Polly Polly In Come Free

Engage

Purpose:
Provide participants the opportunity to investigate a variety of data derived from the measurement of a variety of polygons. Assess participants' experience and comfort level with various avenues and tools for collecting data. Compare and contrast the use of technology-based exploration and technology-free traditional methods.

Descriptor:
Participants will rotate between two stations to gather and explore data:
- Polygons Rule: technology-free traditional method
- Techno Polly: technology-based method

Upon completion of both activities, participants will compare and contrast their experiences. Participants will then be introduced to the formulation of questions that will spark data collection and investigation.

Duration:
2 hours

TEKS:

a(5) Tools for geometric thinking. Techniques for working with spatial figures and their properties are essential in understanding underlying relationships. Students use a variety of representations (concrete, pictorial, numerical, symbolic, graphical, and verbal), tools, and technology (including, but not limited to, powerful and accessible hand-held calculators with graphing capabilities, data collection devices, and computers) to solve meaningful problems by representing and transforming figures and analyzing relationships.

a(6) Underlying mathematical processes. Many processes underlie all content areas in mathematics. As they do mathematics, students continually use problem solving, language and communication, connections within and outside mathematics, and reasoning (justification and proof). Students also use multiple representations, technology, applications and modeling, and numerical fluency in problem solving contexts.

G.2B Make conjectures about angles, lines, polygons, circles, and three-dimensional figures and determine the validity of the conjectures, choosing from a variety of approaches such as coordinate, transformational, or axiomatic.

G.5A Use numeric and geometric patterns to develop algebraic expressions representing geometric properties and to make generalizations about geometric properties, including properties of polygons, ratios in similar figures and solids, and angle relationships in polygons and circles.

TAKS Objectives:
- Objective 3: Linear Functions
- Objective 4: Formulate and Use Linear Equations and Inequalities
- Objective 6: Geometric Relationships and Spatial Reasoning
- Objective 7: Two- and Three-Dimensional Representations of geometric relationships and shapes
- Objective 8: Concepts and Uses of Measurement and Similarity
- Objective 10: Mathematical Processes and Tools

Technology:
- Dynamic geometry software (Geometer's Sketchpad)

Materials:
Advance Preparation:
- Participant access to computers with Geometer's Sketchpad(latest version update available from http://www.keypress.com/sketchpad) and/or a projection device to use Geometer's Sketchpad as a whole group demonstration tool.
- TechnoPolly.gsp sketch loaded in a folder on the desktop entitled Geometry Jump Drive.
- Cut out sets of polygons (Activity Master) on cardstock.
- Chart paper statements about technology, one statement per page.
- Chart paper Venn diagram Reflections on Data

For each group of four:
- Rulers
- 1 set of card stock polygons (cut out).

For each participant:
- Transparency Pen

Handouts
- Polygons Rule: Data Collection
- Polygons Rule: Questions About Data
- Techno Polly: Data Collection
- Techno Polly: Questions About Data
- Reflections on Data
- Debriefing the Exploration of Data
- Polly Polly In Come Free Intentional Use of Data (printed on green paper)

Polly Polly Income Fee—Leader Notes:

The goal of the Engage phase is to begin conversations about data. As teachers see the value of data and the mathematics that can be explored and reinforced through the use of data, they will begin to seek out data. Technology offers the tools to make sense of data in an efficient way. Technology also offers effective means for representing data so that analysis may take place. Participants should interact with each other. The presenter(s) should be moving around the room facilitating the activity. Use the **Facilitation Questions** *to guide and redirect participants, as needed.*

1. *Record the following statements on chart paper. Post these statements around the room.*

Technology offers the opportunity to strengthen mathematical learning in my classroom.

Strongly
Disagree

Strongly
Agree

Students should learn first with paper-and-pencil methods and then with technology.

Strongly
Disagree

Strongly
Agree

My students know how to discern which of these methods best serves the purposes of a given problem: mental strategies, paper-and-pencil techniques, and technology applications.

Strongly
Disagree

Strongly
Agree

The best technology tool for the geometry classroom is the dynamic geometric software.

Strongly
Disagree

Strongly
Agree

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2. *As participants enter the session, direct them to respond to the posted statements by placing a marker, such as a sticky dot, in the location that best corresponds to their response. Use only one color of sticky dot for this activity.*

3. *As you provide a welcome and introduction to this professional development session, direct the participants' attention to the posted statements, sharing that continued reflection about these statements will be explored in greater detail during the course of this professional development.*

4. *Separate the participants into two groups. Explain that they will have 15 minutes for each activity. Half of them will do the **Polygons Rule** activity at their tables while the other half will do the **Techno Polly** activity at their computer station. Both groups will have the appropriate **Questions About Data** activity sheet and will be answering questions as they collect data. Float among the groups and use the **Questions About Data** to encourage discussion among the group members. Distribute handouts as appropriate. Switch the groups after 15 minutes. A count-down timer is a beneficial tool for keeping participants on task.*

5. *After both groups have completed the activities at each station distribute the **Reflection on Data** activity sheet (see Reflection on Data—Leader Notes).*

6. *After debriefing the Reflection on Data Venn diagram activity distribute the **Debriefing the Exploration of Data** activity sheet. Prompt the participants to reflect upon the discussion summarized by the Venn diagrams and record their responses to each of the questions posed on the activity sheet. After a few minutes of recording time, prompt the participants to share their responses with another participant. Debrief the responses in whole-group setting, keeping in mind that the goal of this phase of the professional development is to consider data.*

Polygons Rule: Data Collection—Leader Notes

1. *Distribute a set of card stock polygons (cut out) to each group.*

2. *Distribute the **Polygons Rule: Data Collection** and **Polygons Rule: Questions About Data** activity sheet to each participant.*

3. *Prompt participants to measure all attributes of the polygons possible, recording their data on the hand out. If they need to draw lines on the polygons they can use transparency pens.*

4. *Prompt participants to answer the questions about data on the handout.*

Polygons Rule: Questions About Data
(possible participant answers)

Data Source	Rulers
How would you describe this set of data? Why?	*Numerical, because the data is actual measurements of different sized polygons.*
What relationships occur within this set of data? Why?	*Linear relationships such as side length to perimeter, because the length and perimeter are both linear measurements and as one changes, the other changes proportionally.* *Quadratic relationships such as area to apothem, because the apothem length is one dimensional and as it changes it affects two dimensions in the area.* *The relationship between the vertex angle and central angle is supplementary, because their sum is always 180°.*
How would you represent this data? Why?	*Graph it, to have a visual picture of the relationships.* *Develop an equation, to emphasize the algebraic relationships.*
What question(s) can we pose to students that this set of data helps to answer?	*What is the relationship between the side length of a polygon and it perimeter? Justify your answer.* *What is the relationship between the vertex angle and the central angle in any polygon? Justify your answer.* *What is the relationship between the apothem length and the area of a polygon? Why?*
How might this data extend what students already understand about our course content?	*This would tie the geometry and algebra concepts together.*

Techno Polly—Leader Notes

1. Have participants move to a computer. Two people per computer would be ideal, larger groups of 3 or 4 can work as well.

2. Distribute the **Techno Polly: Data Collection** and **Techno Polly: Questions about Data** activity sheets to each participant.

3. Participants will need to open the sketch **Techno Polly** in the Geometer's Sketchpad program. Directions about where this program is on their particular computer will need to be given at this time.

Techno Polly—Questions About Data
(possible participant answers)

Data Source	Geometer's Sketchpad
How would you describe this set of data? Why?	*Numerical, because the data are actual measurements of different sized polygons.*
What relationships occur within this set of data? Why?	*Linear relationships such as side length to perimeter, because the length and perimeter are both linear measurements and as one changes, the other changes proportionally.* *Quadratic relationships such as area to apothem, because the apothem length is one dimensional and as it changes it affects two dimension in the area.* *The relationship between the vertex angle and central angle is supplementary because their sum is always 180°.*
How would you represent this data? Why?	*Graph it, to have a visual picture of the relationships.* *Develop an equation, to emphasize the algebraic relationships.*
What question(s) can we pose to students that this set of data helps to answer?	*What is the relationship between the side length of a polygon and it perimeter? Justify your answer.* *What is the relationship between the vertex angle and the central angle in any polygon? Justify your answer.* *What is the relationship between the apothem length and the area of a polygon? Why?*
How might this data extend what students already understand about our course content?	*This would tie the geometry and algebra concepts together.*

Reflection on Data—Leader Notes

1. *Upon completing rotation through each station, reorganize participants into groups of 4. Prompt the participants to complete the **Reflections on Data** activity sheet individually. Allow approximately 5 minutes for the completion of these activity sheets.*

2. *While the participants are completing their individual **Reflections on Data** activity sheets, post 1 set of Venn Diagrams for every 12 participants.*

3. *Prompt participants to move to the chart paper Venn diagrams in groups of 12 by combining 3 existing groups of 4 participants.   Share with participant that they will work silently in these groups of 12 to create summary Venn diagrams of the three groups' discussions.*

4. *Prompt the group to identify the person with the longest hair. This person will be the first recorder. Prompt this person to record one statement on the large chart paper Venn diagrams. The statement may be a personal observation or an observation from the group's Venn Diagrams.*

5. *Prompt the participant to pass the marker to a new recorder, preferably a person who was not a member of his or her discussion group. This person will record a new statement on the Venn diagram. Prompt participants to continue this process until each participant has had an opportunity to record a statement. Participants may record new observations or statements that occur as a result of seeing the reflections of others. Participants may record one statement, one at a time on the Venn diagram. This should be done silently with the whole group looking on and reading as one participant adds one statement to the Venn diagrams. Allow approximately 5 minutes for this process. Debrief using these facilitation questions:*

Facilitation Questions
- Which similarities did each group note?
- Which similarities were new to you?
- Which differences did each group note?
- Which differences were new to you?
- What are the benefits of a computer-based tool over a measurement tool?
  Answers might include: The computer-based tool measures more accurately. The computer based-tool is quicker.
- What are the benefits of a ruler over a computer-based tool?
  Answers might include: The rule helps students develop a kinesthetic sense of measurement. Rulers are readily available.

Reflections on Data

Complete the following Venn diagram to compare and contrast the uses of the dynamic geometric software and a ruler as data sources.
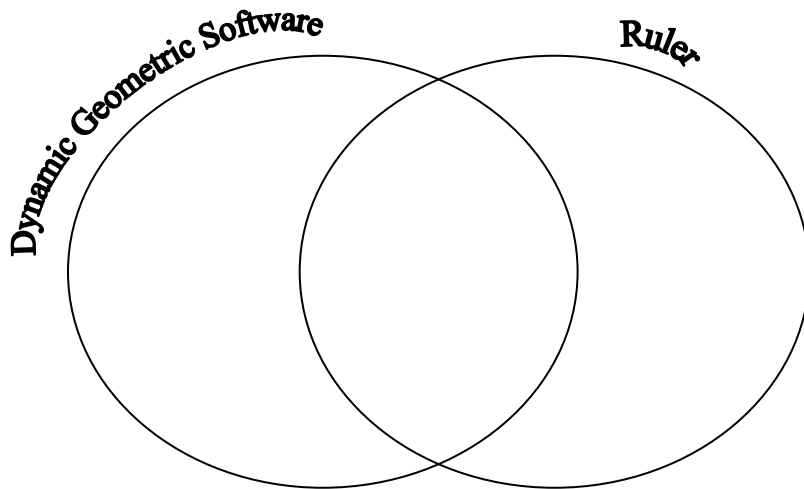
What are the benefits of using data derived from the dynamic geometric software?
Possible answers might include: The dynamic geometric software allowed for the same collection of data in a greatly reduced amount of time. The dynamic geometric software made it easy to focus on the mathematical concepts.

