Constellations

Grade 6 Mathematics

Pre-task and Assessment Activities
Using Geometer's Sketchpad™

Description of the Task

The task requires students to classify triangles according to angle and side properties. Students use Geometer's Sketchpad™ to manipulate triangles to see that *constructed* triangles have imposed restrictions whereas *drawn* triangles can be freely dragged to change properties. Students will use mathematical language to describe geometric concepts as they explore, manipulate, and hypothesize about the classifications of triangles.

Students will use geometry to find a hidden constellation in a group of "stars".

Overall Expectations

6m64	identify, describe, compare, and classify geometric figures
6m69	use mathematical language effectively to describe geometric concepts, reasoning, and investigations, and coordinate systems

Specific Expectations

6m75	classify two-dimensional shapes according to angle and side properties (e.g., acute, isosceles)
6m81	use a computer application to explore and extend geometric concepts
6m82	use mathematical language to describe geometric ideas (e.g., obtuse-angled triangle, triangular prism)
6m84	discuss geometric concepts with peers and use mathematical language to explain their understanding of the concepts
6m85	explain, make conjectures about, and articulate hypotheses about geometric properties and relationships

Classroom Setup

Pre-task activities can occur in a small to large computer lab setting where students work in pairs or groups of three. Students should be brought together in a whole class setting to discuss the results of each pre-task before moving to the next pre-task or the assessment task. Students should work in small groups to complete the pre-tasks.

The assessment task should be an individual task. The task could be separated into two parts. Students could work in small groups or pairs for the computer portion then work in a classroom setting individually to write the report.

Recommendations for classroom with a single computer or a small number of computers:

Step 1: The teacher works with small groups of students on the pre-tasks.
Step 2: A classroom schedule is established for individuals or pairs to complete the assessment task. Allow students to print results.
Step 3: Students work individually at their desks to write the report.

Materials Needed

- Geometer's Sketchpad™ needs to be installed on all computers
- Four files need to be saved on each computer
  - *Pretask1.gsp*
  - *Pretask2.gsp*
  - *Pretask3.gsp*
  - *Constellations.gsp*
- Class set of handouts
  - Constellations (*RecordingSheet.doc* or *RecordingSheet.pdf*)
  - Classification of Triangles (*Quiz.doc* or *Quiz.pdf*)
  - Task Specific Rubric – Constellations (*Rubric.doc* or *Rubric.pdf*)
- Prepared game cards (*TraingleCards.pdf)*

Prior Knowledge and Skills Required

Before attempting the task, students should know how to:

- Sort and classify angles (acute, obtuse, right)
- Correctly name a triangle (example: ΔABC)
- Open a file then save it under a different name
- Select and deselect objects in Geometer's Sketchpad™
- Move objects in Geometer's Sketchpad™
- Construct line segments
- Construct and colour polygon interiors
- Use "Reset", "Show" and "Hide" buttons in sketches
- Delete objects

You may choose to embed the Geometer's Sketchpad™ skills in the pre-task activities.

Time

Pre-tasks		Assessment Task	
Pre-task 1:	20 minutes	Computer Time:	30 minutes
Pre-task 2:	40 minutes	Report Writing:	40 minutes
Pre-task 3:	20 minutes		
Pre-task 4:	20 minutes		

General Instructions

1. Give students the following instructions:
   - Open the appropriate file (e.g. *Pretask1.gsp*).
   - Save the file using a different name (repeat this each time a new sketch is opened).
   - Follow the instructions on the sketch.
   - Click the "Reset" button to return the sketch to its original positions.
   - Click the "Hide Text" button if more working space is needed.

2. Clarify classroom procedures for printing.

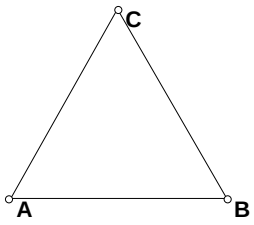
Introductory Activities

Pre-Task 1

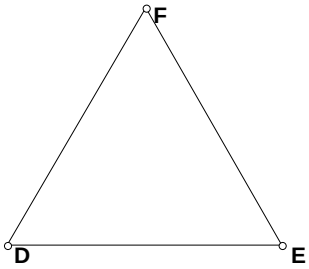
Filename: *Pretask1.gsp*

Constructed or Drawn?

