# Pre-AP Geometry with Statistics Instructional Planning Guide Teacher Sample

The goal of the instructional planning guide is to help you create a roadmap of the key instructional activities and assessments   
you will use to design your course in alignment with the Pre-AP course framework and instructional principles. This sample   
illustrates one way in which you might use the guide. Pre-AP National Faculty and educators with experience teaching Pre-AP   
provided ideas for additional activities and resources that they might use alongside Pre-AP model lessons and formative   
assessment to build their full course.

**Using and Customizing Your Own Instructional Planning Guide:**

* When planning additional lessons, consider how they support the Pre-AP course framework, areas of focus,   
  and shared principles. These three elements represent the key ingredients of aligning to Pre-AP.
* Take time to capture your reflections as you move through the course.

## Unit 1 Measurement in Data

| **Pacing**  **in min** | **Actual Date(s)** | **Key Concepts** | **Materials/Resources/Tasks**  *Pre-AP Model Lessons, Additional Lessons, Textbooks,  Performance Tasks, Assessments* | **Learning Objectives** | **State Standards** | **Reflections on  Areas of Focus & Shared Principles** |
| --- | --- | --- | --- | --- | --- | --- |
| ~60 |  | 1.1: The Shape of Data | Pre-AP Model Lesson 1.1: A-Maze-ing Statistics | 1.1.1, 1.1.2 | S.ID.A.1, 2 |  |
| ~135 |  | 1.1: The Shape of Data | Pre-AP Model Lesson 1.2: Exploring Variables | 1.1.2 | S.ID.A.1 |  |
| ~90 |  | 1.1: The Shape of Data | Pre-AP Model Lesson 1.3: Measures of Center | 1.1.1, 1.1.3, 1.1.4, 1.1.6 | S.ID.A.2–4 |  |
| ~90 |  | 1.1: The Shape of Data | Pre-AP Model Lesson 1.4: Standard Deviation and Variance | 1.1.1, 1.1.5 | S.ID.A.2 |  |
| ~90 |  | 1.1: The Shape of Data | Pre-AP Model Lesson 1.5: Distributions as Functions | 1.1.2 | S.ID.A.1 |  |
| ~45 |  | 1.1: The Shape of Data | Pre-AP Model Lesson 1.6: The Normal Distribution | 1.1.6 | S.ID.A.4 |  |
| ~45 |  | 1.1 | **Learning Checkpoint 1**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~45 |  | 1.1 | **Practice Performance Task 1**  Staffing the Grocery Store  *This practice performance task assesses learning objectives and essential knowledge statements addressed up to this point in the unit.* |  | S.ID.A.1–4 |  |
| ~135 |  | 1.2: Chance Events | Pre-AP Model Lesson 1.7: Introduction to Probability | 1.2.2 | S.CP.A.1 |  |
| ~45 |  | 1.2: Chance Events | Pre-AP Model Lesson 1.8: Venn Diagrams | 1.2.1, 1.2.3 | S.CP.A.1, 3, 4  S.CP.B.6 |  |
| ~90 |  | 1.2: Chance Events | Pre-AP Model Lesson 1.9: Contingency Tables | 1.2.1, 1.2.3 | S.CP.A.1, 3, 4  S.CP.B.6 |  |
| ~90 |  | 1.2: Chance Events | Pre-AP Model Lesson 1.10: Independent Events | 1.2.4 | S.CP.A.2, 5 |  |
| ~45 |  | 1.2: Chance Events | Pre-AP Model Lesson 1.11: Modeling Probability with the Normal Distribution | 1.2.5 | S.MD.A.1 |  |
| ~45 |  | 1.2 | **Practice Performance Task 2**  Are Grades and Homework Connected?  *This practice performance task assesses learning objectives and essential knowledge statements addressed up to this point in the unit.* |  | S.CP.A.1, 3, 4, 6 |  |
| ~90 |  | 1.3: Inferences from Data | Pre-AP Model Lesson 1.12: Accuracy and Precision | 1.3.1 | S.IC.A.1  S.IC.B.6 |  |
| ~45 |  | 1.2, 1.3 | **Learning Checkpoint 2**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~180 |  | 1.3 | **Performance Task**  Designing a Study  *This performance task assesses learning objectives and essential knowledge statements addressed in the unit.* |  | S.IC.A.1 S.IC.B.3–6 |  |

[add or remove rows as needed]

### Reflections

What went well in this unit?