What are the benefits of using data derived from actual measurement?
Possible answers might include: Actual measurement helps students gain a tactile experience of measurement.   Actual measurement helps students develop measurement conceptually.

How might these data sources function in a geometry classroom?
Possible answers might include: The dynamic geometric software can provide efficient exploration of data and quick analysis. The actual measurement might work better in situations where long distances or objects might need to be measured.

Debriefing the Exploration of Data—Leader Notes

1. *Distribute the **Debriefing the Exploration of Data** activity sheet. Prompt participants to reflect upon the discussions summarized by the Venn diagrams and record their responses to each of the questions posed on the activity sheet. After a few minutes of recording time, prompt the participants to share their responses with another participant. Debrief the responses in whole-group setting, keeping in mind that the goal of this phase of the professional development is to consider data.*

2. *Pose the questions listed below to the whole group. Explain to the participants that these questions serve as "filtering questions" when seeking to incorporate the use of data into classroom instruction.*

a.   *What TEKS in Geometry does the use of data enhance?*

b.   *What data are essential to enhance the study of these TEKS?*

c.   *What question(s) does using data answer?*

d.   *How does using data allow one to increase the rigor of the learning experience? How might using data move the learner from remembering, understanding, and applying to analyzing and evaluating?*

e.   *What type of data would be most useful for the stated TEKS?*

f.   *What setting will be available during instruction related to these mathematical goals?*

g.   *What actual data source(s) may prove helpful in enhancing mathematical learning related to these TEKS?*

Debriefing the Exploration of Data

1. What questions can we ask as reflective practitioners to determine the appropriateness of a data source for promoting mathematical learning?

Participant answers might include: Will this help my students develop a conceptual understanding of the TEKS? Will this data source be interesting to my students?

2. How does the technology-based data offer an opportunity to strengthen mathematical learning?

Participant answers might include: Technology is quicker allowing students to focus on the analysis portion rather then collection portion of data.   Technology is more accurate in measure allowing relationships easier to see.

3. How might hands-on activities complement the judicious use of technology?

Participant answers might include: This might allow for good compare and contrast situations. Technology can analyze data collected by hand.

4. What paper-and-pencil methods do students need to know to make sense of the data we explored?

Participant answers might include: They need to have some experience with creating a table, developing a function rule, plotting points, etc.

Polly Polly In Come Free Intentional Use of Data—Leader Notes

1. *Distribute the **Polly Polly Income Free Intentional Use of Data** activity sheet to each participant. Share with the participants that these reflective questions form the basis for the **Planning for Intentional Use of Data in the Classroom** activity done during the Evaluate phase of the professional development. Share with the participants that these filtering questions helped develop each of the activities contained within this professional development. This template will serve as a reflection tool to summarize each phase of the professional development in order to identify elements that support the judicious use of technology.*

2. *Prompt the participants to work in pairs to identify those TEKS that received greatest emphasis during this activity. Prompt the participants to also identify two key questions that were emphasized during this activity. Allow four minutes for discussion.*

Facilitation Questions
- Which TEKS formed the primary focus of this activity?
- What additional TEKS supported the primary TEKS?
- How do these TEKS translate into guiding questions to facilitate student exploration of the content?
- How do your questions reflect the depth and complexity of the TEKS?
- How do your questions support the use of technology?

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3. *As a whole group, share responses for two to three minutes.*

4. *As a whole group, identify the level(s) of rigor (based on Bloom's taxonomy) addressed, the types of data, the setting, and the data sources used during this Engage cycle. Allow three minutes for discussion.*

Facilitation Question
- What attributes of the activity support the level of rigor that you identified?

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5. *As a whole group, discuss how this activity might be implemented in other settings. Allow five minutes for discussion.*

Facilitation Questions
- How would this activity change if we had access to one computer per participant?
- How would this activity change if we had access to one computer per small group of participants?
- How would this activity change if we had access to one computer for the entire group of participants?
- Could this activity be done using graphing calculators instead of computer-based applications? If so how?
- How might we have made additional use of available technologies during this activity?
- Why was technology withheld during the ruler measurements part of this activity?
- How does technology enhance learning?

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6. *Prompt the participants to set aside the completed Intentional Use of Data activity sheet for later discussion. These completed activity sheets will be used during the elaborate phase as prompts for generating attributes of judicious users of technology.*

Polly Polly In Come Free Intentional Use of Data

(possible participant answers)

TEKS			*a(5), a(6), G.2B, G.5A*
Question(s) to Pose to Students		**Math**	*What type of relationships could be found among the measurements you gathered?*
		Tech	*How did technology help you with the gathering of data?*
Cognitive Rigor		**Knowledge**	√
		Understanding	√
		Application	√
		Analysis	√
		Evaluation	√
		Creation	√
Data Source(s)		**Real-Time**	*When using the computer sketch.*
		Archival	*none*
		Categorical	*none*
		Numerical	*When using the rulers.*
Setting		**Computer Lab**	*Each student uses the computer.*
		Mini-Lab	*In groups students take turns or groups switch out.*
		One Computer	*A student operates the control as other students read directions, entire class records data.*
		Graphing Calculator	*Could be used to enter data and find relationships.*
		Measurement Based Data	*Could be done at stations or individually.*
Bridge to the Classroom			*This activity transfers directly to the classroom with the only modifications being the settings addressed above.*

Data Station Tents
Activity Master

_____

(fold)

Polygons Rule

Use the following tools to gather data and answer questions.
- Ruler—measuring with centimeters
- Handout—Polygons Rule: Data Collection
- Handout—Polygons Rule: Questions About Data

(fold)

Techno Polly

Use the following tools to gather data and answer questions.

- **Techno Polly.gsp** sketch (found in the folder on the desktop "Geometry Jump Drive" in the "Geometry-Engage-Sketches)
- Handout—Techno Polly: Data Collection
- Handout—Techno Polly: Questions About Data