Reset



m $\overline{BA}$ = 4.8 cm m∠CAB = 60.0°
m $\overline{CB}$ = 4.8 cm m∠ABC = 60.0°
m $\overline{AC}$ = 4.8 cm m∠BCA = 60.0°



m $\overline{EF}$ = 6.1 cm m∠FDE = 60.0°
m $\overline{DE}$ = 6.1 cm m∠DEF = 60.0°
m $\overline{FD}$ = 6.1 cm m∠EFD = 60.0°

Instructions:

The sketch shows two triangles and the measures of their sides.

1. What type of triangle is ΔABC?

2.What type of triangle is ΔDEF?

3.Choose the Selection Tool. Drag point A, then point B, then point C. Record your observations.

4. Drag each vertex of ΔDEF. Record your observations.

5. Which triangle was constructed rather than just drawn? Give reasons for your answer.

1. Engage the whole class in concept clarification of the classification of figures. Discuss the properties of triangles (sides and angles) and how they might contribute to a classification system for triangles (examples: all sides/angles have the same measure, exactly two sides/angles have the same measure, no sides/angles have the same measure).

2. Use brainstorming to assess prior knowledge of the following classifications:

Classification by Angles	**Classification by Sides**
Acute - all angles have measures of less than 90^o	**Equilateral** - all sides have the same measure
Obtuse - 1 angle has a measure greater than 180^o	**Isosceles** - exactly two sides have the same measure
Right-angled - 1 angle has a measure of 90^o	**Scalene** - no sides have the same measure

Review the correct terminology throughout the pre-task activities.

3. Students will work in the same pairs or small groups at a computer. Give the students the following instructions:
   - Open the file *Pretask1.gsp*
   - Save the file using a different name
   - Follow the instructions on the sketch (students may type responses in the sketch and then print *or* record responses on notepaper)
   - The reset button will return the points to their original positions

4. At the end of the task verify that students know how to:
   - Construct and colour polygon interiors

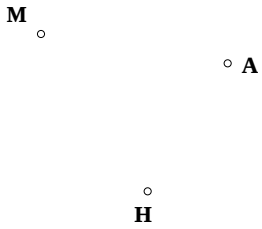
5. Move back to a whole class discussion format. Summarize student observations. Students should be able to answer the following:
   - What is an equilateral triangle?
   - What is an acute triangle?
   - Which of the triangles can be dragged so that it can be described using any of the classifications?
   - Explain how you can tell if a sketch has been *constructed* or *drawn?*
   - Can triangles have two classifications?
   - Do all triangles have two classifications?
   - On a diagram how would you indicate that two sides have the same measure?
   - On a diagram how would you indicate that two angles have the same measure?

Pre-Task 2

Filename: *Pretask2.gsp*

How are they connected?

Reset



Instructions

The sketch shows three points: M, H and A.

1. Drag point M, then point H, then point A. Record your observations.

2. Construct line segments to join the points. What figure is formed?

3. Drag point M, then point H, then point A. Record any new observations.

4.Measure the sides and angles of the triangle. Record the measurements. Drag any or all of the vertices. Record the measurements.

5. What type of triangle is ΔMHA? Give evidence to support your statements.

1. Students will work in the same pairs or small groups at a computer. Give the students the following instructions:
   - Open the file *Pretask2.gsp*
   - Save the file using a different name
   - Follow the instructions on the sketch (students may type responses in the sketch and then print *or* record responses on notepaper)
   - The reset button will return the points to their original positions

2. The teacher should demonstrate how to measure angles and lengths of line segments.

3. This task provides a good opportunity to introduce the table feature of Geometer's Sketchpad™. In step 4 of the task, the measurements could be included in a table. After the vertices have been dragged the new data could become new entries in the table.