When were students most engaged during this unit?

How have students grown? What opportunities for growth stand out at this time?

What needs modification or differentiation next time?

## Unit 2 Tools and Techniques of Geometric Measurement

| **Pacing in min** | **Actual Date(s)** | **Key Concepts** | **Materials/Resources/Tasks**  *Pre-AP Model Lessons, Additional Lessons, Textbooks,  Performance Tasks, Assessments* | **Learning Objectives** | **State Standards** | **Reflections on  Areas of Focus & Shared Principles** |
| --- | --- | --- | --- | --- | --- | --- |
| ~45 |  | 2.1: Measurement in Geometry | * Provide students with different figures and have them develop a list of observations about each figure. * Chart group share outs and use those to develop definitions of each figure. * Have students play a “Heads Up” game to introduce some high-utility vocabulary. * Write different types of figures and names of figures on note cards. Group students in pairs. One student holds the note card on their forehead without looking at the card while the other student provides clues for the student with the card to guess what type of figure is being described. | 2.1.1, 2.1.2 | G.CO.A.1 |  |
| ~90 |  | 2.1: Measurement in Geometry | Pre-AP Model Lesson 2.1: Measuring Segments and Angles | 2.1.3–2.1.6 | G.CO.A.4  G.CO.B.6 |  |
| ~90 |  | 2.1: Measurement in Geometry | Pre-AP Model Lesson 2.2: Copying Line Segments and Angles | 2.1.7 | G.CO.D.12 |  |
| ~45 |  | 2.1: Measurement in Geometry | Pre-AP Model Lesson 2.3: Measuring Distance in the Coordinate Plane | 2.1.8 | G.SRT.C.8 |  |
| ~45 |  | 2.1: Measurement in Geometry | * Provide students with a line segment. Have students measure the line segment. * Instruct students to draw a point anywhere on the line segment. Have students measure the two line segments formed by that point. * In groups, have students to compare and contrast their line segments and measurements, allowing them to recognize that the two segments formed sum to the measure of the entire line segment regardless of where they placed the point. | 2.1.9 | G.CO.C.9 |  |
| ~45 |  | 2.1: Measurement in Geometry | * Complete the same task with an angle. Have students draw a ray that divides the angle into two angles. * Introduce supplementary and complementary angles by asking students to identify two specific, unique angle measures. * Explain that these are significant and we want to be able to identify them within figures. * Allow students to complete graphic organizers for the terms supplementary and complementary. | 2.1.9 | G.CO.C.9 |  |
| ~45 |  | 2.1 | **Learning Checkpoint 1**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~90 |  | 2.2: Parallel and Perpendicular Lines | Pre-AP Model Lesson 2.4: Parallel and Perpendicular Lines in the Coordinate Plane | 2.2.1–2.2.3, 2.2.5, 2.2.7 | G.CO.C.9  G.CO.D.12  G.GPE.B.4, 5 |  |
