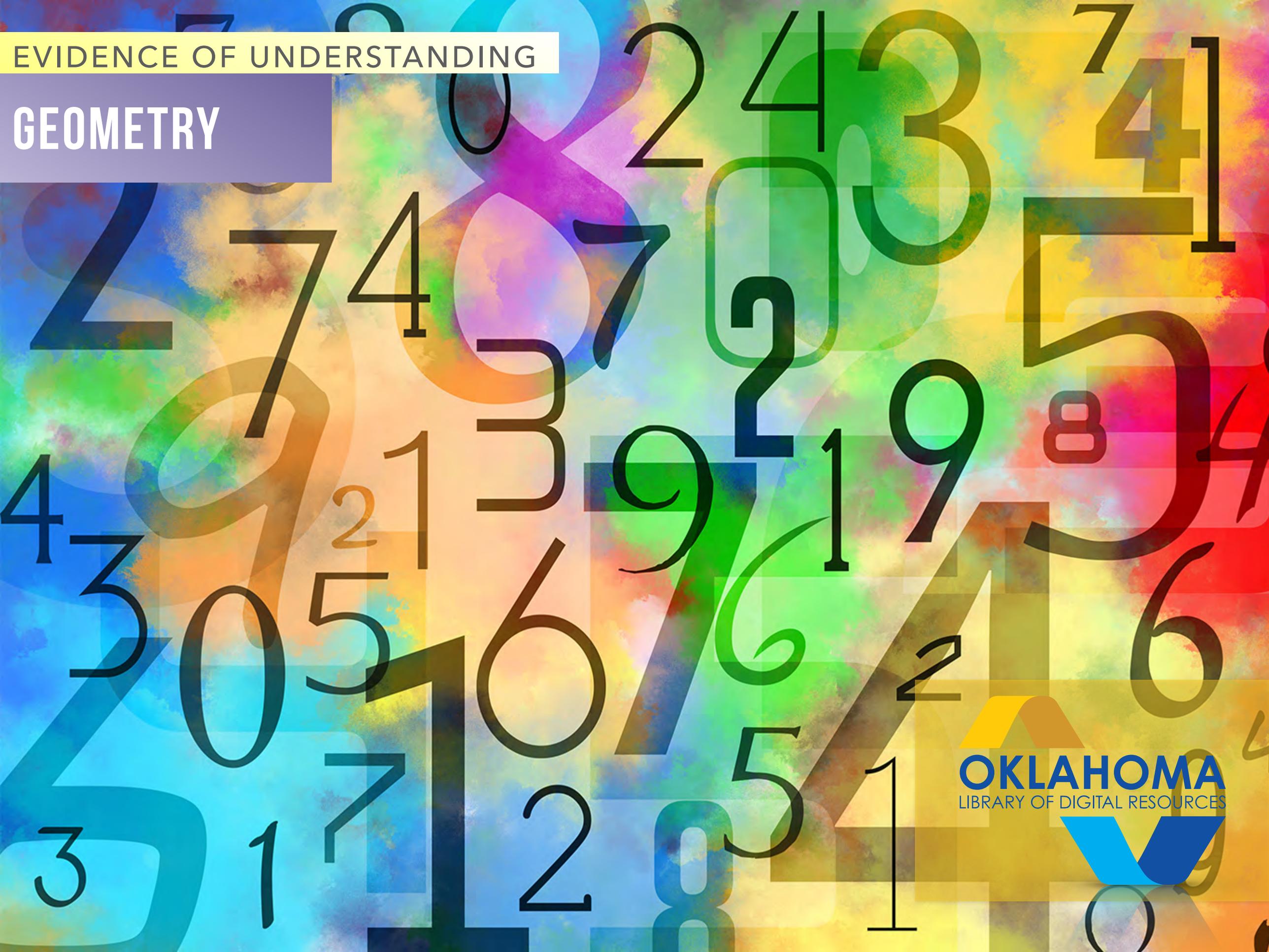
EVIDENCE OF UNDERSTANDING

GEOMETRY



OKLAHOMA
LIBRARY OF DIGITAL RESOURCES

Thank you to the following educators for their work in curating digital resources:

Carolyn Baker, Norman Public Schools
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The Oklahoma Library of Digital Resources is an innovative initiative to provide Oklahoma educators with high-quality, interactive teaching resources.