4. Summarize student observations. Make sure students can answer the following:
   - What is an isosceles triangle?
   - Can an isosceles triangle be acute (yes), obtuse (yes) or right-angled (yes)?
   - How do you indicate that line segments have the same length?
   - What did you observe about the angles in an isosceles triangle? (The two angles opposite the two equal sides have the same measure.)

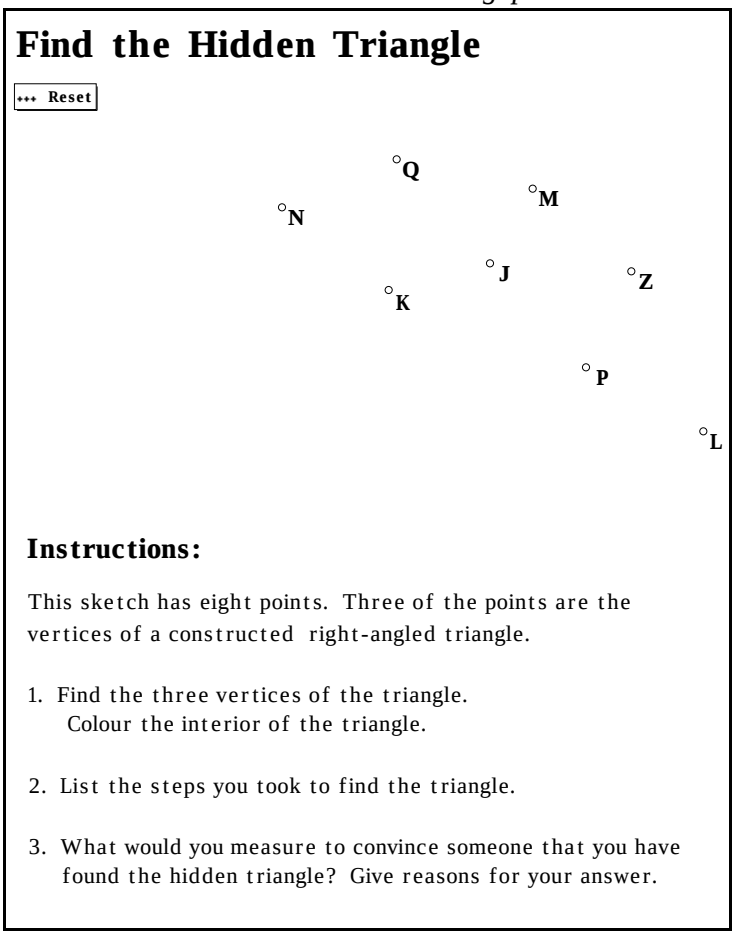
5. As a class discuss the tools they used to assist them in making conjectures:
   - Constructing line segments
   - Taking measurements

   Joining points to form line segments can help you visualize "hidden" geometry at work! Taking measurements helps you make connections and see relationships. (Note that two measurements of 60^o could actually be 59.98^o and 59.57^o rounded, therefore the measurements are not mathematical proof.)

6. Optional: Introduce students to the *Show all Hidden* command under the *Display* menu. Show them how to construct an isosceles triangle using Geometer's Sketchpad™. There are a variety of ways this can be done (see resources and posters). Emphasize that a constructed isosceles triangle always has 2 sides of equal length even when the vertices are dragged to a different location.

Pre-Task 3

Filename: *Pretask3.gsp*

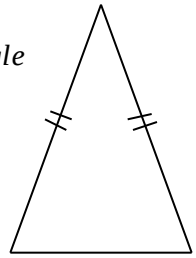


1. Students will work in the same pairs or small groups at a computer. Give the students the following instructions:
   - Open the file *Pretask3.gsp*
   - Save the file using a different name
   - Follow the instructions on the sketch (students may type responses in the sketch and then print *or* record responses on notepaper)
   - The reset button will return the points to their original positions

2. Summarize student observations. Students should be able to answer the following:
   - What is a right-angled triangle?
   - Can a right-angled triangle be equilateral (no), isosceles (yes) or scalene (yes)?
   - How do you indicate on a diagram that an angle has a measure of 90^{o}

3. Suggested homework: Draw two different types of triangles. Use appropriate identifying marks on the diagrams. Classify each triangle using one word that describes the angles (e.g. acute) and a different word to describe the sides (e.g. isosceles).

