TI-*nspire*™

Grade level: 8-12

Subject: Mathematics
Time required: 60 to 90 minutes

Exploring the Black Box of Quadrilaterals
by – Amanda Hawkins

Activity overview
In this activity students will explore several quadrilaterals. The exploration will begin with students dragging the quadrilateral given to them about the screen. Initially, they will be asked to simply identify the quadrilateral's name by sight. This will require simply a visual recognition of the quadrilaterals parallelogram, rectangle, square, rhombus, trapezoid, and kite. Next students will be asked to identify as many properties about the shape as possible and verify them using the tools provided to them in the Graph & Geometry applications.

Concepts
Recognizing various quadrilaterals by sight (parallelogram, rectangle, square, rhombus, trapezoid, and kite). [Note to teacher: The definition of trapezoid being used for this construction is a quadrilateral with at least one side parallel as opposed to a quadrilateral with exactly one side parallel.]

Discovering the properties of various parallelograms.

Teacher preparation
This activity was designed to be used in a Middle School or High School Geometry unit. Prior to beginning the activity, students should be able to visually distinguish between various types of quadrilaterals such as parallelograms, rectangles, squares, rhombi, trapezoids, and kites). Refer to the screenshots on pages 7-8 for a preview of the student TI-Nspire document (.tns file).

Classroom management tips
This activity is intended to be a student exploration. The teacher should plan to launch the activity with a brief review over the types and names of quadrilaterals, being careful to only do this visually with students and not listing properties in advance, since this is for students to explore. One possible way to do this would be for students to approach this activity with the definitions of these quadrilaterals in hand, from the previous days' lessons potentially. Next, students will have a period of approximately 40-45 minutes of exploration. While students are working, it is expected that the teacher is walking around asking question such as what are you noticing about the various quadrilaterals?

During this time it would be wise for the teacher to carry a clipboard to record students conjectures and thoughts. These will be useful in the final wrap up discussion of this activity. After the students have worked together through the activity, the teacher should bring them back together to discuss the big ideas that they found. It is during this time, that the teacher should carefully select and sequence students ideas according to the clipboard notes she has been taking during the exploration. The discussion should center around the concepts highlighted above. After each exploration of a new quadrilateral, there is a summary page with questions about what the student noticed from the exploration. As the explorations continue, the questions ask students to compare and contrast their findings from the previous explorations to the current exploration.

TI-Nspire Applications
*Graph & Geometry, and Notes.*

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Step-by-step directions

On page 1.3, students are simply asked to move the point labeled "A". While moving this point, they should be observing shape that this quadrilateral is able to take on.

After a short time of dragging, students should come to the conclusion that this quadrilateral is a parallelogram. Next, students should begin looking to conjectures and verify various properties about this quadrilateral. This properties should be recorded on page 1.4 for later discussion with the class.
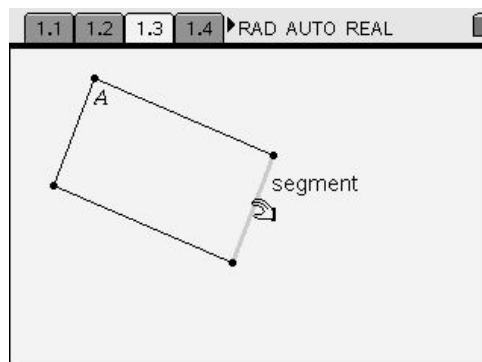
On page 1.4, students are asked what things they notice about the sides of this parallelogram. Expected answers include:

1) Opposite sides are parallel
2) Opposite sides are congruent

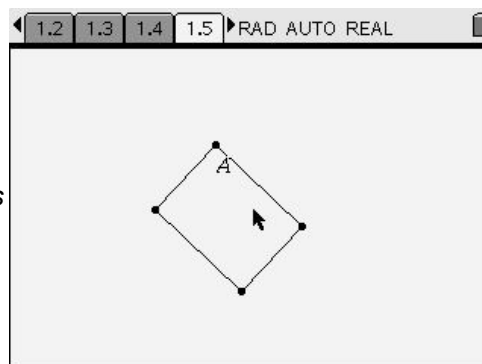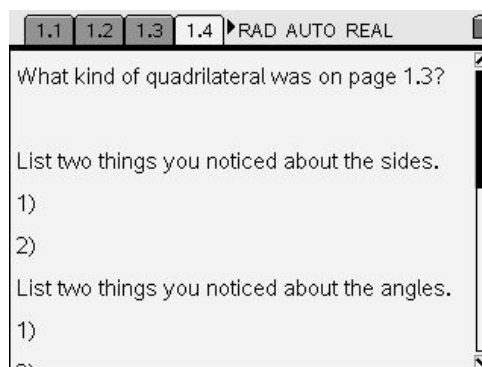Students are next asked what they notice about the angles. Expected answers include:

1) Opposite angles are congruent
2) Consecutive angles are supplementary

Finally, students are asked what they notice about the diagonals. Students may have very different ways of expressing this and it should be allowed in order to create discussion at the lesson summary. The final form of this property is very cleaned up compared to where many students will start. Expected (FINAL) student answer:

1) Diagonals bisect each other

On page 1.5, students are simply asked to move the point labeled "A". While moving this point, they should be observing shape that this quadrilateral is able to take on.

