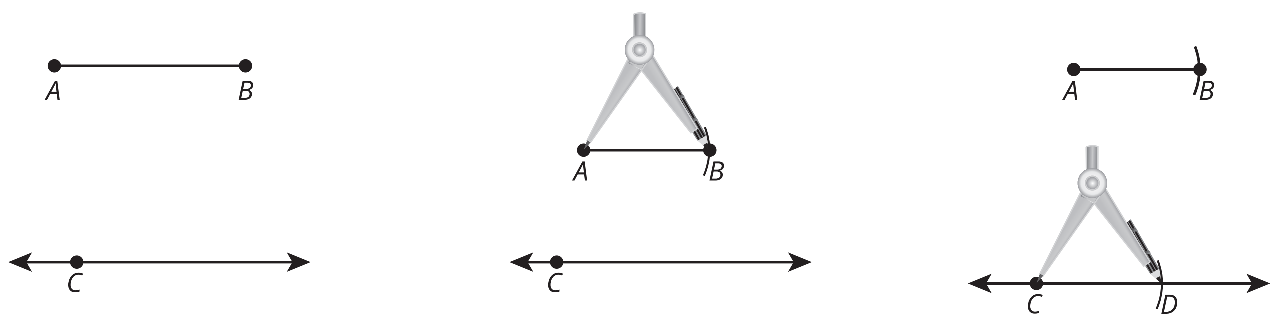


$\angle a$, $\angle b$, and $\angle c$ sum to 90°.

Constructing a Duplicate Line Segment

Students then review the properties of squares and **rigid motions** and use constructions to build a rectangular coordinate system by creating and transforming squares.

You can duplicate a **line segment** by constructing an exact copy of the original line segment.



Construct a Starter Line

Use a straightedge to construct a starter line longer than $\overline{AB}$. Label point *C* on the line.

Measure Length

Set your compass to the length *AB*.

Copy Length

Place the compass at point *C* and mark point *D* on the new segment.

Line segment *CD* is a duplicate of $\overline{AB}$.

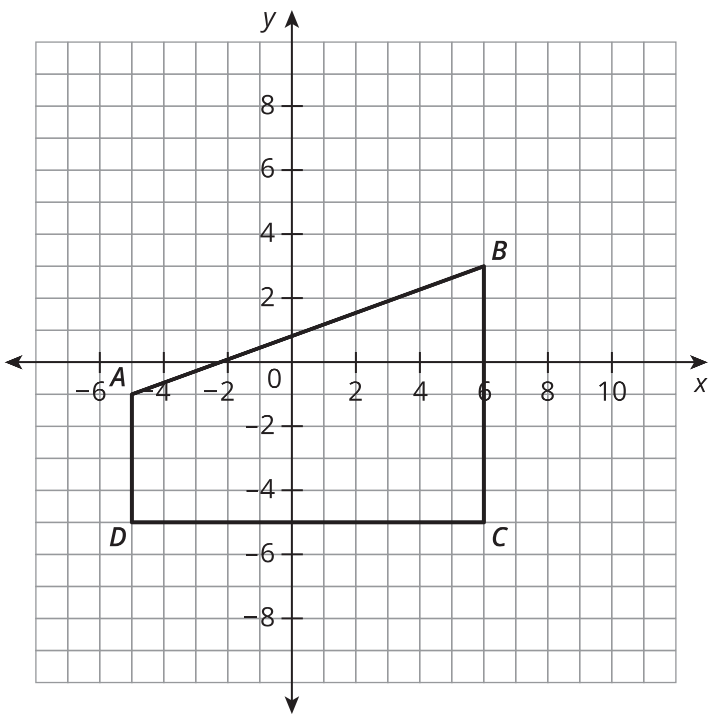
ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS

https://www.carnegielearning.com/texas-help/students-caregivers/

TEXAS MATH SOLUTION

Area of a Composite Figure

Students then study parallel and perpendicular line relationships on the coordinate plane, classify polygons on the coordinate plane, and determine the area and perimeter of shapes on the coordinate plane.