**Polygons Rule
Activity Master**

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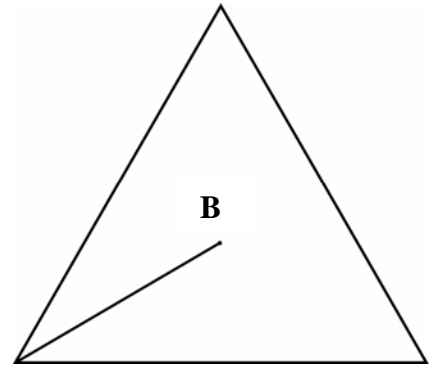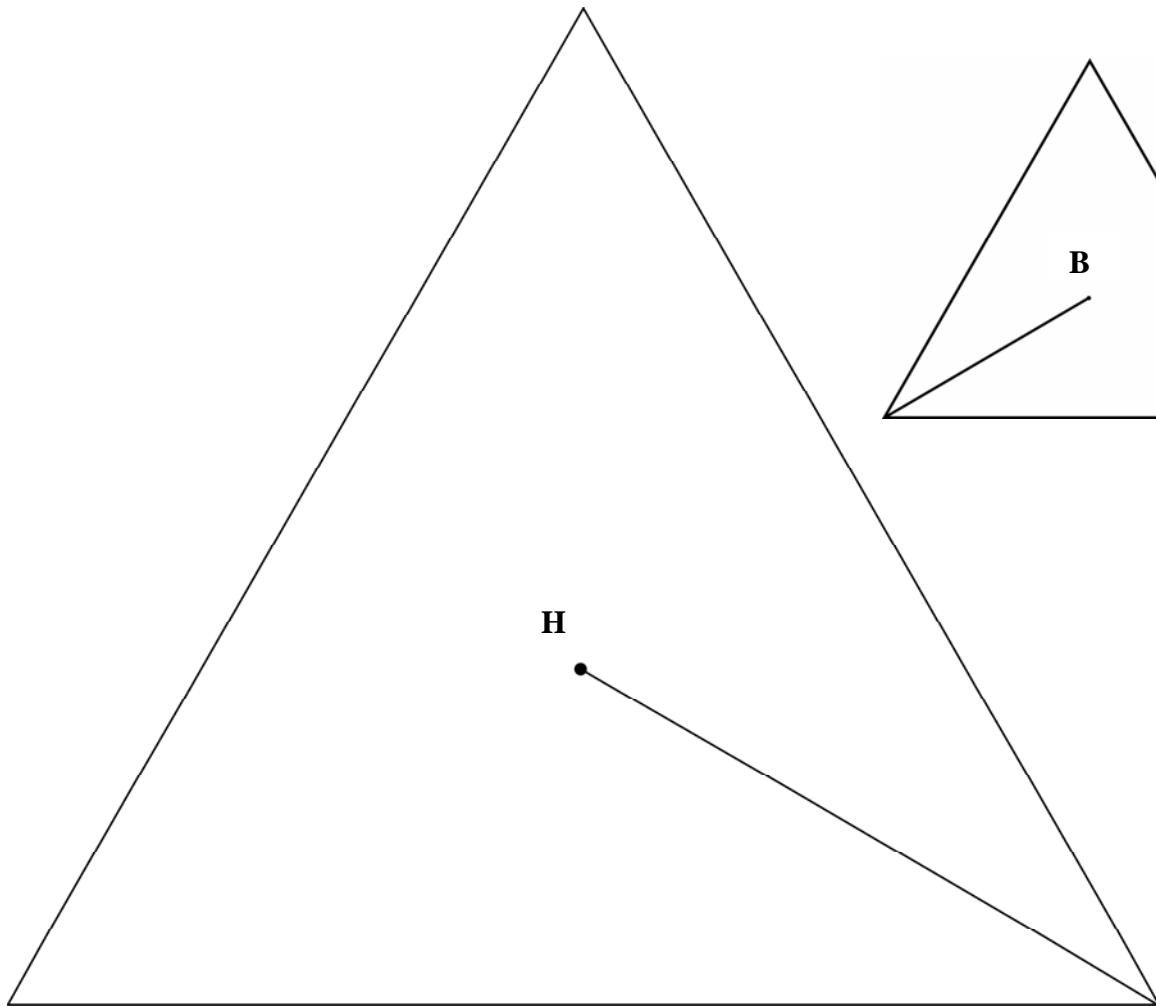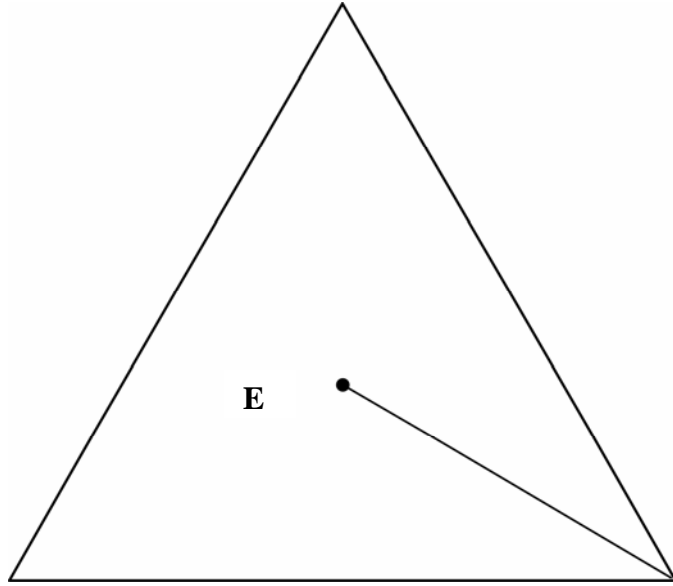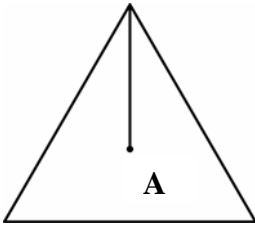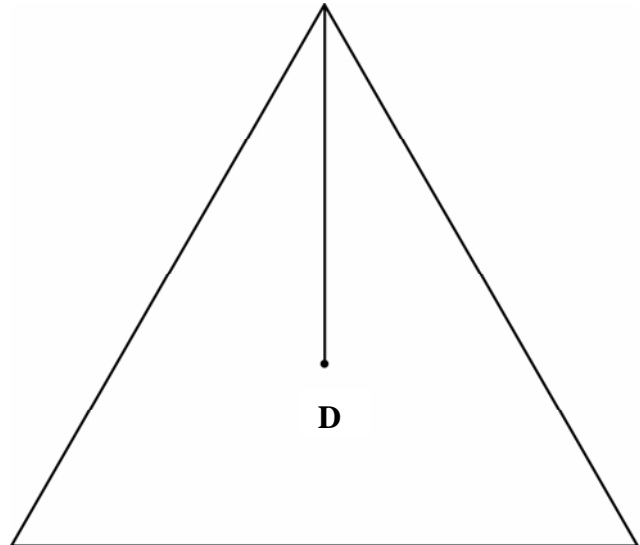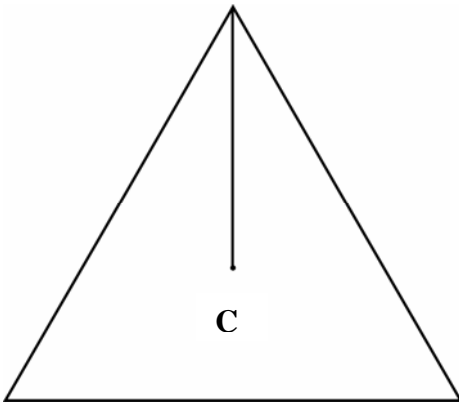