| ~90 |  | 2.2: Parallel and Perpendicular Lines | Pre-AP Model Lesson 2.5: The Perpendicular Bisector Theorem | 2.1.10  2.2.6 | G.CO.C.9  G.CO.D.12  G.GPE.B.4 |  |
| ~30 |  | 2.2: Parallel and Perpendicular Lines | * Provide students with a series of triangles. * Ask students to label and cut out the three angles of each triangle. * Have students arrange the angles so that they are adjacent. Students should record their findings then discuss them with a partner. * Debrief their discoveries. * Provide students with examples for which they must “predict” the measure of a missing angle. | 2.2.4 | G.CO.C.10 |  |
| ~45 |  | 2.2 | **Practice Performance Task**  The Flatiron Footprint  *This practice performance task assesses learning objectives and essential knowledge statements addressed up to this point in the unit.* |  | G.CO.D.12  G.GPE.B.4, 5  G.SRT.C.8 |  |
| ~45 |  | 2.3: Measurement in Right Triangles | Pre-AP Model Lesson 2.6: Using Right Triangles in the Coordinate Plane | 2.3.1, 2.3.2 | G.GPE.B.4, 6  G.SRT.A.2, 3  G.SRT.B.5 |  |
| ~90 |  | 2.3: Measurement in Right Triangles | Pre-AP Model Lesson 2.7: Similarity and the Pythagorean Theorem | 2.3.2, 2.3.3 | G.GPE.B.4–6 |  |
| ~90 |  | 2.3: Measurement in Right Triangles | Pre-AP Model Lesson 2.8: Introducing the Tangent Ratio | 2.3.4, 2.3.5, 2.3.7 | G.MG.A.1  G.SRT.B.5  G.SRT.C.6, 8 |  |
| ~135 |  | 2.3: Measurement in Right Triangles | Pre-AP Model Lesson 2.9: The Sine and Cosine Ratios | 2.3.4, 2.3.5, 2.3.7 | G.MG.A.1  G.SRT.B.5  G.SRT.C.6, 8 |  |
| ~60 |  | 2.3: Measurement in Right Triangles | * Provide students with a real-world problem requiring them to find the angle given a ratio of side lengths using either a 30°-60°-90° or 45°-45°-90° triangle. *Example: A painter needs to reach a given height on a house and the ladder is a given length. At what angle should the painter set the ladder with respect to the ground?* * Utilize the foundation laid in Pre-AP Model Lesson 2.9 to have students work backwards to understand that a given angle measure has a specific ratio. * Provide students with triangles of various side lengths but the same common angle measures (30°-60°-90°, 45°-45°-90°). * Have students determine the angle measures given the ratio of side lengths. * Have students write a response to the following: “What can we conclude about the acute angle measures of a right triangle and the ratio of side lengths?” * Explain that inverse trigonometric ratios allow students to identify the angle associated with that specific ratio of side lengths. | 2.3.6, 2.3.7 | G.SRT.C.6 |  |
| ~45 |  | 2.2, 2.3 | **Learning Checkpoint 2**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~45 |  | 2.1, 2.3 | **Performance Task**  Prove Me Wrong  *This performance task assesses learning objectives and essential knowledge statements addressed in the unit.* |  | G.CO.D.12  G.GPE.B.4 |  |