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GETTING TO KNOW OKLDR

WHO IS OSSBA?

The Oklahoma State School Boards Association (OSSBA) works to promote quality public education for the children of Oklahoma through training and information services to school board members. The Association is a leader among leaders in Oklahoma education and a visible presence in the local school districts and throughout the state.

The OSSBA was created in 1944 to provide support for local school board members with a variety of information, assistance, and representation services. OSSBA reaches every school board member through training opportunities. It creates and encouraged effective leaders to promote public education and cultivates productive alliances with governing bodies. OSSBA trains school board members to participate in an effective and supportive manner to provide direction for educational innovation and improves public perception of education in Oklahoma by sharing strategies and tools with our member school districts to focus on the success of Oklahoma public education.

OSSBA works with school boards to demonstrate the impact they have on student achievement. We work to provide meaningful two-way communication of advocacy, services, and training activities to local boards of education and their stakeholders. Other services we provide that have a direct impact on student achievement include strategic planning and superintendent searches. Our legal team provides free legal information to the school districts.

WHY OKLDR?

In the summer of 2016, OSSBA set out on a journey assist teachers in the integration of technology into their classrooms. The Oklahoma Library of Digital Resources (OKLDR) became a collection of digital content resources selected by Oklahoma educators to support the Oklahoma Academic Standards. The resources were curated by teachers from school districts across Oklahoma. Each collection contained a variety of learning resources, such as videos, apps, pdf documents, and websites, and are designed so that teachers can then build their lesson plans. The resources helped bridge the digital equity gap among students while helping schools make the most of limited resources.

After collaborating with educators, school and district leaders for a couple of years, OKLDR has been enhanced in the following ways:

- Resources are now an Open Education Resource (OER) "book" format, making it easier to use and accessible on multiple devices.
- Resources map to ESSA expectations for evidence of student understanding and students' mastery of the academic standards.
- Tools are now agnostic and can be used on multiple devices.
- Lessons are now focused on student engagement through the use of technology. The first OKLDR version focused on teacher resources. **This is a major change**.
- To prioritize student learning, teacher resources are now located at the back of each book.

HOW TO USE THE BOOK

The Oklahoma Academic Standards for this lesson are grouped together by key topics. Sometimes you will see only one standard, but other times you will see a grouping of standards.

Evidence of Understanding is the key. This is the concept you want your students to master that reinforces the standards. Mastery means deeper understanding, not just "skim the surface" learning.

Digital Tools are the recommended applications and/or tools for the lesson. Think of this element as the "supplies box."

In Practice is a suggested activity to engage the students to demonstrate mastery of the standard. You will notice that this is just one suggested lesson, and sometimes there might be a second lesson. The suggested lesson, developed by Oklahoma teachers, is meant to give you a starting point. You might decide to use the lesson or it might give you an idea of something else you could do to teach the concept.

MOVING FORWARD

As you can see the OKLDR book has been designed to inspire educators to have students demonstrate their understanding of the Oklahoma Academic Standards through the use of technology as a productivity tool. While educators have limited time in the day to plan and research high quality content, this book is a jumping off point, with suggested peer-reviewed activities and resources.

While you might encounter extra white space in the book, it is intentional for growth. As you integrate the activities into your lessons, you are encouraged to send us student work samples that might be included in the book, as well as additional activities and resources that could be included in future revisions.

Next Steps:

- We would love to add samples of student work to the activities, so please send the work to: okldr@ossba.org.
- If you would like to be involved in future course creation, or know teachers who would like to be involved, please contact us at: okldr@ossba.org.
- See anything that needs to be changed or enhanced? Contact us at: okldr@ossba.org.

REASONING AND LOGIC

COMPLEX NUMBERS

G.RL.1.1: Understand the use of undefined terms, definitions, postulates, and theorems in logical arguments/proofs.