Example: *Acute Isosceles Triangle*



Note: Although the bottom angles are equal this should not be indicated on the diagram. Since an isosceles triangle has two equal sides, marking equal angles is providing too much information. The equal angles are not part of the definition – they are a result of the definition. This distinction is too fine for Grade 6 students. However, teachers should be aware so they do not require students to place unnecessary information on their diagrams.

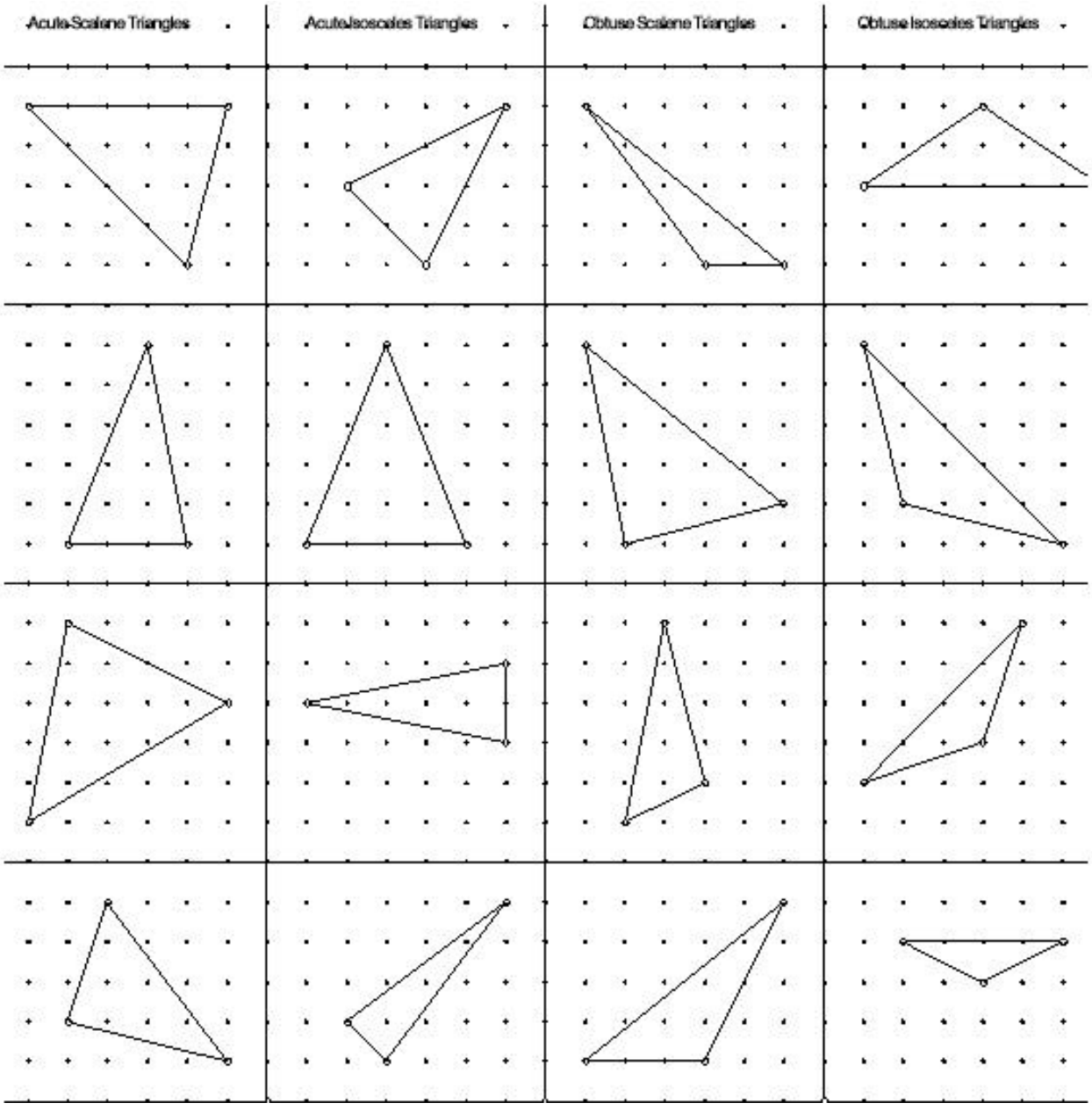
The list below shows all combinations of the two sets of words. Some of the combinations are not possible. *Don't initiate a discussion about the impossible cases. This concept is part of the problem solving on the assessment task.*