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### Reflections

What went well in this unit?

When were students most engaged during this unit?

How have students grown? What opportunities for growth stand out at this time?

What needs modification or differentiation next time?

## Unit 3 Measurement in Congruent and Similar Figures

| **Pacing in min** | **Actual Date(s)** | **Key Concepts** | **Materials/Resources/Tasks**  *Pre-AP Model Lessons, Additional Lessons, Textbooks,  Performance Tasks, Assessments* | **Learning Objectives** | **State Standards** | **Reflections on  Areas of Focus & Shared Principles** |
| --- | --- | --- | --- | --- | --- | --- |
| ~45 |  | 3.1: Transformations of Points in a Plane | Pre-AP Model Lesson 3.1: Symmetries of Objects | 3.1.3 | G.CO.A.4 |  |
| ~45 |  | 3.1: Transformations of Points in a Plane | Pre-AP Model Lesson 3.2: Rigid Motions Without Coordinates | 3.1.1, 3.1.2, 3.1.4 | G.CO.A.4, 5  G.CO.B.6  G.GPE.B.4  G.SRT.A.2 |  |
| ~90 |  | 3.1: Transformations of Points in a Plane | Pre-AP Model Lesson 3.3: Rigid Motions in the Coordinate Plane | 3.1.1–3.1.4 | G.CO.A.4, 5  G.CO.B.6  G.GPE.B.4  G.SRT.A.2 |  |
| ~90 |  | 3.1: Transformations of Points in a Plane | Pre-AP Model Lesson 3.4: Dilations | 3.1.5, 3.1.6 | G.GPE.B.4  G.SRT.A.1, 2 |  |
| ~45 |  | 3.1: Transformations of Points in a Plane | Pre-AP Model Lesson 3.5: Defining Congruence and Similarity Through Transformation | 3.1.1, 3.1.3–3.1.6 | G.CO.A.4, 5  G.CO.B.6  G.GPE.B.4  G.SRT.A.1, 2 |  |
| ~45 |  | 3.1: Transformations of Points in a Plane | **Practice Performance Task**  Transformations in the Coordinate Plane  *This practice performance task assesses learning objectives and essential knowledge statements addressed up to this point in the unit.* |  | G.CO.A.4, 5  G.CO.B.6  G.GPE.B.4  G.SRT.A.1, 2 |  |
| ~45 |  | 3.2: Congruent and Similar Polygons | * Using Desmos Geometry, have students construct triangles giving them a set of measurements. Ensure that measurements are given in different orders. * In their groups, ask students to compare the triangles constructed; they should conclude that the triangles are congruent. * Using the transformation tools in Desmos, have students prove that the triangles are congruent while reinforcing the use of rigid motion to prove figures to be congruent. * Challenge students to provide a counterexample by providing two triangles that have the same measurements but are not congruent. * Ensure students can answer the following: “What can we conclude about two triangles if we know they are congruent?” Students should support their argument by constructing congruent triangles and proving they are congruent. * Challenge students to turn their informal proof into a formal proof. | 3.2.1 | G.CO.B.7  G.SRT.B.5 |  |
| ~45 |  | 3.2: Congruent and Similar Polygons | * Have students develop a comprehensive list of all possible combinations of 3 parts of a triangle including: SSS, AAA, SAS, ASA, and SSA. * Using Desmos Geometry, challenge students to develop a counterexample for each of the criteria. * Using transformation tools in Desmos, have students prove that the triangles are congruent or not congruent while reinforcing the use of rigid motion to prove figures to be congruent. | 3.2.2 | G.CO.B.8  G.SRT.B.5 |  |
| ~45 |  | 3.2: Congruent and Similar Polygons | * Provide students with a real-world challenge: *Engineers build a model of a bridge with triangular trusses for the city. Once their model is approved the design is passed on to the construction company. In order for the bridge to cross the river, it needs to be the appropriate size. What is a process the construction company can use to maintain the model’s integrity, but it be the right size? How can they prove to the city that the actual bridge has the same structural integrity as the model tested by the engineers?* * Provide student pairs with schematics of the structure including angle measurements and side lengths. * Challenge students to determine the scale factor. * Debrief: “When are triangles not similar?” | 3.2.3 | G.SRT.A.2, 3  G.SRT.B.5 |  |
| ~75 |  | 3.2: Congruent and Similar Polygons | * Provide students with a parallelogram using Desmos Geometry. * With a partner, have students examine the figure, take various measurements, and make a list of their findings. * Have partners share with a small group then have the groups share their findings with the whole class. * Chart their findings and use those findings to create a list of properties of parallelograms. * Provide students with a parallelogram on the coordinate plane. * Challenge students to use the list of properties that created to prove whether or not the figure is a parallelogram using only the coordinates of the parallelogram. * Ask student pairs to share how they determined if their figure is a parallelogram with their group. * Have groups share out while charting a list of ways to prove a figure is a parallelogram. | 3.2.4 | G.CO.C.11 |  |