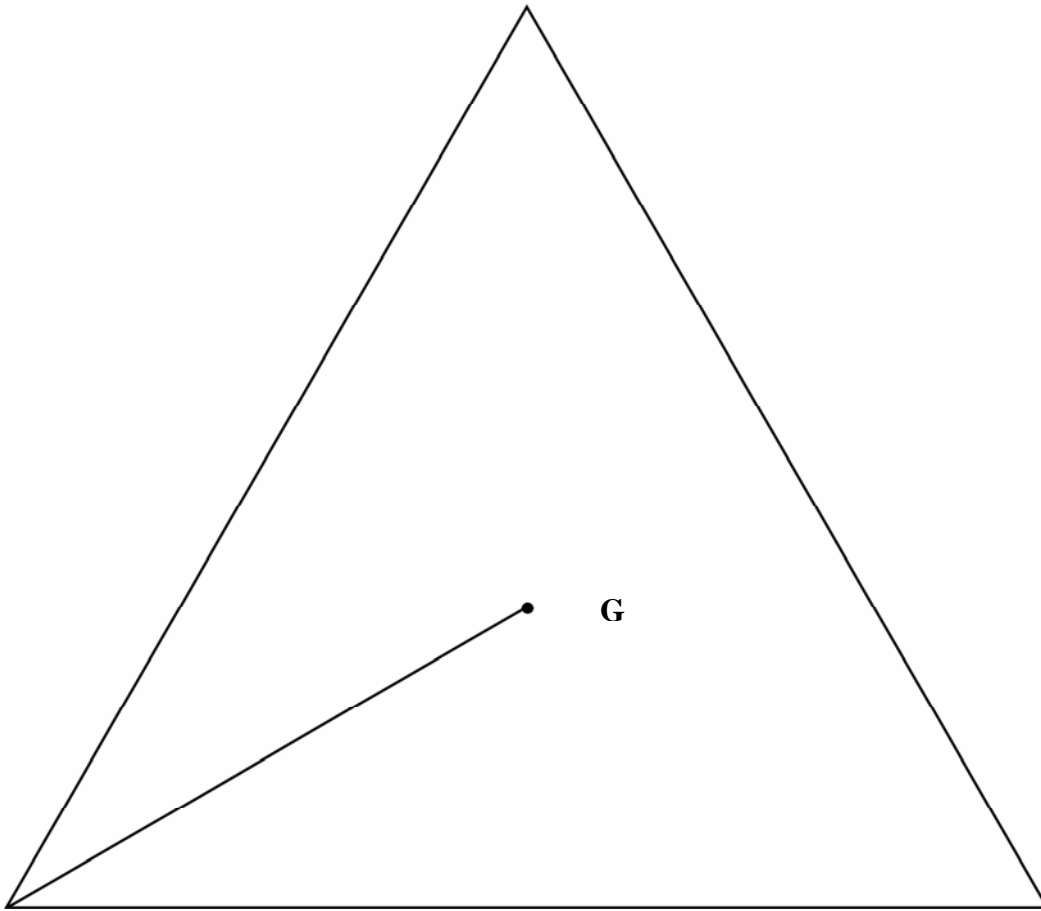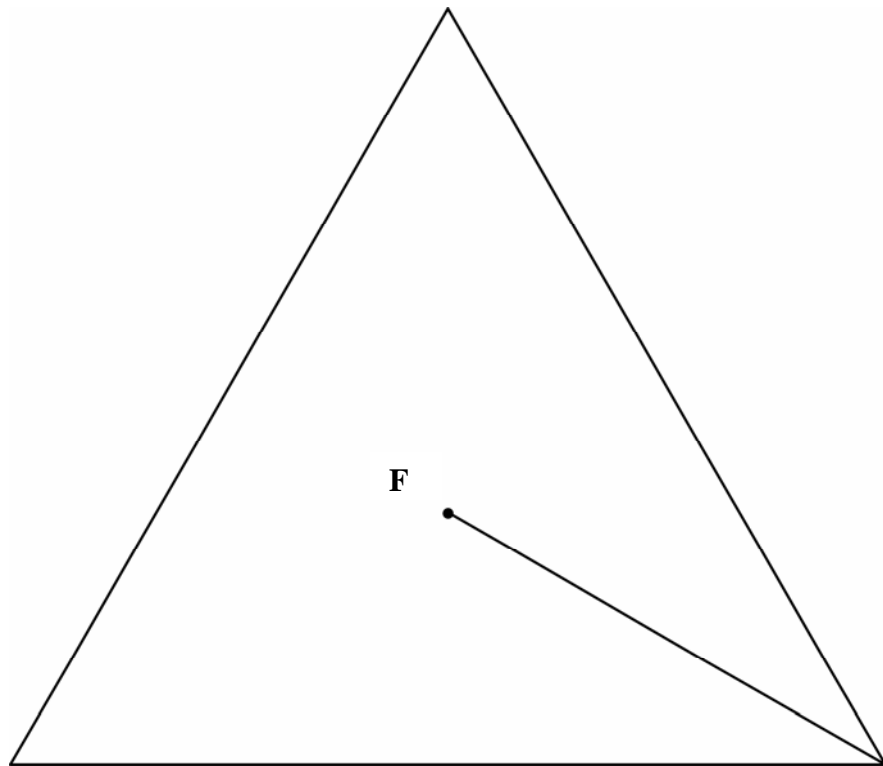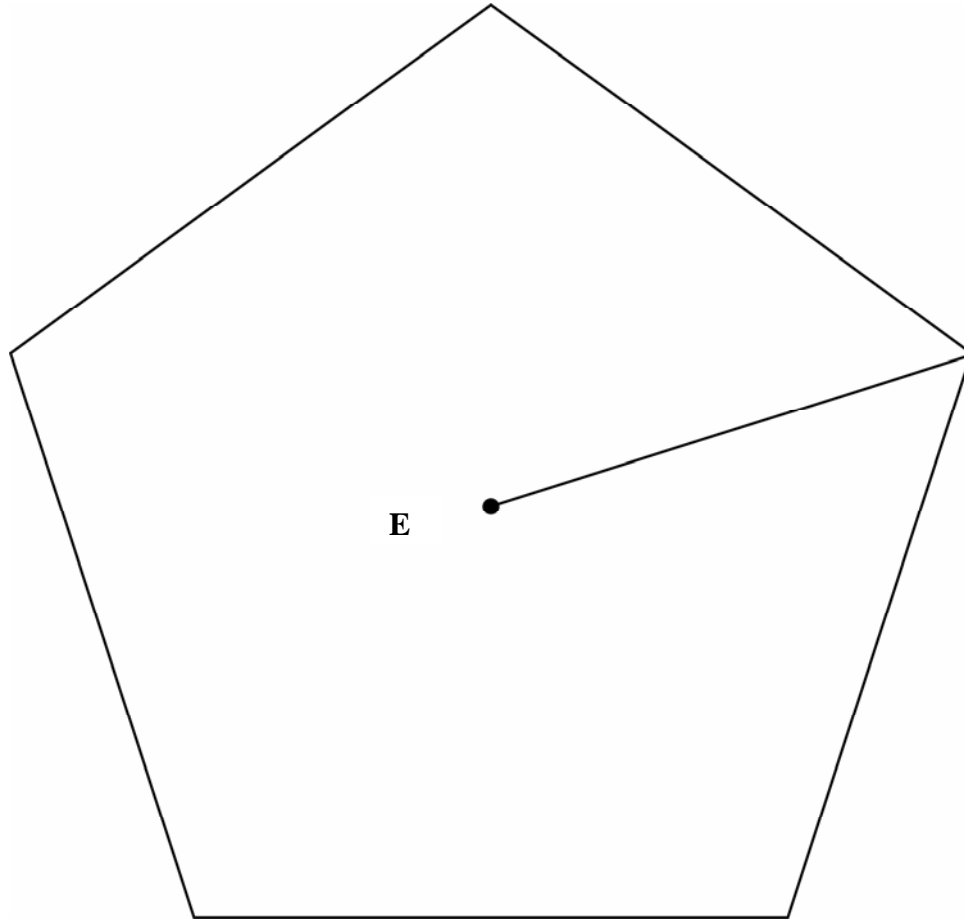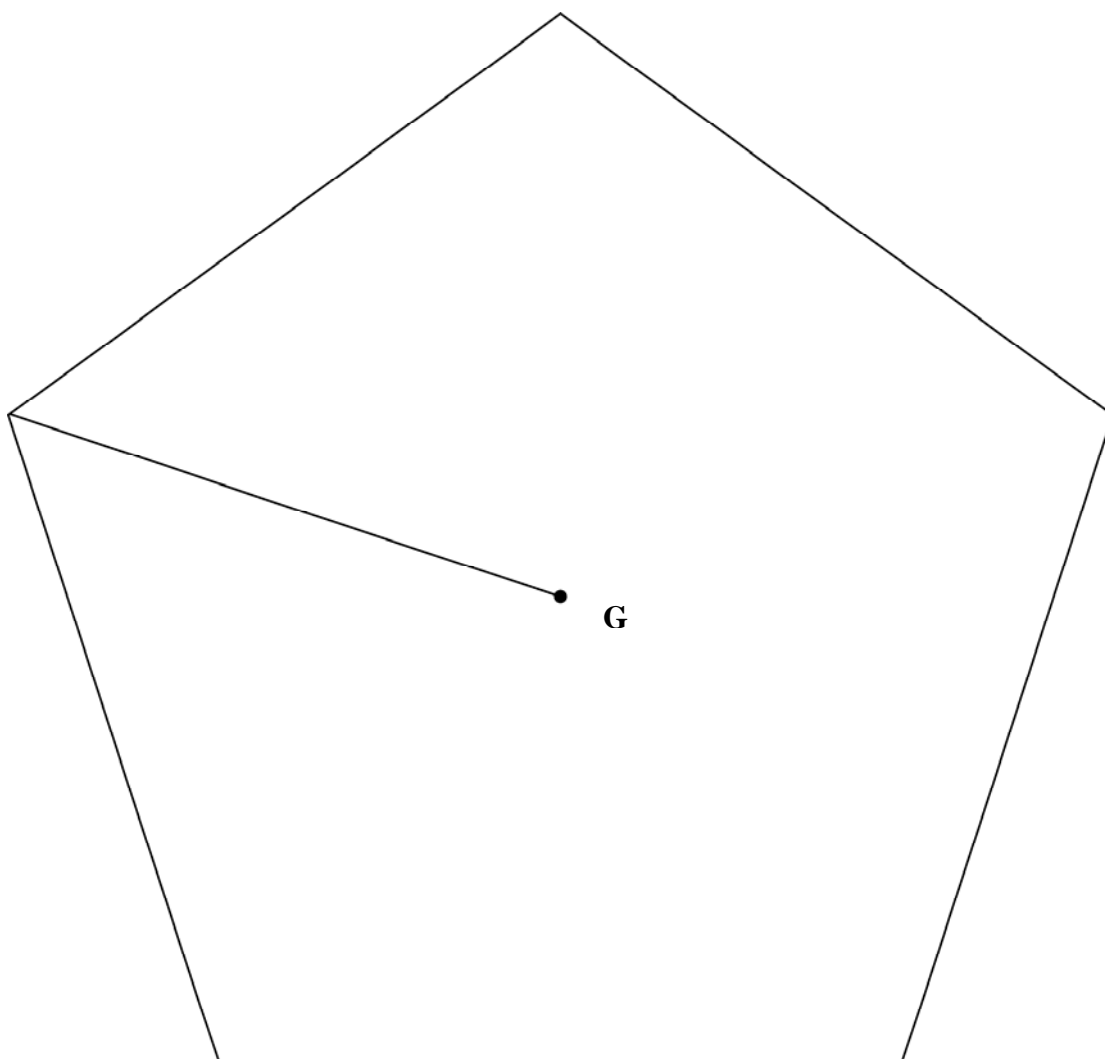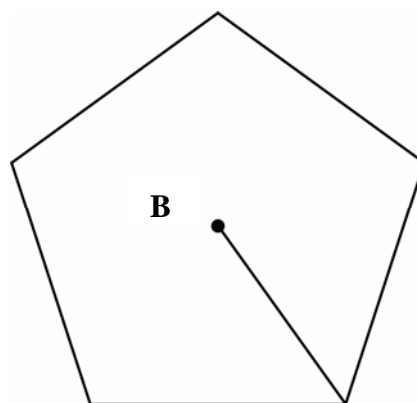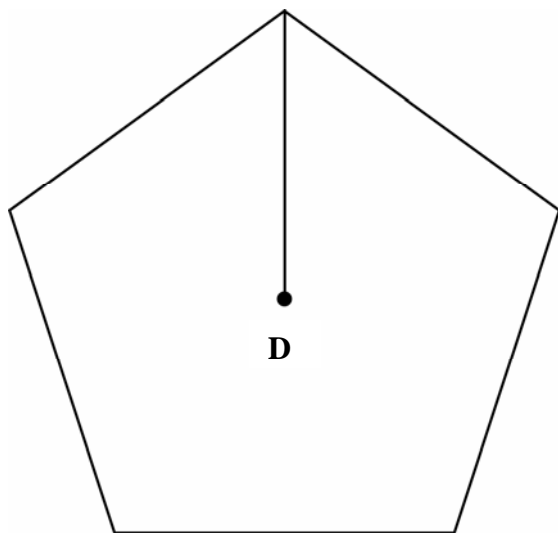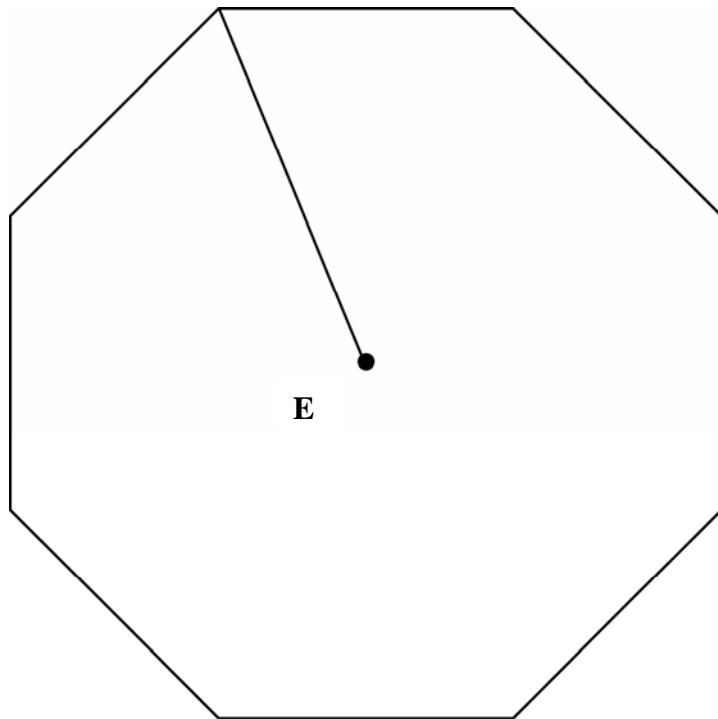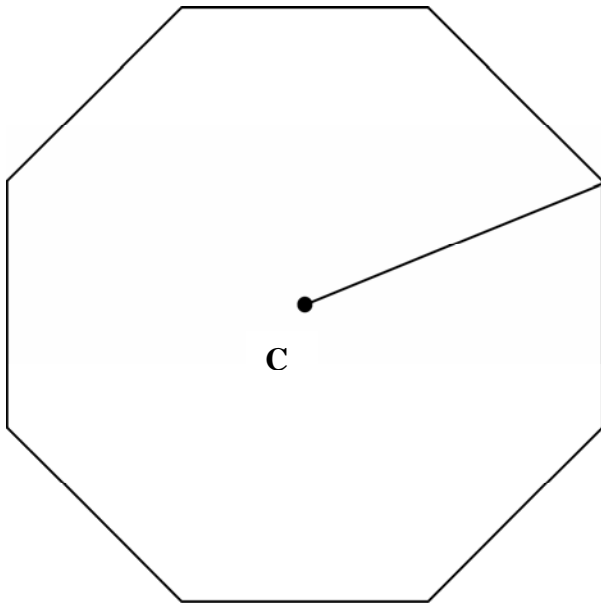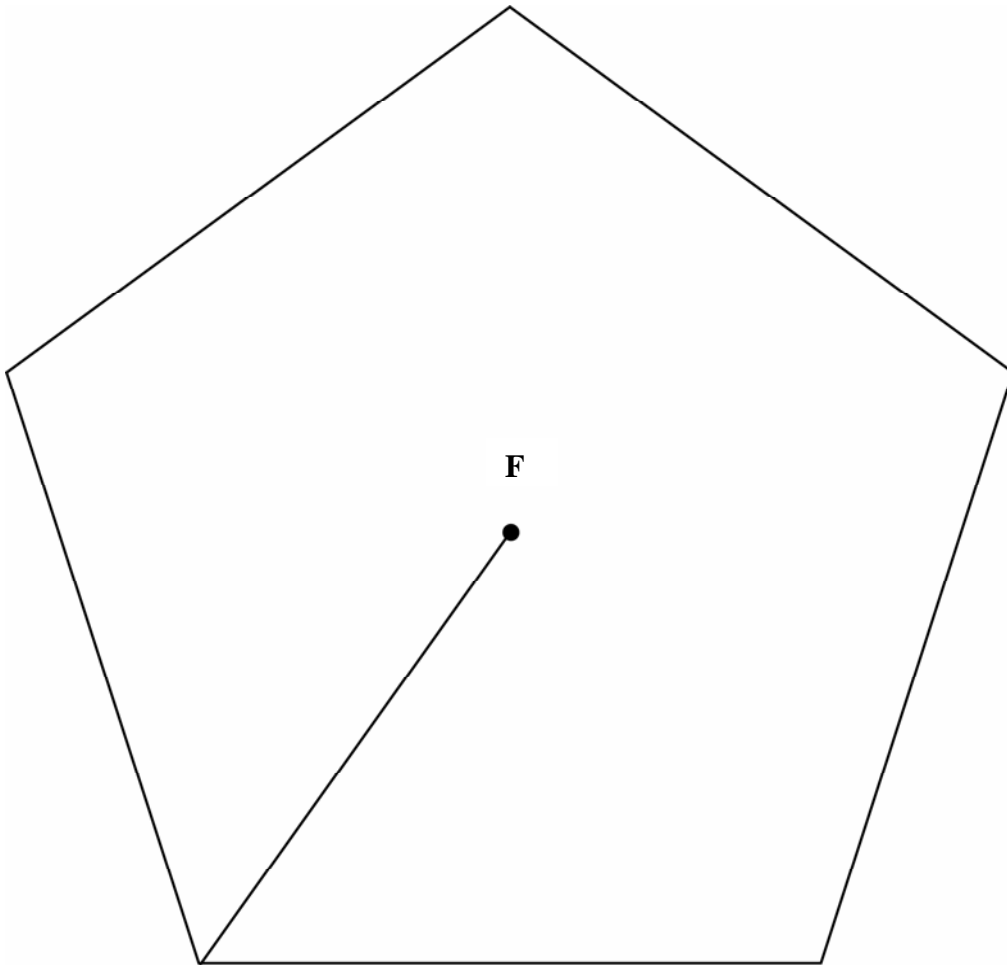