G.RL.1.2: Analyze and draw conclusions based on a set of conditions using inductive and deductive reasoning. Recognize the logical relationships between a conditional statement and its inverse, converse, and contrapositive.

G.RL.1.3: Assess the validity of a logical argument and give counterexamples to disprove a statement.

Evidence of Understanding

Students will use a story telling application to create a comic with a logical argument and a counterexample to disprove a statement.

Digital Tools

- *Story Telling Application* - StoryLines Comix,Toontastic 3D

In Practice

- Students will use a story telling application to create a comic or cartoon where one character will state and defend an argument and the other character will give a counterexample to disprove the argument.

TWO-DIMENSIONAL SHAPES

REAL WORLD EQUATIONS

G.2D.1.1: Apply the properties of parallel and perpendicular lines, including properties of angles formed by a transversal, to solve real-world and mathematical problems and determine if two lines are parallel, using algebraic reasoning and proofs.

G.2D.1.2: Apply the properties of angles, including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve real-world and mathematical problems using algebraic reasoning and proofs.

Evidence of Understanding

Students will show understanding of the properties of lines and angles by creating an infomercial utilizing masking tape on the floor or wall, video editor application, and data collection application.

Digital Tools

- Video Editor- Clips, WeVideo, iMovie
- *Data Collection Application* - Science Journal, Easy Measure or Smart Measure , Measure, AngleMeter, Stanley Level

In Practice

- Students create a visual model of a pair of parallel lines and a transversal with masking tape either on the floor or the wall.
- Using this model, the students create an infomercial. In the infomercial, they must prove their lines are parallel using an angle measuring app.
- They must also explain corresponding angles, exterior, interior, vertical, and supplementary angles.

ANALYZING LINE SEGMENTS

G.2D.1.5: Use coordinate geometry to represent and analyze line segments and polygons, including determining lengths, midpoints, and slopes of line segments.

Evidence of Understanding

Students will show their understanding of line segment, mid-point and slope of a line segment by designing a ski slope on a coordinate grid using a note taking application, sketch application and video editor.

Digital Tools

- *Note Taking*- Notes, Paper by 53, Book Creator
- *Sketch Application*- Sketches School, Notes, ibis, Absolute Board, Google Draw, Notability, Sketchbook
- *Video Editor*- Clips, WeVideo, Do-Ink, iMovie

In Practice

- Students will use a sketch application to begin the process of designing a ski resort with 3 different slopes.
- Students will use graph paper within a note taking application to design a ski slope on a coordinate graph that includes three difficulties:
  - Green (easy slope),
  - Blue (moderate slope),
  - Black Diamond (steep slope).
- Students will calculate and record the slope of each section of the mountain.
- Students will determine the midpoint of each mountain section (line segment) to show where the ski lift will stop midway along each section of the mountain.
- Students will create a video using a video editor to describe and advertise the ski slopes were designed.

POLYGON PROPERTIES

G.2D.1.3: Apply theorems involving the interior and exterior angle sums of polygons and use them to solve real-world and mathematical problems using algebraic reasoning and proofs.

G.2D.1.4: Apply the properties of special quadrilaterals (square, rectangle, trapezoid, isosceles trapezoid, rhombus, kite, parallelogram) and use them to solve real-world and mathematical problems involving angle measures and segment lengths using algebraic reasoning and proofs.

G.2D.1.6: Apply the properties of polygons to solve real-world and mathematical problems involving perimeter and area (e.g., triangles, special quadrilaterals, regular polygons up to 12 sides, composite figures).

G.2D.1.9: Use numeric graphic and algebraic representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90°, to solve problems involving figures on a coordinate plane and identify types of symmetry.

Evidence of Understanding

Using 3D design, sketching applications and data collection applications, students will apply knowledge of properties of polygons to design a children's park. The design must include accurate area measurements of each feature included.