After a short time of dragging, students should come to the conclusion that this quadrilateral is a rectangle. Next, students should begin looking to conjectures and verify various properties about this quadrilateral. This properties should be recorded on page 1.6 for later discussion with the class.

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On page 1.6, students are asked about the things that are different about a rectangle than a parallelogram. Expected answers include (although answers may vary):

1) All angles are right angles
2) Adjacent sides are perpendicular
3) Diagonals are congruent
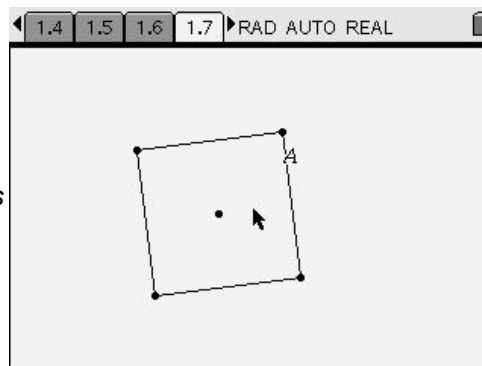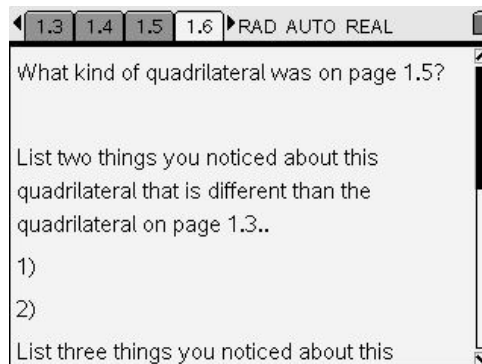4) Triangles formed by diagonals are isosceles.

Students are then asked to notice what is the same about a rectangle and parallelogram. Expected answers include:

1) Opposite angles are congruent
2) Consecutive angles are supplementary
3) Diagonals bisect each other
4) Opposite sides congruent.
5) Opposite sides parallel

Finally, students are asked about one other observation about the rectangle. Any of the above observations that have not yet been listed are possible.

On page 1.7, students are simply asked to move the point labeled "A". While moving this point, they should be observing shape that this quadrilateral is able to take on.

After a short time of dragging, students should come to the conclusion that this quadrilateral is a square. Next, students should begin looking to conjectures and verify various properties about this quadrilateral. This properties should be recorded on page 1.8 for later discussion with the class.

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On page 1.8, students are asked about the things that are different about a square than a parallelogram. Expected answers include (although answers may vary):

1) All angles are right angles
2) Adjacent sides are perpendicular
3) Diagonals are congruent
4) Diagonals are perpendicular
5) All sides are equal
6) Triangles formed by diagonals are right isosceles or 45-45-90.
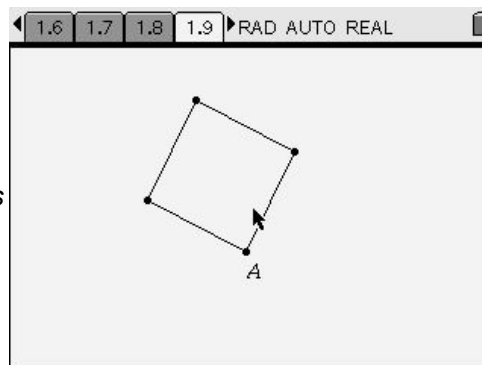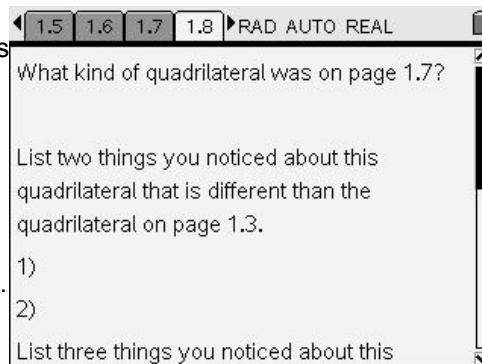7) Diagonals bisect opposite angles.