| ~45 |  | 3.1, 3.2 | **Learning Checkpoint 1**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~90 |  | 3.3: Measurement of Lengths and Angles  in Circles | Pre-AP Model Lesson 3.6: The Equation of a Circle | 3.3.1, 3.3.2 | G.CO.A.1  G.GPE.A.1  G.GPE.B.4 |  |
| ~45 |  | 3.3: Measurement of Lengths and Angles  in Circles | Pre-AP Model Lesson 3.7: Intersections of Circles and Lines | 3.3.8 | G.GPE.B.4 |  |
| ~45 |  | 3.3: Measurement of Lengths and Angles  in Circles | Pre-AP Model Lesson 3.8: Lines Tangent to a Circle | 3.3.7, 3.3.8 | G.C.A.2, 4 |  |
| ~20 |  | 3.3: Measurement of Lengths and Angles  in Circles | * Using Desmos Geometry, provide students with a several circles with different radii. * Instruct students to take one circle and, using transformations, map that designated circle onto the other circles. * Debrief student findings by asking: “What relationship do all these circles have?” * Challenge students to find a counterexample for their finding that all circles are similar. | 3.3.3 | G.C.A.1 |  |
| ~45 |  | 3.3: Measurement of Lengths and Angles  in Circles | * Provide students with circle using hand construction or Desmos. * Instruct students to draw the diameter of the circle. * Ask them to describe the angle formed by the two radii drawn; allow them to define central angle in their own words. * Using student knowledge that a circle is 360 degrees, ask them to determine the angle measure of a half-circle. * Divide the half-circle in half again, so that the arc is 90 degrees. * Using student knowledge that a circle is 360 degrees, ask them to determine the angle measure of a quarter-circle. Continue if necessary. * Debrief by generalizing student findings that the measure of the arc is defined as the measure of the central angle. | 3.3.4 | G.CO.A.1  G.C.A.2  G.C.B.5 |  |
| ~45 |  | 3.3: Measurement of Lengths and Angles  in Circles | * Using Desmos, provide students with a diagram that contains a circle with two radii forming a right angle and two chords containing the same arc with the central and inscribed angles identified. * Challenge student pairs to find the angle measures using trigonometric ratios. * Debrief by having student groups compare answers and identify the relationship between the two angle measures. * Ask students to describe the inscribed angle in their own words then formalize the vocabulary term. | 3.3.5 | G.CO.A.1  G.C.A.2 |  |
| ~45 |  | 3.3: Measurement of Lengths and Angles  in Circles | * Provide students with the diagram used for Learning Objective 3.3.4 to capitalize on students using the fraction of a circle to describe an arc. * Ask students the following questions: “How can we mathematically describe the circumference of a circle?” “What is the central angle of the circle?” “What is the circumference of a circle?” * Ask students: “How do we calculate the length of the arc if we only have one-fourth of the circle as identified in the diagram?” (Make sure radius of the circle is 1 unit.) * Allow students to discuss with their partner. If students need assistance with expressing the circumference, guide them to use the knowledge that an arc that is ¼ of a full circle will measure 90 degrees, leading to the mathematical relationship: ¼(360) = 90. * Challenge students: “What if the radius is different?” * Provide students with a circle with a radius of 2 units. * Debrief: “What happens to arc length when the radius changes?” (Provide students with other circles with varying radii if necessary.) * Using student findings, have students derive a formula they can use for a circle with radius *r* and central angle of *n*o. * Discuss: “How can we express the relationship as a ratio?” Lead into this exercise by having students review their process for identifying arc length. Students should be able to identify that the central angle is ¼ of 360 degrees and that arc length is ¼ of the circumference of the circle allowing them to express the relationship as the ratio: | 3.3.6 | G.C.A.2 |  |
| ~45 |  | 3.3 | **Learning Checkpoint 2**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~45 |  | 3.3 | **Performance Task**  Olga’s Walkie Talkie  *This performance task assesses learning objectives and essential knowledge statements addressed in the unit.* |  | G.C.B.5  G.CO.A.1  G.GPE.A.1  G.GPE.B.4 |  |