Digital Tools

- *Sketch Application*- Sketches School, Notes, ibis, Absolute Board, Google Draw, Notability, Sketchbook,
- *3D Design* - 3DCio, Tinkercad, uMake, GeoGebra
- *Data Collection* - Science Journal, Easy Measure, Smart Measure , Measure, AngleMeter, CamToPlan

In Practice

- Using a sketch application, students design a children's park utilizing the following polygons: square, rectangle, trapezoid, isosceles trapezoid, rhombus, kite or parallelogram, triangle, regular polygon with 5-12 sides and one composite figure.
- Students will design their park using a 3D design application.
- Once the design is complete, student will use a data collection application to calculate the area of each feature, recording the segment lengths and angle measures of each feature.
- Parks must have (but are not limited to) the following features: sand box, water feature, climbing toy, swings, slide, and seating area. Total park area should not exceed 250m by 100m.
- Once students have finished their park design, the teacher can add this scenario: The gas company has to run a pipeline through one of your park features.
- Students must use reflection, rotation, dilation, or translation to accommodate the pipeline and show how it will be accommodated into the plan.

SIMILARITY AND CONGRUENCE

G.2D.1.7: Apply the properties of congruent or similar polygons to solve real-world and mathematical problems using algebraic and logical reasoning.

G.2D.1.8: Construct logical arguments to prove triangle congruence (SSS, SAS, ASA, AAS and HL) and triangle similarity (AA, SSS, SAS).

Evidence of Understanding

Students will use a presentation application, digital camera and data collection application, to incorporate pictures of real life objects that correctly demonstrate triangle congruence and similarity postulates and theorems and verify each by measuring segments and angles.

Digital Tools

- Digital camera
- *Data Collection* - Science Journal, Easy Measure or Smart Measure , Measure, AngleMeter, GeoGebra, CamToPlan, Angle Meter (Google Play)
- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint

In Practice

- Students will photograph real life objects that depict congruent and similar triangles.
- Students will use editing feature of digital camera to highlight the congruent or similar triangles in each picture.
- Students will use the measuring tools to verify each congruence or similarity postulates or theorems.
- Students will create a presentation of their work.

THREE-DIMENSIONAL SHAPES

SURFACE AREA AND VOLUME

G.3D.1.1: Solve real-world and mathematical problems using the surface area and volume of prisms, cylinders, pyramids, cones, spheres, and composites of these figures. Use nets, measuring devices, or formulas as appropriate..

Evidence of Understanding

Students will use 3D design and sketch applications to apply surface area and volume formulas to a Polyhedron Pet they create digitally.

Digital Tools

- *3D Design* - 3DCio, Tinkercad, uMake, GeoGebra
- *Sketch Application*- Sketches School, Notes, ibis, Absolute Board, Google Draw, Notability, Sketchbook

In Practice

- Students will use a sketch application to sketch out a Polyhedron Pet.
- Students will use 3D design to create a pet out of a minimum of 6 polyhedron, spheres, and cylinders. Each pet must include a cone, triangular prism, or any pyramid.
- Once the polyhedron pet has been created digitally, students when then use appropriate formulas to calculate the surface area and volume of the pet they have created.
- Students will record their calculations on their sketch of the pet.

SIMILARITY AND CONGRUENCE

G.3D.1.2: Use ratios derived from similar three-dimensional figures to make conjectures, generalize and to solve for unknown values such as angles, side lengths, perimeter or circumference of a face, area of a face, and volume.

Evidence of Understanding

Students will use everyday household items' measurements to find ratios to sketch a scale model, and find areas and perimeters of each to generalize similarity conjectures.

Digital Tools

- *Note Taking*- Notes, Paper by 53, Book Creator
- *Data Collection* - Science Journal, Easy Measure or Smart Measure , Measure, AngleMeter, GeoGebra, CamToPlan, Angle Meter (Google Play)
- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint
- *Sketch*- Sketches School, Notes, ibis, Absolute Board, Google Draw, Notability, Sketchbook,

In Practice

- Students will bring a household item, i.e., a cereal box, a canister, etc. Using a data collection application, students will measure side lengths, radius, etc.
- Students will decide on a scale to use and convert their measurements according to the scale.
- Students will use a sketch application to create a sketch of the model, using their converted measurements and labeling them on the sketch.
- Students will calculate area and perimeter of a face of their actual object and area and perimeter of a face of their scale drawing.
- Students will share their conclusions using a presentation application.