Students are then asked to notice what is the same about a square and parallelogram. Expected answers include:

1) Opposite angles are congruent
2) Consecutive angles are supplementary
3) Diagonals bisect each other
4) Opposite sides congruent.
5) Opposite sides parallel

Finally, students are asked about one other observation about the rectangle. Any of the above observations that have not yet been listed are possible.

On page 1.9, students are simply asked to move the point labeled "A". While moving this point, they should be observing shape that this quadrilateral is able to take on.

After a short time of dragging, students should come to the conclusion that this quadrilateral is a rhombus. Next, students should begin looking to conjectures and verify various properties about this quadrilateral. This properties should be recorded on page 1.10 for later discussion with the class.
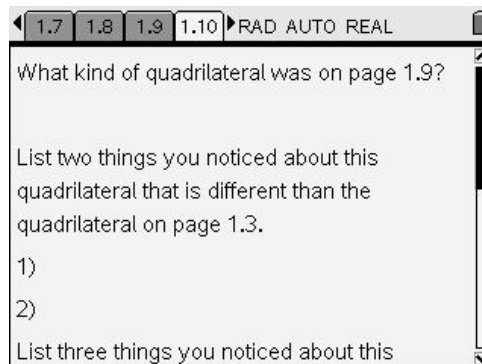

Exploring the Black Box of Quadrilaterals

On page 1.10, students are asked about the things that are different about a rhombus than a parallelogram. Expected answers include (although answers may vary):

1) All sides are equal
2) Diagonals are congruent
3) Diagonals are perpendicular
4) Triangles formed by diagonals are right triangles.
5) Diagonals bisect opposite angles.

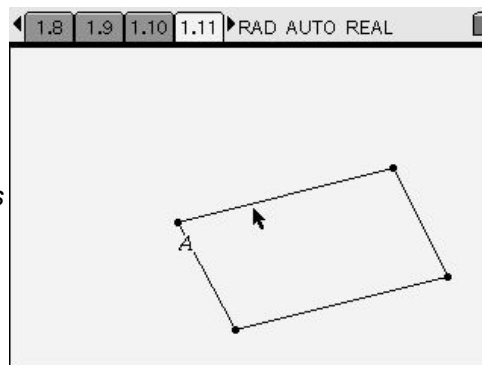   Students are then asked to notice what is the same about a rhombus and parallelogram. Expected answers include:
1) Opposite angles are congruent
2) Consecutive angles are supplementary
3) Diagonals bisect each other
4) Opposite sides congruent.
5) Opposite sides parallel
   Finally, students are asked about one other observation about the rectangle. Any of the above observations that have not yet been listed are possible.

On page 1.11, students are simply asked to move the point labeled "A". While moving this point, they should be observing shape that this quadrilateral is able to take on.

After a short time of dragging, students should come to the conclusion that this quadrilateral is a trapezoid. Next, students should begin looking to conjectures and verify various properties about this quadrilateral. This properties should be recorded on page 1.12 for later discussion with the class.

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On page 1.12, students are asked about the things that are different about a trapezoid than a parallelogram. Expected answers include (although answers may vary):

1) Only one side is parallel
2) Opposite sides are not congruent
3) Diagonals do not bisect one another
4) Opposite angles are not congruent
5) Only two pair of consecutive angles are supplementary

   Students are then asked to notice what is the same about a trapezoid and parallelogram. Expected answers include:
1) One pair of parallel sides
2) Some consecutive angles are supplementary

   Finally, students are asked about one other observation about the rectangle. Any of the above observations that have not yet been listed are possible.
On page 1.13, students are simply asked to move the point labeled "A". While moving this point, they should be observing shape that this quadrilateral is able to take on.

After a short time of dragging, students should come to the conclusion that this quadrilateral is a kite. Next, students should begin looking to conjectures and verify various properties about this quadrilateral. This properties should be recorded on page 1.14 for later discussion with the class.