[add or remove rows as needed]

### Reflections

What went well in this unit?

When were students most engaged during this unit?

How have students grown? What opportunities for growth stand out at this time?

What needs modification or differentiation next time?

## Unit 4 Measurement in Two and Three Dimensions

| **Pacing in min** | **Actual Date(s)** | **Key Concepts** | **Materials/Resources/Tasks**  *Pre-AP Model Lessons, Additional Lessons, Textbooks,  Performance Tasks, Assessments* | **Learning Objectives** | **State Standards** | **Reflections on  Areas of Focus & Shared Principles** |
| --- | --- | --- | --- | --- | --- | --- |
| ~90 |  | 4.1: Area as a Two-Dimensional Measurement | Pre-AP Model Lesson 4.1: Shear Transformations and Cavalieri’s Principle | 4.1.1 | G.GMD.A.1 |  |
| ~45 |  | 4.1: Area as a Two-Dimensional Measurement | * Provide students with the diagram used for Learning Objective 3.3.4 to capitalize on students using the fraction of a circle to describe an arc. * Ask students: “How can we mathematically describe the area of a circle?” * Ask students: “How do we calculate the area if we only have a one-fourth of the circle as identified in the diagram?” (Make sure radius of the circle is 1 unit.) * Allow students to discuss with their partner. If students need assistance with expressing the area, guide them to use the knowledge that an arc that is ¼ of the circle will measure 90 degrees, leading to the mathematical relationship: ¼(360) = 90. * Challenge students: “What if the radius is different?” * Provide students with a circle with a radius of 2 units. * Debrief: “What happens to area when the radius changes?” (Provide students with other circles with varying radii if necessary.) * Using student findings, have students derive a formula they can use for a circle with radius *r* and central angle of *n*o. * Discuss: “How can we express the relationship as a ratio?” Lead into this exercise by having students review their process for identifying area of the sector. Students should be able to identify that the central angle is ¼ of 360 degrees and that area of the sector is ¼ of the area of the circle allowing them to express the relationship as the ratio: | 4.1.2 | G.C.B.5 |  |
| ~45 |  | 4.1: Area as a Two-Dimensional  Measurement | * Using Desmos Geometry tools, have students construct basic geometric figures to explore the relationship between the area of dilated images (both the preimage and image). * Students take measurements using the geometry tools. * Have students create a table to organize their measurements. * Have students use those measurements along with close observation and analysis to identify that the area of the preimage is scaled by the square of the scale factor of the dilation. | 4.1.3 |  |  |
| ~90 |  | 4.2: Volume as a Three-Dimensional Measurement | Pre-AP Model Lesson 4.2: Volumes of Prisms and Cylinders | 4.2.1, 4.2.3, 4.2.5 | G.GMD.A.1  G.GMD.B.4 |  |
| ~45 |  | 4.2: Volume as a Three-Dimensional  Measurement | * Provide students with pictures of different types of pyramids with different types of polygons for bases. * Have students compare and contrast these pyramids. * Discuss: “What would the cross section by a plane parallel to the base of each pyramid look like?” If students are struggling, reframe the question to: “If we were to pour water into the pyramid, looking down at the water, what shape would you see?” * Discuss: “What polygons form the construction of each pyramid?” * Pick a pyramid and have students write a response to the following prompt: “Using cross sections, how could you describe the structure of a pyramid?” * Provide each group with a series of three oblique pyramids with square bases that form a square when placed together. * Have students arrange the pyramids to identify a polygon for which they know how to calculate the area. Have them identify the figure and the equation for the area of that figure. * Ask students to determine how they can use the equation and the relationship between the three pyramids to calculate the area of one pyramid. | 4.2.2 | G.GMD.A.1  G.GMD.B.4 |  |