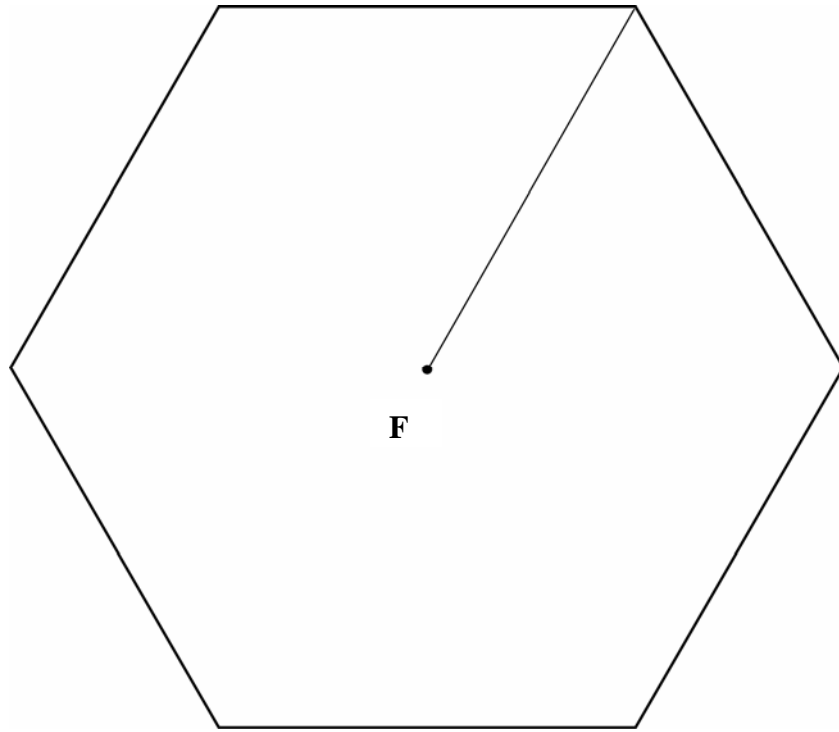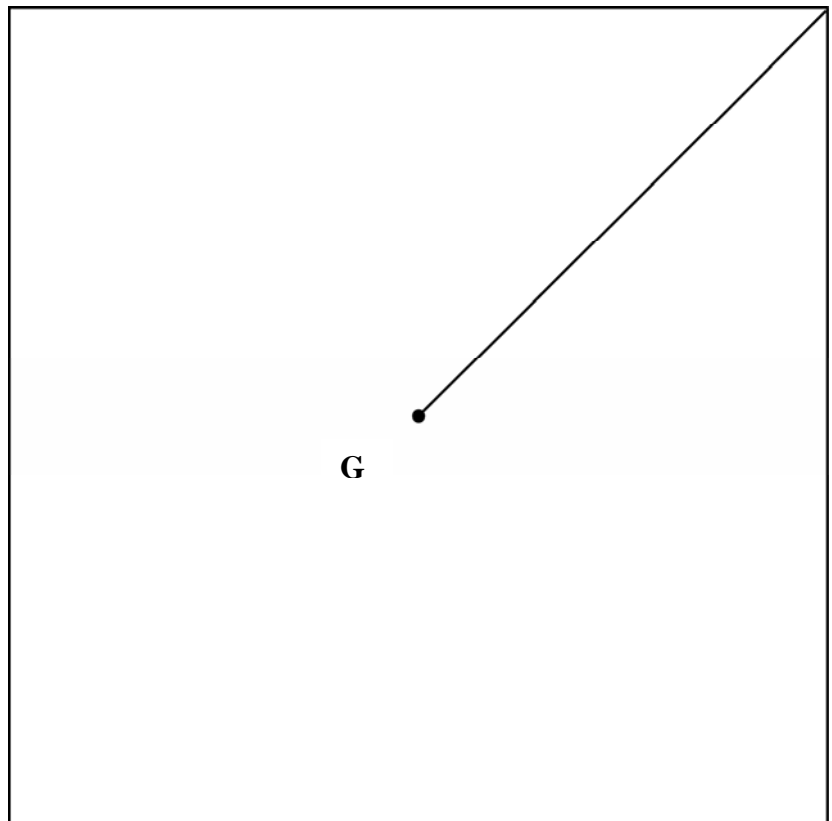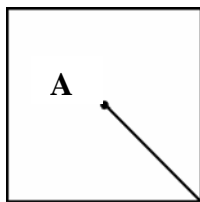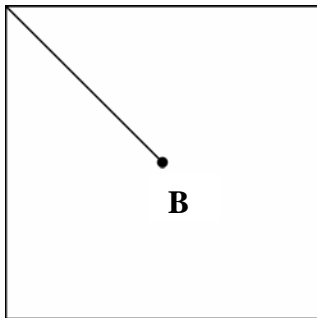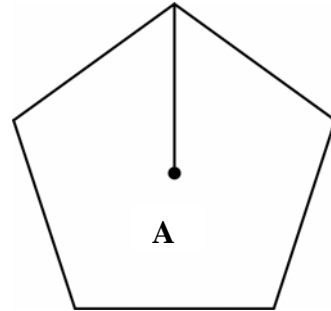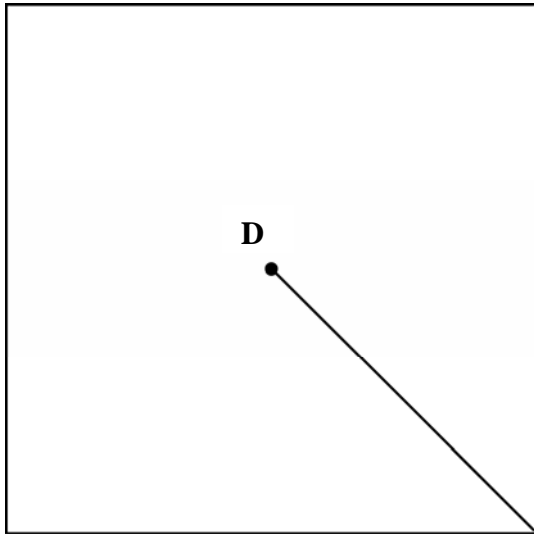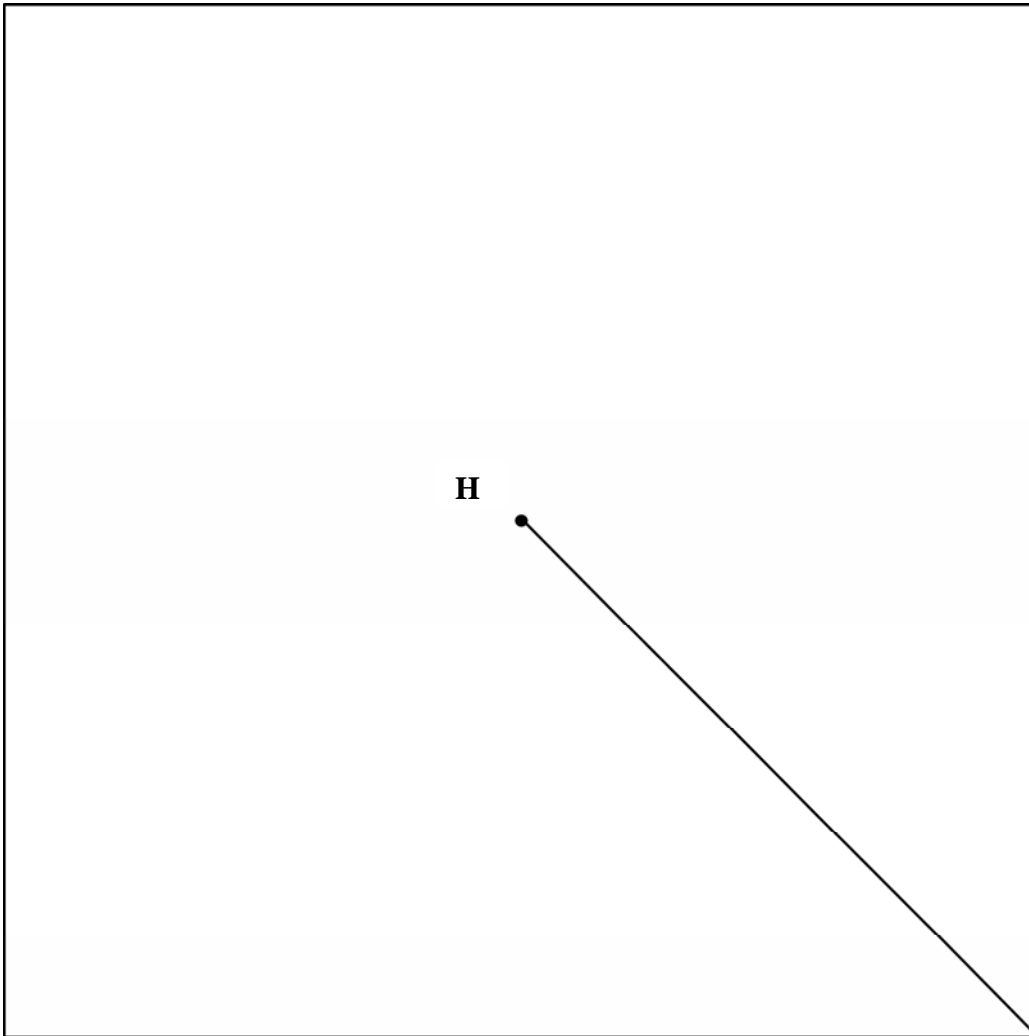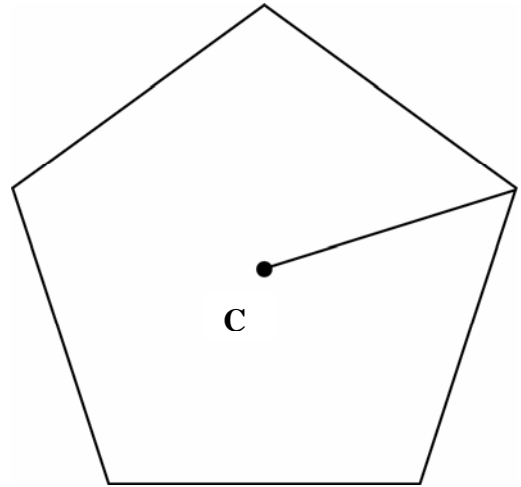