On page 1.14, students are asked about the things that are different about a kite than a parallelogram. Expected answers include (although answers may vary):
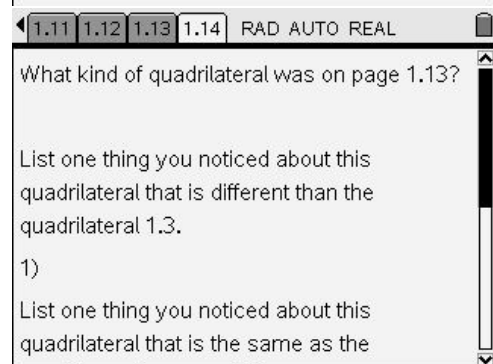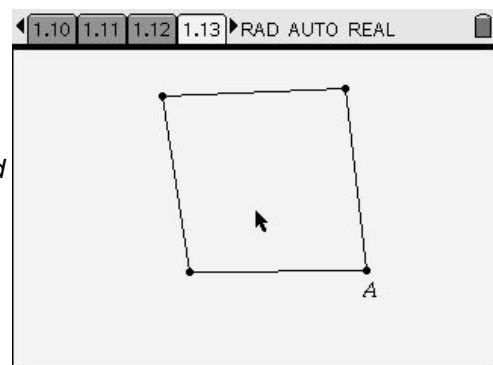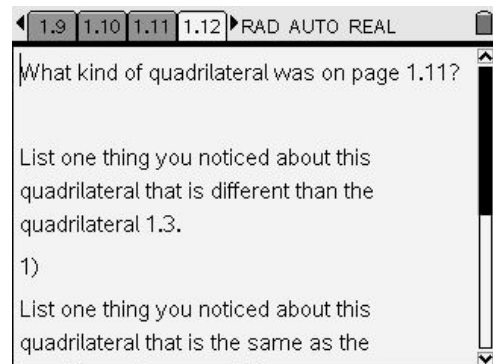
1) Opposite sides are not congruent
2) Opposite sides are not parallel
3) Two pair of adjacent sides are congruent
4) Diagonals are perpendicular
5) Diagonals do not bisect one another
6) Opposite angles are not congruent
7) Consecutive angles are not supplementary

   Students are then asked to notice what is the same about a trapezoid and parallelogram. Expected answers include:

1) All four angles sum to 360 in both
2) Nothing
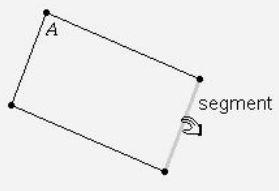3) THey both have four sides
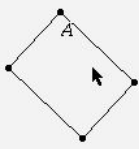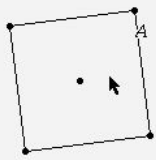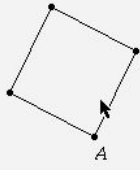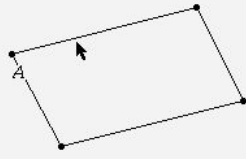4) They both have two pairs of equal sides

   Finally, students are asked about one other observation about the rectangle. Any of the above observations that have not yet been listed are possible.

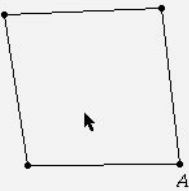## Exploring the Black Box of Quadrilaterals

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Student TI-Nspire Document

quad black box.tns

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL

Exploring the Black Box of Quadrilaterals

Authored by

Amanda Hawkins

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL

In the following screens, you will find several quadrilaterals to explore.

Your task is to start by dragging the point A around and try to figure out what kind of quadrilateral is represented on the screen.

After you think you know what the name of the quadrilateral is, you will try to figure out as many properties as possible about the quadrilateral. Feel free to use the tools in

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| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL

A

segment

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL

What kind of quadrilateral was on page 1.3?

List two things you noticed about the sides.
1)
2)
List two things you noticed about the angles.
1)

| 1.2 | 1.3 | 1.4 | 1.5 | ▶RAD AUTO REAL

A

| 1.3 | 1.4 | 1.5 | 1.6 | ▶RAD AUTO REAL

What kind of quadrilateral was on page 1.5?

List two things you noticed about this quadrilateral that is different than the quadrilateral on page 1.3..
1)
2)
List three things you noticed about this

| 1.4 | 1.5 | 1.6 | 1.7 | ▶RAD AUTO REAL

A

| 1.5 | 1.6 | 1.7 | 1.8 | ▶RAD AUTO REAL

What kind of quadrilateral was on page 1.7?

List two things you noticed about this quadrilateral that is different than the quadrilateral on page 1.3.
1)
2)
List three things you noticed about this

| 1.6 | 1.7 | 1.8 | 1.9 | ▶RAD AUTO REAL

A

| 1.7 | 1.8 | 1.9 | 1.10 | ▶RAD AUTO REAL

What kind of quadrilateral was on page 1.9?

List two things you noticed about this quadrilateral that is different than the quadrilateral on page 1.3.
1)
2)
List three things you noticed about this

| 1.8 | 1.9 | 1.10 | 1.11 | ▶RAD AUTO REAL

A

| 1.9 | 1.10 | 1.11 | 1.12 | ▶RAD AUTO REAL

What kind of quadrilateral was on page 1.11?

List one thing you noticed about this quadrilateral that is different than the quadrilateral 1.3.
1)
List one thing you noticed about this quadrilateral that is the same as the

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