| ~45 |  | 4.2: Volume as a Three-Dimensional  Measurement | * Provide students with pictures of various sizes of cones. Have students do a close observation and analysis of these cones. * Discuss: “What would the cross section by a plane parallel to the base of each cone look like?” If students are struggling, reframe the question to: “If we were to pour water into the cone, looking down at the water, what shape would you see?” * Have students write a response to the following prompt: “Using cross sections, how could you describe the structure of a cone?” * Play video (0:00-1:30) or conduct the same experiment in class if materials are available (the cone and cylinder need to have the same height and radius). * Have students observe and take notes during the video. * Debrief any student questions, prompt with: “What would we need to know is the same or different between the two objects?” * Have students use the observations from the experiment to derive a formula for volume of a cone. Remind students of the volume formulas for a cylinder that they have already discovered. | 4.2.4 | G.GMD.A.1  G.GMD.B.4 |  |
| ~30 |  | 4.2: Volume as a Three-Dimensional  Measurement | * Provide students with task cards containing multiple real-world examples of various three-dimensional figures that require them to calculate and apply their knowledge of volume for each type of figure. * Include tasks that require students to find missing volume. For example: “If the cylindrical tank is filled half-way with gasoline, what is the remaining volume in the tank?” | 4.2.6 | G.GMD.A.3  G.MG.A.1 |  |
| ~45 |  | 4.2 | **Practice Performance Task**  Digging a Ditch  *This practice performance task assesses learning objectives and essential knowledge statements addressed up to this point in the unit.* |  |  |  |
| ~45 |  | 4.1, 4.2 | **Learning Checkpoint 1**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~20 |  | 4.3: Measurements of Spheres | * Have students begin with a journaling exercise: “How would you describe the construction of a sphere?” * Have students share a paraphrase of their writing with their partner and have them engage in peer revision. * Ask student pairs to share any challenges with the descriptions they or their partner wrote. * Students descriptions should mention radius or having the same distance. If necessary prompt with: “How can we use distance to describe a sphere?” * Have students formalize their definition of a sphere and create an artifact that contains the definition along with a visual representation of the definition. | 4.3.1 | N/A |  |
| ~45 |  | 4.3: Measurements of Spheres | * Provide students with the image of a sphere inside of a cylinder with the same radius whose height is twice the radius of the sphere. * Have students label the measurements they know using variables *r* and *h*. * Provide students with the information that the lateral surface area of the cylinder is equal to the surface area of the circle. This can be done using a manipulative constructed of paper if materials are available. * Have students derive an equation for surface area using *h = 2r*: | 4.3.2 | N/A |  |
| ~30 |  | 4.3: Measurements of Spheres | * Play video or conduct the same experiment in class if materials are available. The cone, cylinder, and sphere need to have the same height and radius. * Have students observe and take notes during the video. * Debrief any student questions, prompt with: “What would we need to know is the same or different between all three objects?” * Have students use the observations from the experiment to derive a formula for the volume of a sphere. Remind students of the volume formulas for cone and cylinder that they have already discovered. | 4.3.3 | N/A |  |
| ~30 |  | 4.3: Measurements of Spheres | * Provide students with task cards containing multiple real-world examples of spheres that require them to calculate and apply knowledge of volume and surface area of spheres. * Include tasks that require them to find missing volume. For example: “If a basketball needs to be mailed, what are the smallest possible dimensions of a box that could contain the ball?” | 4.3.4 | G.MG.A.1, 3 |  |
| ~45 |  | 4.2, 4.3 | **Learning Checkpoint 2**  *This learning checkpoint can assess any of the learning objectives from its associated Key Concepts.* |  |  |  |
| ~45 |  | 4.3 | **Performance Task**  Star Energy  *This performance task assesses learning objectives and essential knowledge statements addressed in the unit.* |  | G.MG.A.1, 3 G.GMD.A.3 |  |

[add or remove rows as needed]

### Reflections

What went well in this unit?

When were students most engaged during this unit?

How have students grown? What opportunities for growth stand out at this time?

What needs modification or differentiation next time?