CIRCLES

PROPERTIES OF CIRCLES

G.C.1.1: Apply the properties of circles to solve problems involving circumference and area, approximate values and in terms of π, using algebraic and logical reasoning.

G.C.1.2: Apply the properties of circles and relationships among angles; arcs; and distances in a circle among radii, chords, secants and tangents to solve problems using algebraic and logical reasoning..

Evidence of Understanding

Using a paper plate as a model, students will create a stop-motion movie demonstrating the properties and relationships of a circle.

Digital Tools

- *Stop Motion*- Stop Motion Studio,Koma Koma , Lego Movie Maker

In Practice

- Students will use a stop motion application to create a stop motion video starring a paper plate.
- Students will model an understanding of the following properties and relationships of a circle: circumference, area, radii, arc, chords, secant, and tangent within the video.

EQUATIONS OF CIRCLES

G.C.1.3: Recognize and write the radius r, center (h, k), and standard form of the equation of a circle with and without graphs.

G.C.1.4: Apply the distance and midpoint formula, where appropriate, to develop the equation of a circle in standard form.

Evidence of Understanding

Students will use a map application and outline a circle of area. Students will use a sketch application to apply the distance and midpoint formula to selected cities.

Digital Tools

- Maps- Google Maps, Apple Maps
- *Sketch Application*- Sketches School, Notes, ibis, Absolute Board, Google Draw, Notability, Sketchbook

In Practice

- Students will use a map tool to circle an area of a map. Students will use a photo of the map and open in a sketch application.
- Students will use the sketch application to draw midpoint and create and solve equations to various locations on the map.

RIGHT TRIANGLES TRIGONOMETRY

APPLICATIONS OF RIGHT TRIANGLES

G.RT.1.1: Apply the distance formula and the Pythagorean Theorem and its converse to solve real-world and mathematical problems, as approximate and exact values, using algebraic and logical reasoning (including Pythagorean Triples).

G.RT.1.2: Verify and apply properties of right triangles, including properties of 45-45-90 and 30-60-90 degree triangles, to solve problems using algebraic and logical reasoning.

G.RT.1.3: Use the definition of the trigonometric functions to determine the sine, cosine, and tangent ratio of an acute angle in a right triangle. Apply the inverse trigonometric functions as ratios to find the measure of an acute angle in right triangles

G.RT.1.4: Apply the trigonometric functions as ratios (sine, cosine, and tangent) to find side lengths in right triangles in real-world and mathematical problems.

Evidence of Understanding

Students will use a presentation application, digital camera, video editor and data collection application to explain and demonstrate the different methods to find missing measures of right triangles.

Digital Tools

- Digital camera
- *Data Collection* - Science Journal, Easy Measure or Smart Measure , Measure, AngleMeter, GeoGebra, CamToPlan, Angle Meter (Google Play)
- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint
- *Video Editor*- Clips, WeVideo, Do-Ink, iMovie

In Practice

- Students will use a digital camera to take a picture representations of right triangles in the real world.
- Student will use a data collection application to find side lengths and angle measures.
- Using a presentation application or video editor, students will create a presentation that incorporates explanations and examples of using Pythagorean Theorem and the converse; special right triangle relationships; sine, cosine, and tangent ratios; solving a right triangle using Pythagorean theorem and trigonometry including the pictures they took.

RESOURCES

TEACHER

- Reasoning in Geometry
- Youtube - Parallel Line Song
- Kahoot!
- Math is Fun - Sine Cosine Tangent
- Schooltube - Gettin Triggy Wit It
- Deductive Reasoning
- Parallel Lines Song
- Cool Math - Interior Angles
- HS Geometry

STUDENT

- GeoGebra Geometry
- GeoGebra Augmented Reality
- Khan Academy
- Photomath