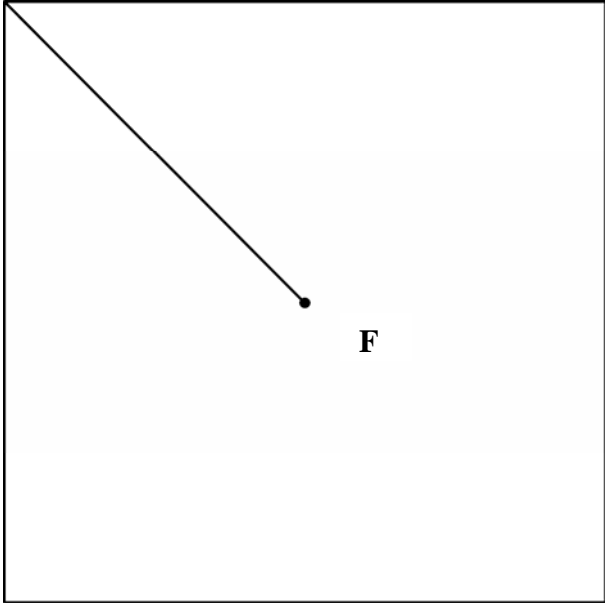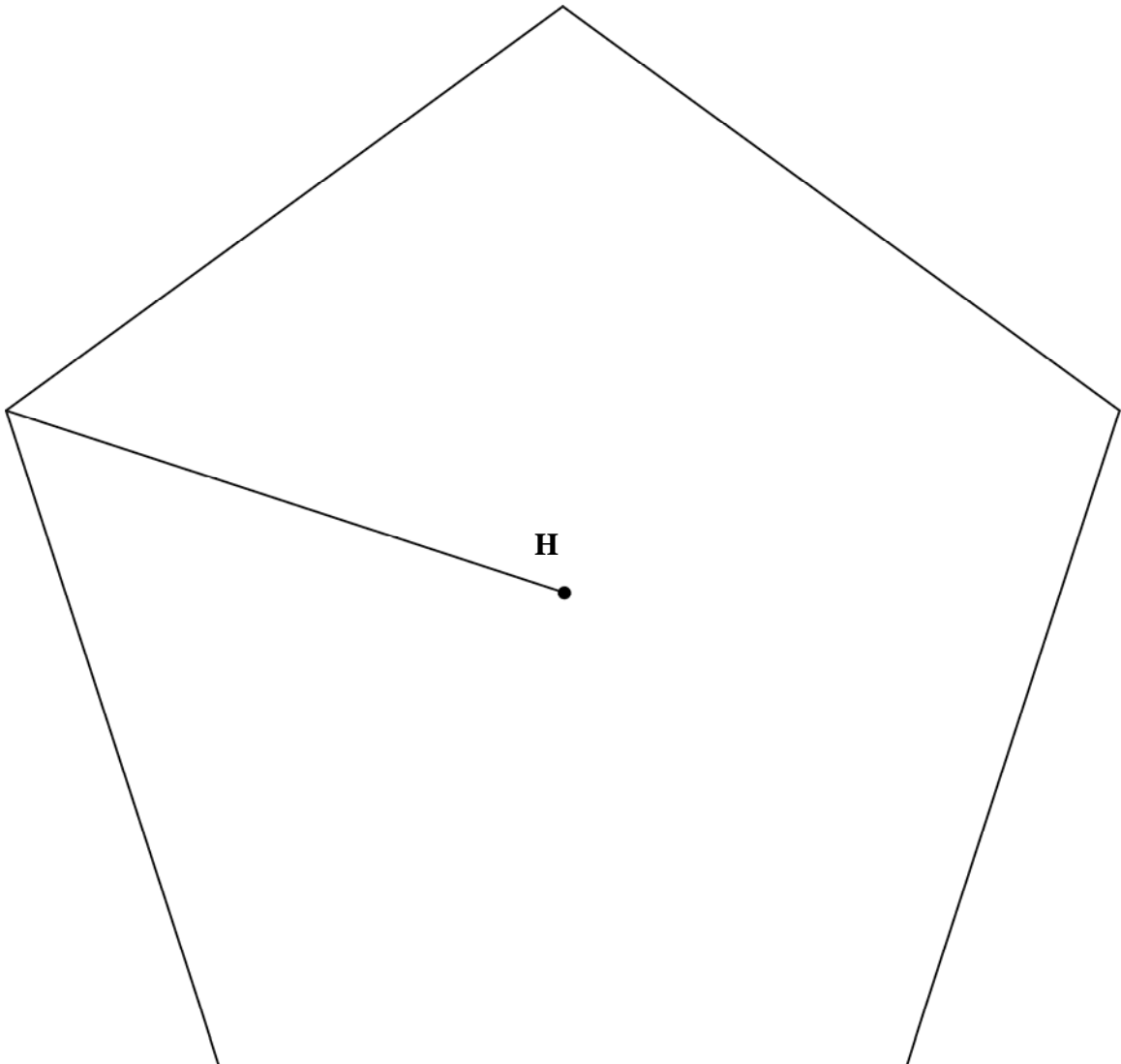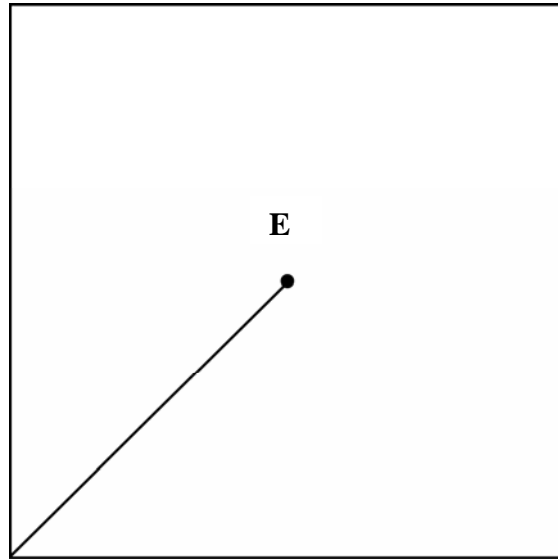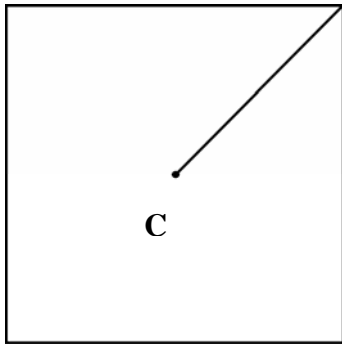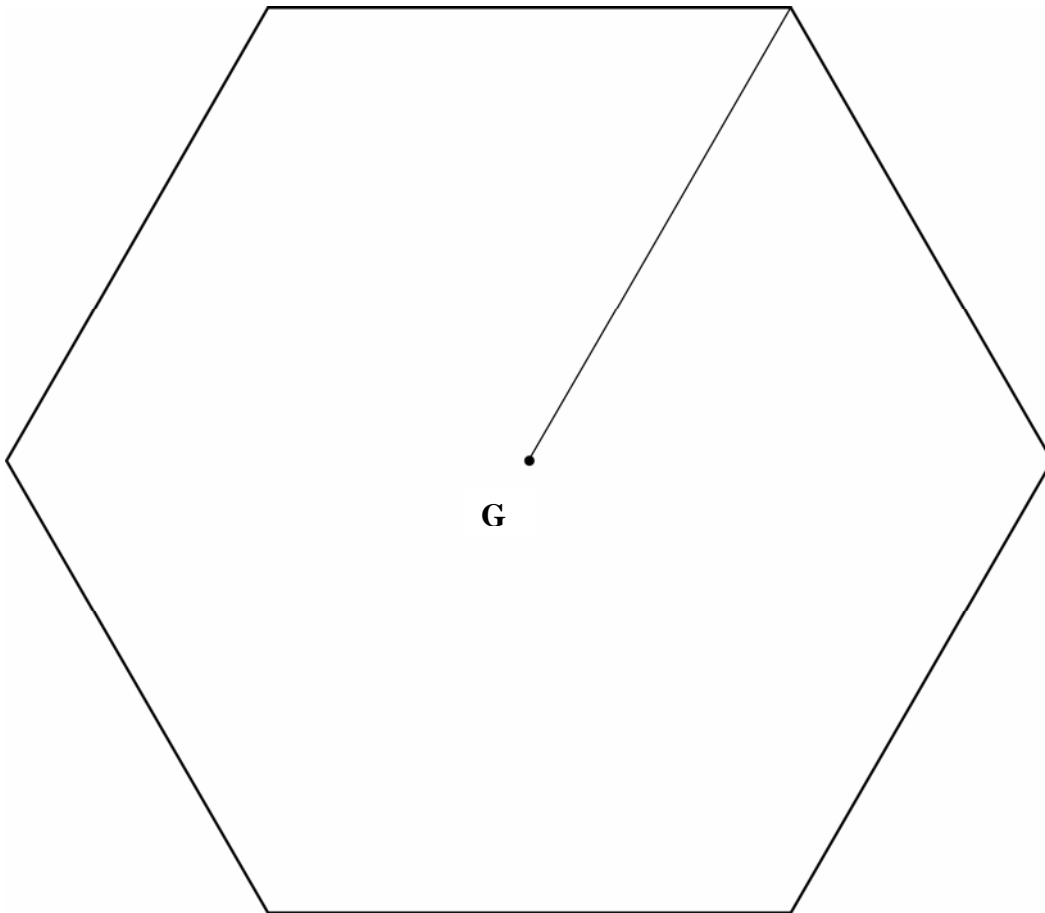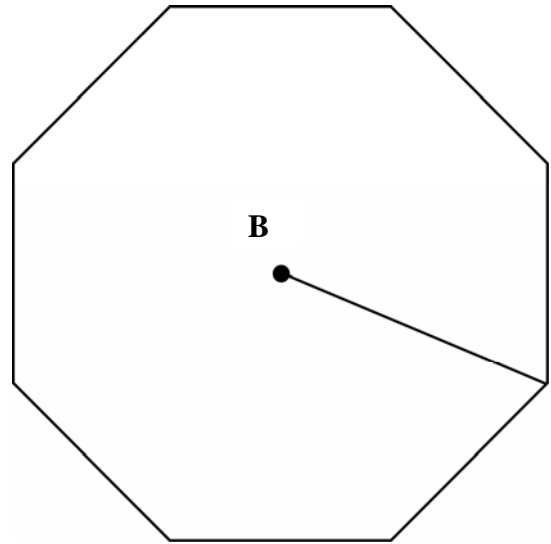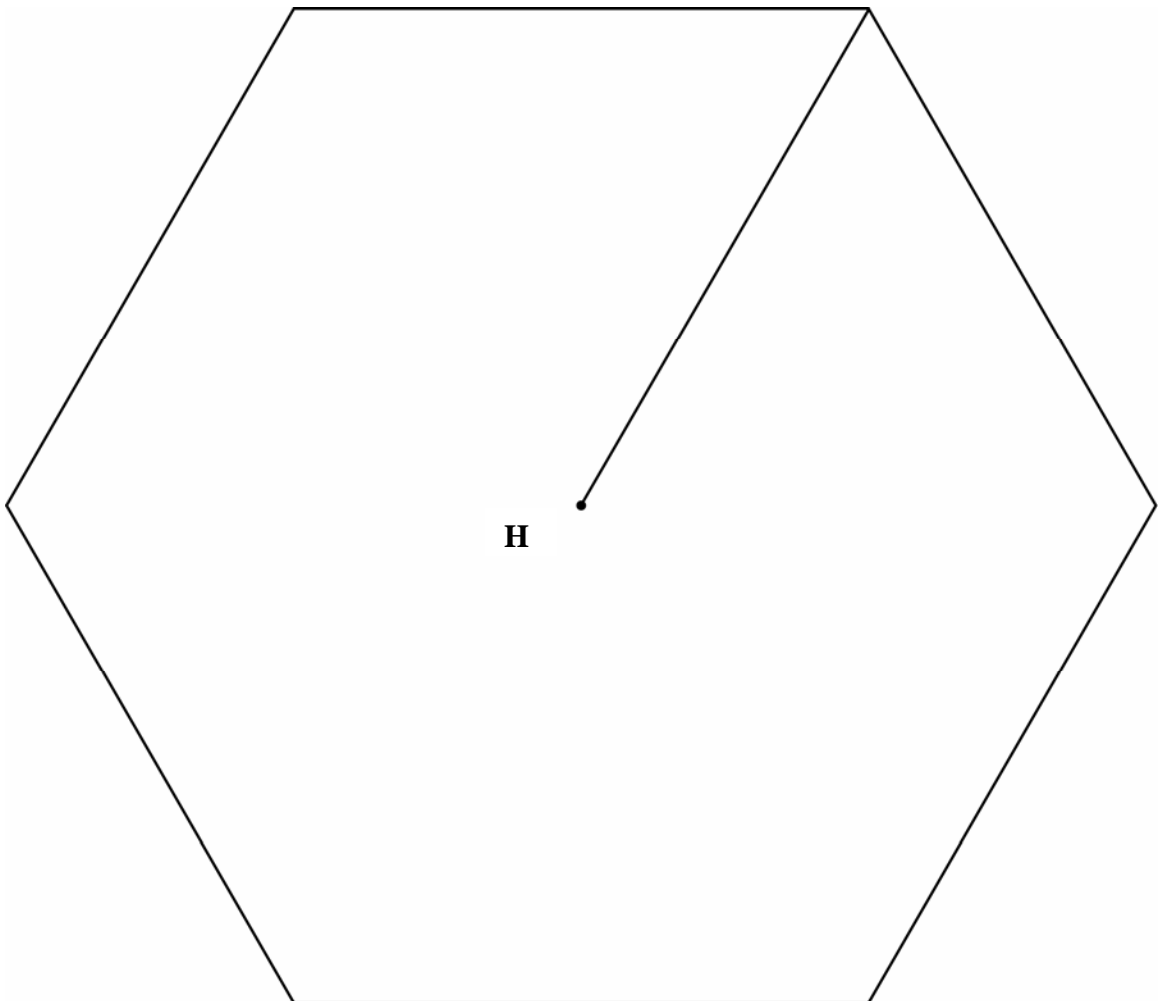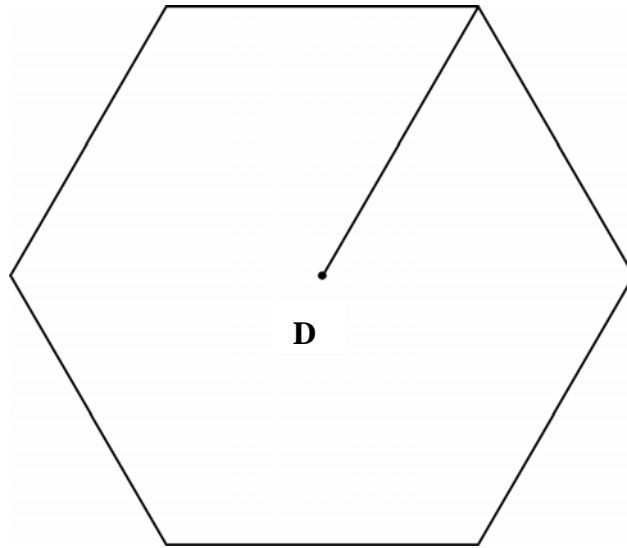