Acute Scalene	Acute Isosceles	Acute Equilateral
Obtuse Scalene	Obtuse Isosceles	~~Obtuse Equilateral~~
Right Angled Scalene	Right Angled Isosceles	~~Right Angled Equilateral~~

Since the only possible type of equilateral triangle is acute we often omit the word acute.

Pre-Task 4

1. The attached sheet (or file *TriangleCards.pdf*) of triangles can be cut into game cards. Mix the cards and challenge students to sort and classify.

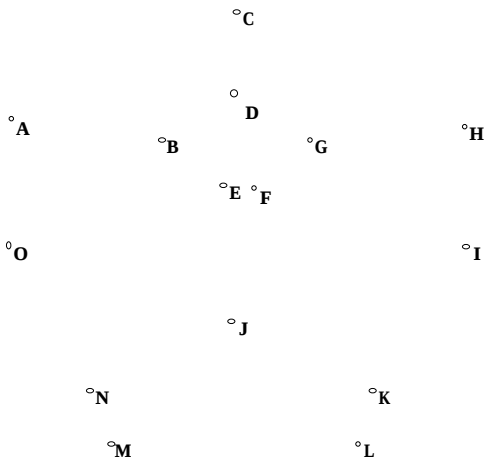


Assessment Task

Filename: *Constellations.gsp*

The Constellation

Reset | Show Text | Hide Text



A constellation is a set of stars that has been given a name because it forms a picture. Ursa Major is a constellation that looks like a bear. (Ursa Major is Latin for Big Bear). Orion is a hunter.

The 15 points shown in this sketch are like the stars in a constellation. When you look at them in a certain way, they form a picture. Follow the instructions to help you see the picture.

Instructions:

Twelve of the points have been constructed to form 4 hidden triangles:

- 2 isosceles triangles
- 1 equilateral triangle
- 1 right-angled triangle

One additional triangle has been drawn. We will call it the "shape-shifter" triangle.

1. Find the 5 triangles.
2. Classify the 4 CONSTRUCTED triangles and give evidence that supports your classifications.
4. Can the fifth triangle - the"shape-shifter" triangle - be dragged to become a right-angled equilateral triangle? Give reasons for your answer.
5. Reset the sketch.
6. Choose a name for the constellation.
7. Write a report that describes the constellation for someone who is looking for it in the night sky. Use mathematical language in your report.

1. Students will work individually or in pairs at a computer:
   - Open the file *Constellations.gsp*
   - Save the file using a different name
   - Read the instructions on the sketch

2. Give the students a copy of the rubric and discuss the criteria.

3. Provide each student with a copy of the recording sheet (filename: *RecordingSheet.doc)* to complete independently.

4. Students can work in the classroom to write the report individually.

5. Students complete a quiz (filename: *Quiz.doc)* independently.

Appendices

- Triangle Game Cards Sheet (see Pre-task 4)
- Quiz Sheet (see Assessment Task)
- Recording Sheet (see Assessment Task)
- Rubric