You can determine the area of quadrilateral *ABCD* by breaking it into a triangle and a rectangle and determining the area of each.

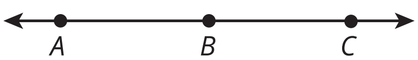
ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS
https://www.carnegielearning.com/texas-help/students-caregivers/

Topic 2: Rigid Motions on a Plane Summary

Key Terms		
• collinear points • angle • ray • rotation angle • translation	• isometry • reflection • Perpendicular Bisector Theorem • proof	• rotation • reflectional symmetry • rotational symmetry

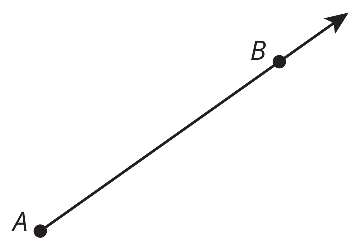
Collinear points are points that are located on the same line.

Points *A*, *B*, and *C* are collinear.



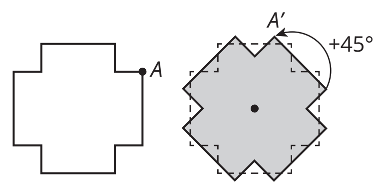
A **ray** is a portion of a line that begins with a single point and extends infinitely in one direction.

The ray shown is a ray *AB*.



A **rotation angle** is a directed angle based on a circle. Positive rotation angles turn countercockwise, and negative rotation angles turn clockwise.

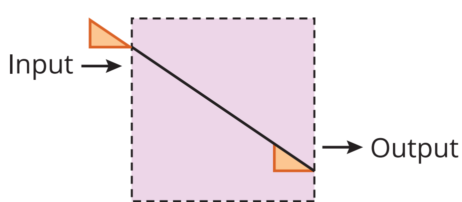
The rotation angle shown rotates point *A* 45° counterclockwise.



Follow the link to access the Mathematics Glossary:
https://www.carnegielearning.com/texas-help/students-caregivers/

A Function Machine

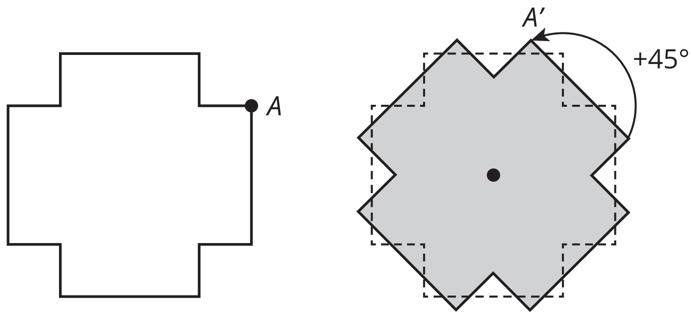
This topic begins by reminding students of what they know about functions via a function machine.



ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS
https://www.carnegielearning.com/texas-help/students-caregivers/

A Geometric Function Machine

Instead of having numbers as input and output, a geometric function machine has a geometric figure as the input and output. Students learn about simple geometric transformation machines, describing how each input shape is "carried" by geometric objects in the transformation machine to result in the output shape.



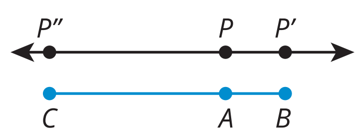
Function Notation

Students then consider each of the rigid motions as functions and identify geometric figures with line symmetry and **rotational symmetry**.

A **translation** function can represent the distance and direction of the translation using a line or line segment, or a parallel line or line segment:

$T_{AB}(P) = P'$

$T_{AC}(P) = P''$



ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS
https://www.carnegielearning.com/texas-help/students-caregivers/

MATH PROCESS STANDARDS

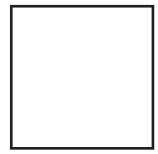
How do the activities in *Rigid Motions on a Plane Summary* promote student expertise in the math process standards?

NOTE: This is an example of the math process standard:

Analyze mathematical relationships to connect and communicate mathematical ideas.

- I can look closely to identify patterns or structure.

Have your student refer to page 2 for more "I can" statements.