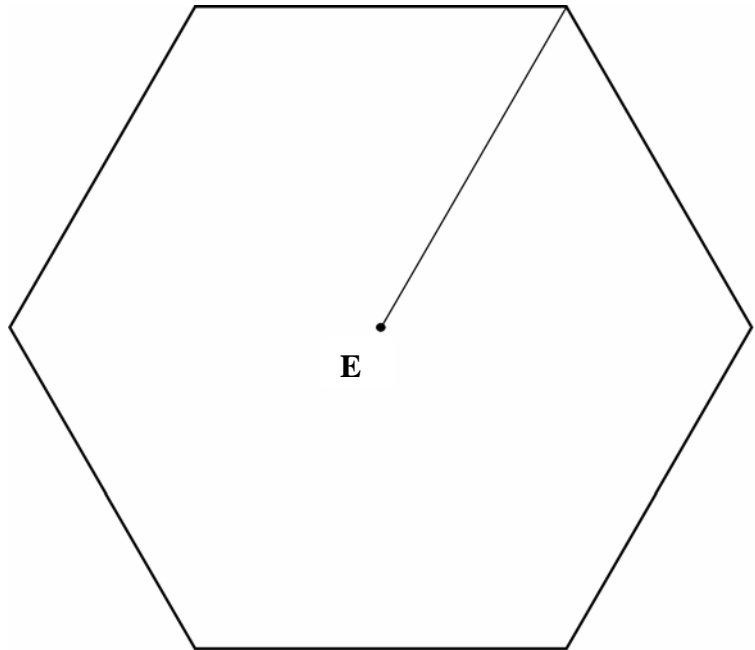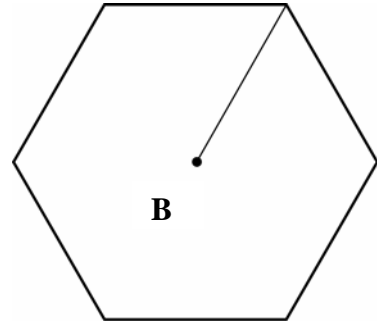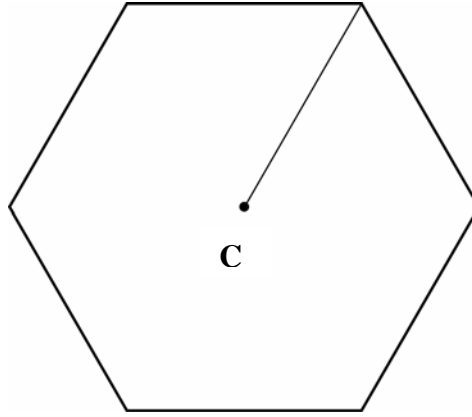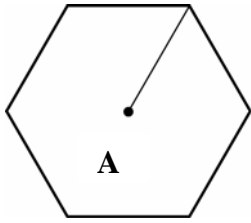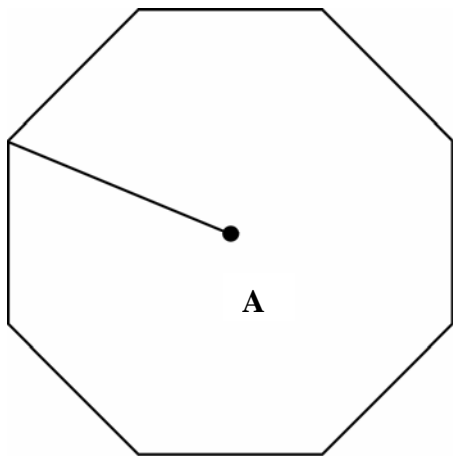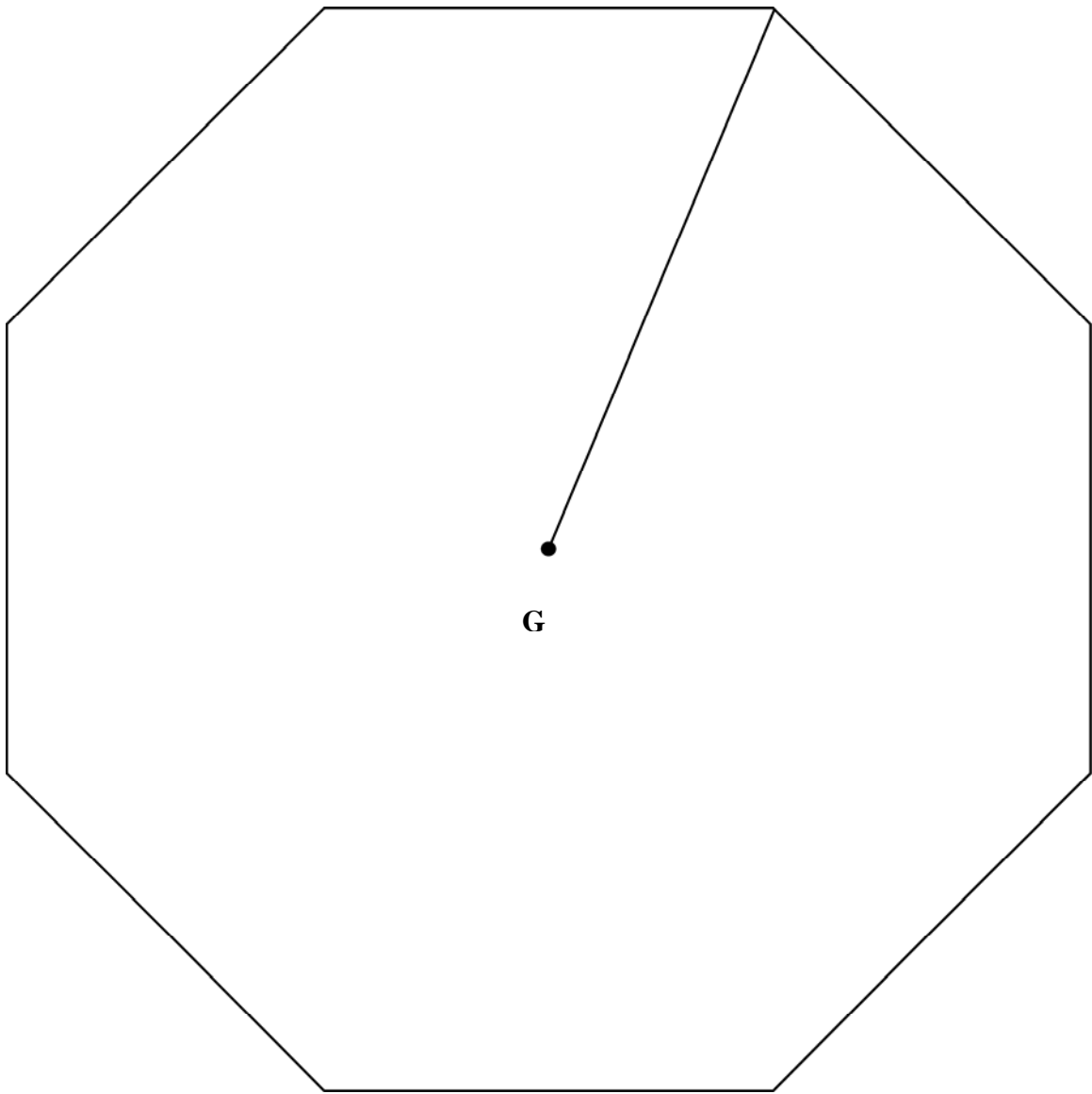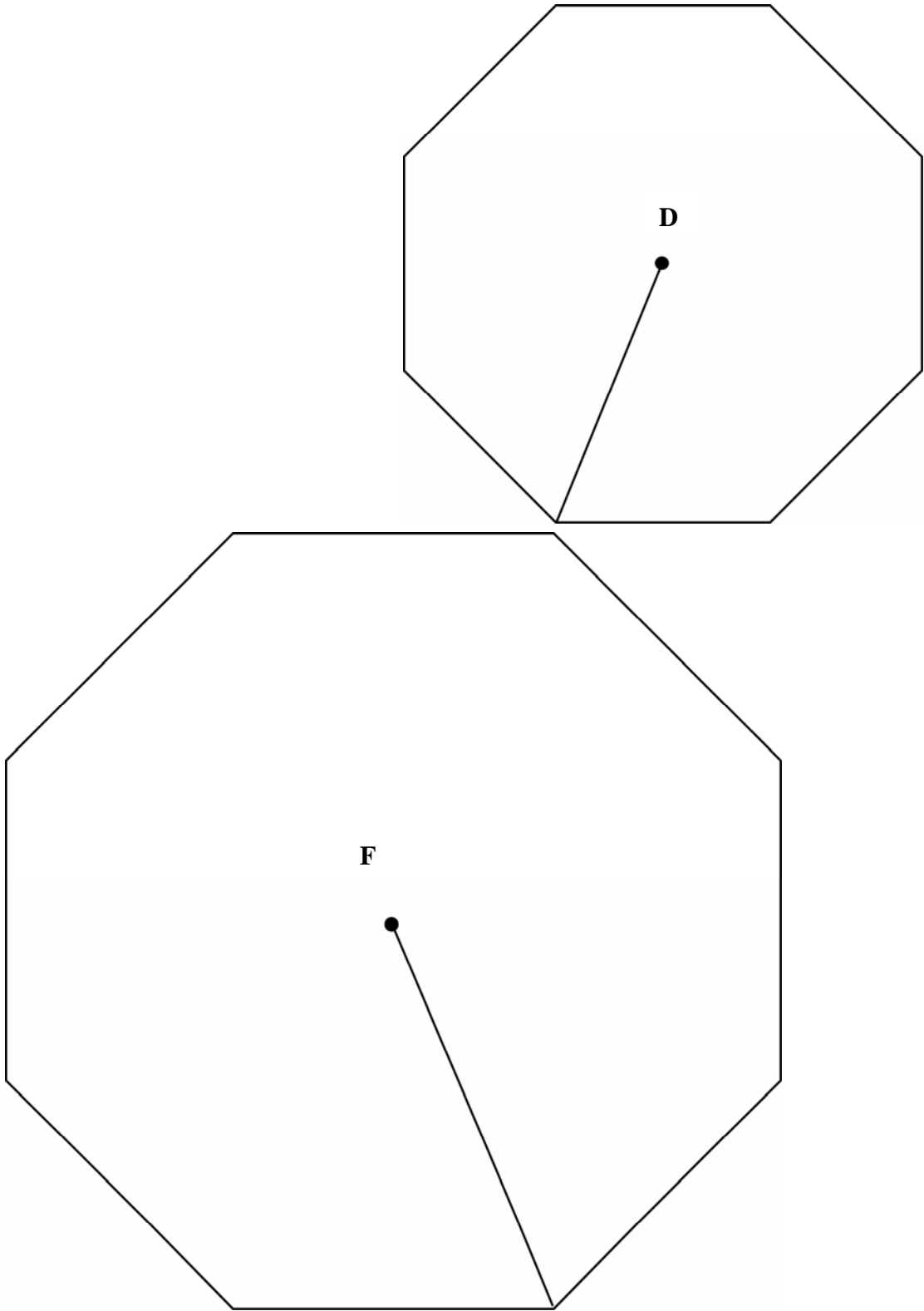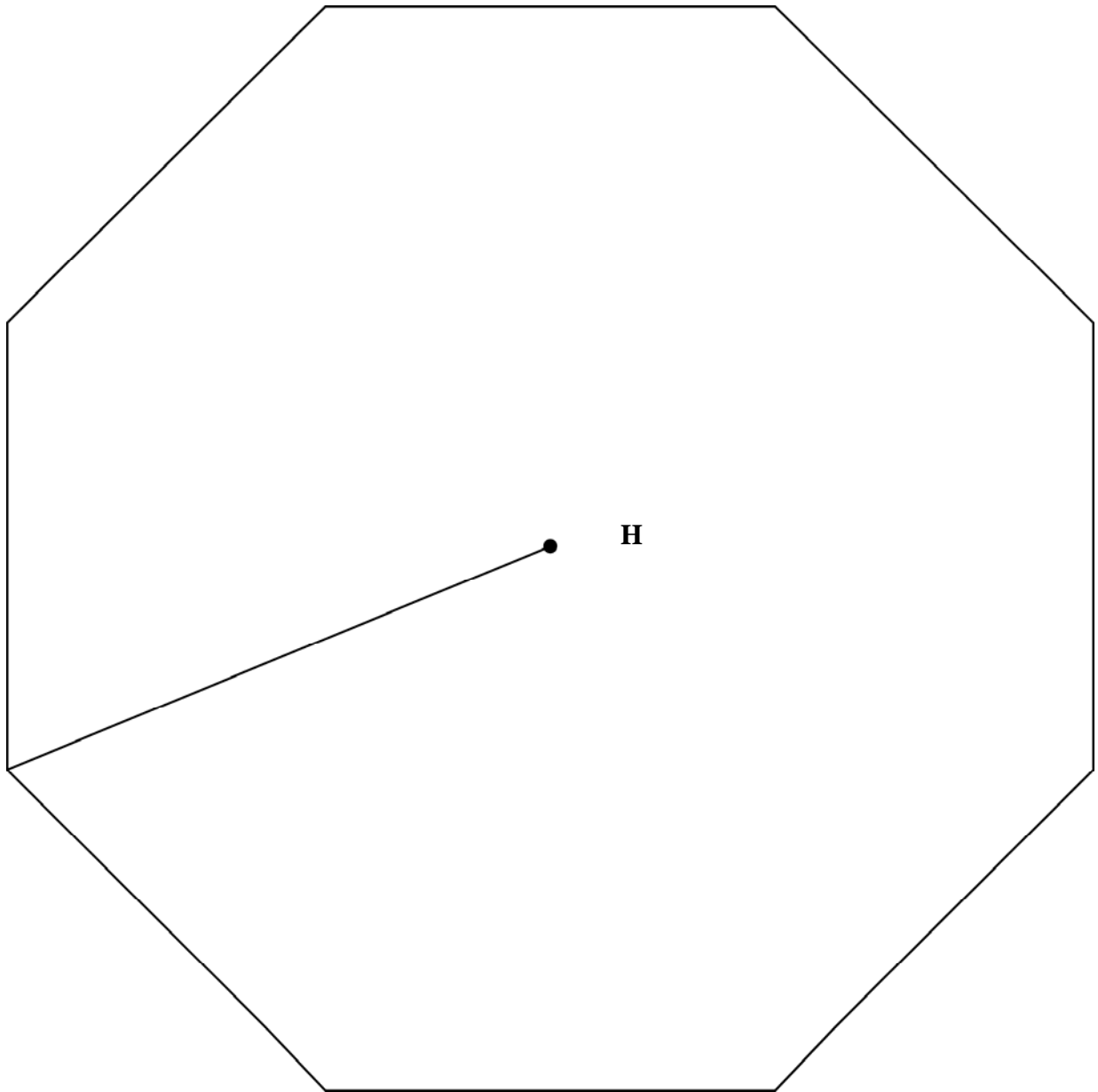
Polygons Rule: Data Collection

Using the polygons provided, measure in ___centimeters___ attributes and fill in the data on the appropriate table.
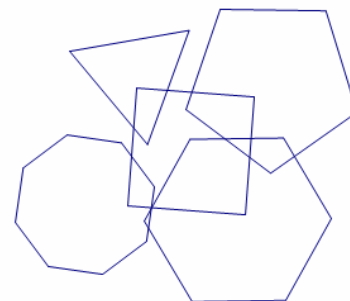
Triangles Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Squares Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Pentagons Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Hexagons Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Octagons Rule

	Side Length	Radius Length	Apothem Length	Perimeter	Area	Vertex Angle	Central Angle
A							
B							
C							
D							
E							
F							
G							
H							

Polygons Rule: Questions About Data

Data Source	Rulers
How would you describe this set of data? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data extend what students already understand about our course content?	

Techno Polly: Data Collection

Open the sketch, **Techno Polly.** Notice the tabs at the bottom of the sketch that say **Triangle**, **Square**, **Pentagon**, **Hexagon** and **Octagon** respectively. Use the same set of direction for each tab, working through them sequentially.
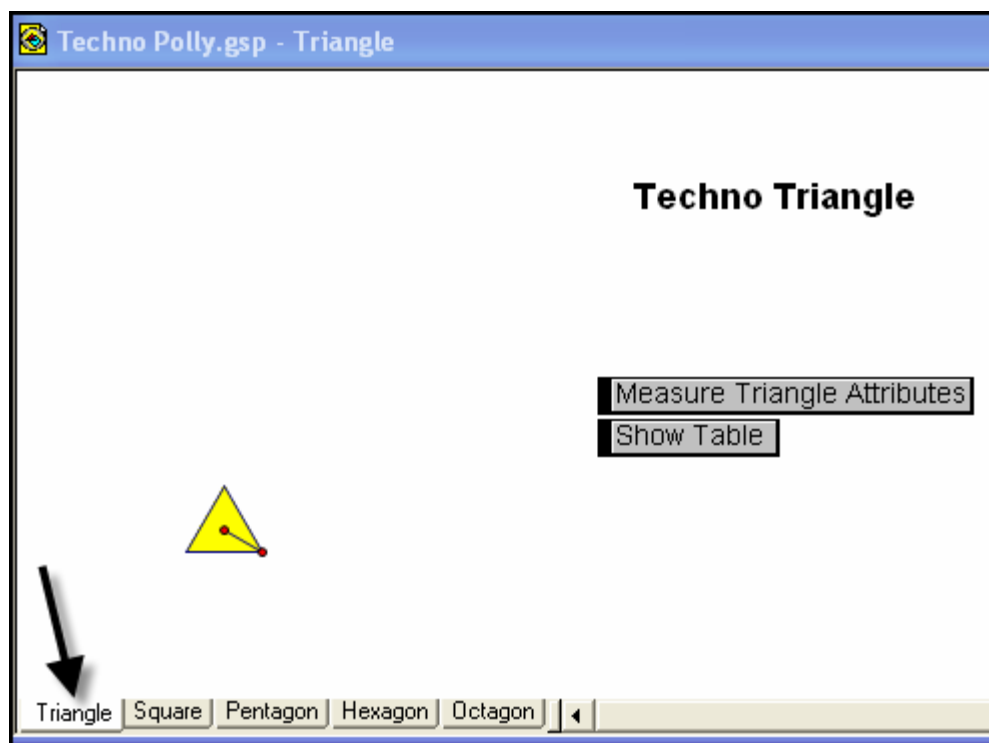
1. Click on the Measure Attributes button. What happens?

2. Click on the Show Table button.

3. Double click on the table to add another row, and then drag the vertex of the polygon increasing the length of the side to approximately 2 cm. What do you observe?

4. Double click on the table again to add another row, and then drag the vertex of the polygon, increasing the length of the side to approximately 3 cm. What do you observe?

5. Repeat this process until you have 8 rows in your table, increasing the side length of the polygon by approximately 1 cm each time.

6. Repeat the above steps for each polygon.

7. To view your data use the tabs at the bottom to transfer from data set to data set.

8. Upon exiting the Geometer's Sketchpad, the program will ask if you wish to save…select NO.

Techno Polly—Questions About Data

Data Source	Geometer's Sketchpad
How would you describe this set of data? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data extend what students already understand about our course content?	

Reflections on Data

Complete the following Venn diagram to compare and contrast the uses of the dynamic geometric software and a ruler as data sources.

Dynamic Geometric Software

Ruler
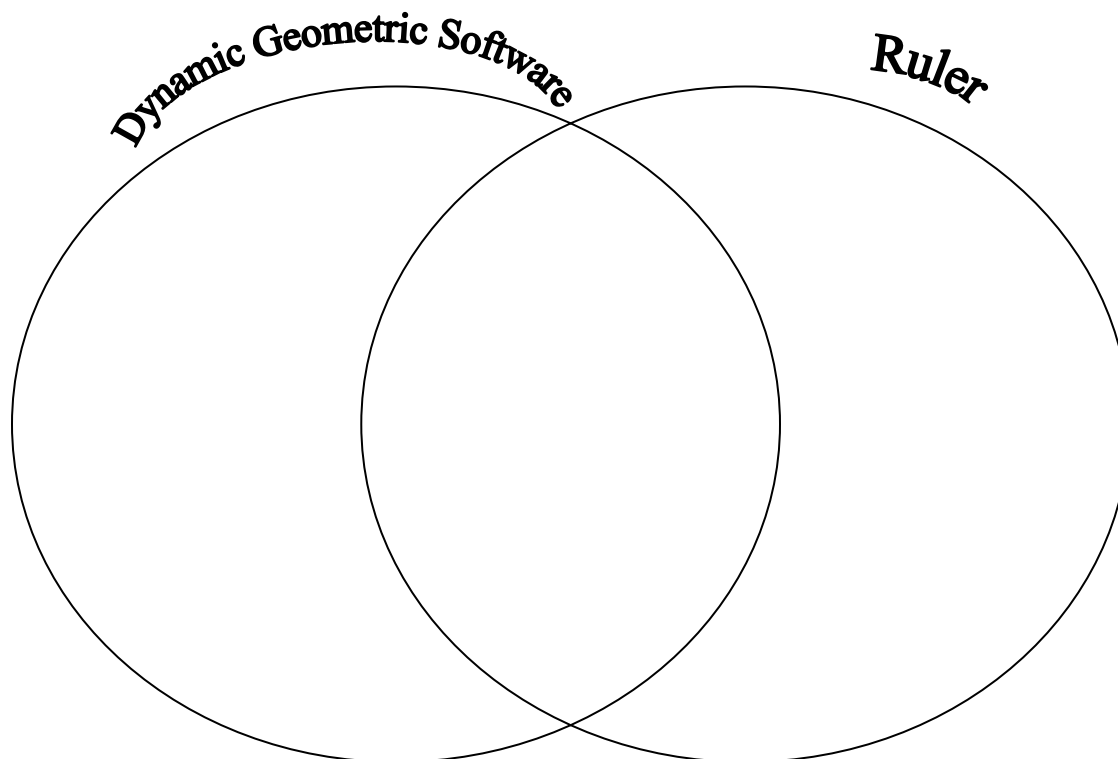
What are the benefits of using data derived from the dynamic geometric software?

What are the benefits of using data derived from actual measurement?

How might these data sources function in a geometry classroom?

Debriefing the Exploration of Data

1. What questions can we ask as reflective practitioners to determine the effectiveness of a data source for promoting mathematical learning?

2. How does the technology-based data offer an opportunity to strengthen mathematical learning?

3. What paper-and-pencil methods do students need to know to make sense of the data we explored?

4. How do you define the use of technology in your classroom?

Polly Polly In Come Free Intentional Use of Data

TEKS			
Question(s) to Pose to Students	**Math**		
	Tech		
Cognitive Rigor		Knowledge	
		Understanding	
		Application	
		Analysis	
		Evaluation	
		Creation	
Data Source(s)		Real-Time	
		Archival	
		Categorical	
		Numerical	
Setting		Computer Lab	
		Mini-Lab	
		One Computer	
		Graphing Calculator	
		Measurement Based Data	
Bridge to the Classroom			