How many lines of symmetry are there in a square? Draw the lines of symmetry.

ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS

https://www.carnegielearning.com/texas-help/students-caregivers/

Topic 3: Congruence Through Transformations

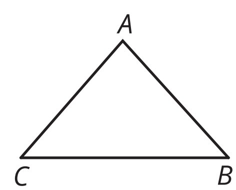
Key Terms		
• counterexample • truth value • truth table • spherical geometry • Euclidean geometry • Linear Pair Postulate • Segment Addition Postulate	• Angle Addition Postulate • Side-Side-Side Congruence Theorem (SSS) • corresponding parts of congruent triangles are congruent (CPCTC)	• Side-Angle-Side Congruence Theorem (SAS) • included angle • Angle-Side-Angle Congruence Theorem (ASA) • included side

A **counterexample** is a single example that shows that a statement is not true.

Your friend claims that you add fractions by adding the numerators and then adding the denominators. A counterexample is $\frac{1}{2} + \frac{1}{2}$. The sum of these two fractions is 1. Your friend's method results in $\frac{1+1}{2+2}$ or $\frac{1}{2}$. Your friend's method is incorrect.

An **included side** is a line segment between two consecutive angles of a figure.

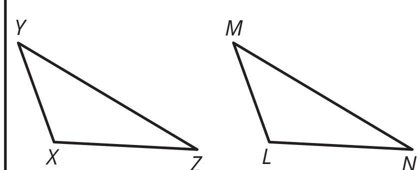
In ΔABC, $\overline{AB}$ is the included side formed by consecutive angles A and B.



CPCTC states that if two triangles are congruent, then each part of one triangle is congruent to the corresponding part of the other triangle.

In the triangles shown, $\Delta XYZ \cong \Delta LMN$. Because **corresponding parts of congruent triangles are congruent (CPCTC)**, the following corresponding parts are congruent.

- $\angle X \cong \angle L$
- $\angle Y \cong \angle M$
- $\angle Z \cong \angle N$
- $\overline{XY} \cong \overline{LM}$
- $\overline{YZ} \cong \overline{MN}$
- $\overline{XZ} \cong \overline{LN}$



Follow the link to access the Mathematics Glossary:
https://www.carnegielearning.com/texas-help/students-caregivers/

ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS
https://www.carnegielearning.com/texas-help/students-caregivers/

If-Then Conditional Statement

In this topic, students use formal reasoning to prove geometric theorems.

$$\underbrace{\text{If } x^2 = 36,}_{\text{Hypothesis}}\ \underbrace{\text{then } x = 6 \text{ or } x = -6}_{\text{Conclusion}}.$$

Triangle Congruence Theorems

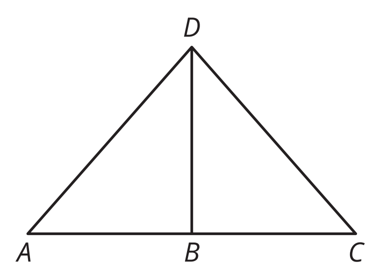
Students use what they know about rigid motions to prove triangle congruence theorems by construction. Students prove the **Side-Side-Side**, **Side-Angle-Side**, and **Angle-Side-Angle Congruence Theorems** by construction. Each proof involves a sequence of transformations that maps one triangle onto another, given the congruence of three corresponding parts.

THEOREM

SIDE-SIDE-SIDE CONGRUENCE THEOREM (SSS)

If three sides of one triangle are congruent to the corresponding sides of another triangle, then the triangles are congruent.

Given: $\overline{AD} \cong \overline{DC}$ and $\overline{DB}$ bisects $\overline{AC}$.



You can use the Side-Side-Side Congruence Theorem to demonstrate that ΔADB is congruent to ΔCDB.

- Using the definition of a bisector, B is the midpoint of $\overline{AC}$ and therefore $\overline{AB} \cong \overline{BC}$.
- Since $\overline{DB}$ is the same side in each triangle, then $\overline{DB} \cong \overline{DB}$.
- Therefore, $\Delta ADB \cong \Delta CDB$ by SSS.

ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS

https://www.carnegielearning.com/texas-help/students-caregivers/

THEOREM

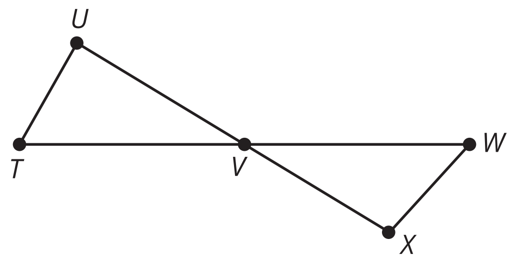
SIDE-ANGLE-SIDE CONGRUENCE THEOREM (SAS)

If two sides and the included angle of one triangle are congruent to the corresponding two sides and the included angle of a second triangle, then the triangles are congruent.

Given: V is the midpoint of $\overline{UX}$ and V is the midpoint of $\overline{TW}$.

You can use the Side-Angle-Side Congruence Theorem to demonstrate that ΔUVT is congruent to ΔXVW.

- By definition of a midpoint, $\overline{UV} \cong \overline{XV}$ and $\overline{TV} \cong \overline{WV}$.
- Using the definition of vertical angles, $\angle UVT \cong \angle XVW$.
- Therefore, $\Delta UVT \cong \Delta XVW$ by SAS.



THEOREM

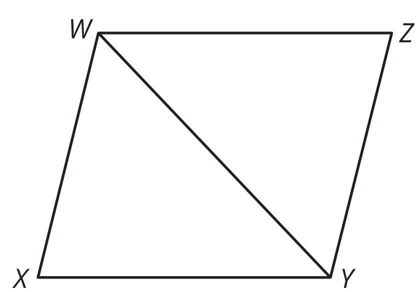
ANGLE-SIDE-ANGLE CONGRUENCE THEOREM (ASA)

If two angles and the included side of one triangle are congruent to the corresponding two angles and the included side of another triangle, then the triangles are congruent.

Given: $\overline{WZ} \parallel \overline{XY}$ and $\overline{WX} \parallel \overline{ZY}$.

You can use the Angle-Side-Angle Congruence Theorem to demonstrate that ΔWXY is congruent to ΔYZW.

- Using the definition of alternate interior angles, $\angle ZWY \cong \angle XYW$ and $\angle XWY \cong \angle ZYW$.
- Since $\overline{WY}$ is the same side in each triangle, then $\overline{WY} \cong \overline{WY}$.
- Therefore, $\Delta WXY \cong \Delta YZW$ by ASA.

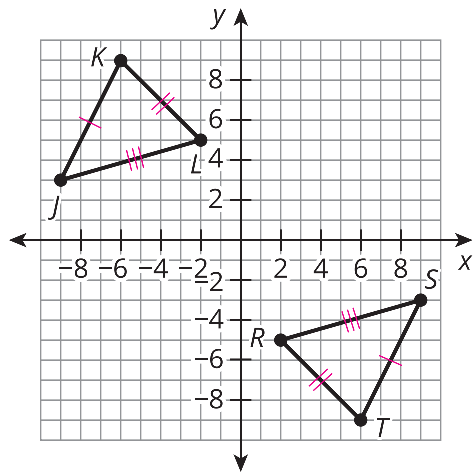


ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS

https://www.carnegielearning.com/texas-help/students-caregivers/

Using the Distance Formula to Show Two Triangles are Congruent by SSS

Putting together their knowledge of geometry and algebra, students use the Distance Formula to apply the congruence theorems to triangles with given measurements on the coordinate plane.



TEXAS MATH SOLUTION

Discuss important dates throughout this module such as assessments, assignments, or class events with your student. Use the table to record these dates and reference them as your student progresses through the module.

Important Dates	
Date	Reason

Using the link below, visit the Texas Math Solution Support Center for students and caregivers to access additional resources such as:

- Mathematics Glossaries
- Videos
- Topic Materials
- A Letter to Families and Caregivers

ONLINE RESOURCES FOR FAMILIES AND CAREGIVERS

https://www.carnegielearning.com/texas-help/students-caregivers/