Educating About and With Technology: Empowering Indigenous Students and Communities

Geometry in the Circle of Innovation: Empowering Indigenous Students Through Technology and Cultural Knowledge

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Introduction

This curriculum unit, *"Geometry in the Circle of Innovation,"* explores the intersections of mathematics, technology, and Indigenous cultural knowledge. Centered around the theme of educating about and with technology, the unit focuses on how Geometry — particularly geometric concepts such as angles, symmetry, area, perimeter, and scale — can be applied to real-world contexts that are culturally meaningful to Indigenous communities. Through the lens of Indigenous knowledge systems, students will investigate traditional and modern innovations such as basket weaving, community architecture, and sustainable agricultural designs while incorporating digital tools and applications like GeoGebra, Tinkercad, and mapping technologies.

Students will explore how technology is not only a tool for innovation but also a medium for preservation and empowerment. Geometry will serve as the bridge to critically engage students in exploring community issues such as land use, water conservation, and design of living spaces. They will build scale models of spaces (e.g., community gardens or traditional structures) using both mathematical principles and cultural teachings. This unit positions students as problem-solvers and innovators who can contribute to their communities by honoring Indigenous traditions and using modern tools.

This curriculum unit is designed for 10th-grade students at Dishchii'bikoh Community School, a Bureau of Indian Education (BIE) school located on the Fort Apache Reservation in Arizona. The majority of students are White Mountain Apache and come from rural, tight-knit communities. Many have rich cultural knowledge and traditions passed down through family, but face barriers in accessing and engaging with STEM fields due to systemic educational inequities.

Geometry is typically taught in the second year of high school mathematics. This unit is planned for the second quarter of the academic year (late October through December), a time when foundational concepts such as transformations, angle relationships, and geometric measurement have been introduced. It will span three to four weeks, aligning with Arizona College and Career Ready Standards and culturally relevant standards such as the CRAIS Tool principles.

The unit integrates hands-on learning, technology use, storytelling, and place-based education. It aligns with the broader teaching schedule that emphasizes culturally sustaining pedagogy and STEM integration in response to both state expectations and the needs of the Indigenous communities we serve.

Rationale

The central reason for designing this curriculum unit is to provide students with culturally relevant, technologically integrated, and empowering mathematics instruction. Mainstream STEM education often lacks culturally sustaining practices and does not reflect the lived experiences, knowledge systems, or worldviews of Indigenous communities. By developing a curriculum that merges geometry with Indigenous technology and design, I aim to change this narrative and create learning opportunities that affirm and empower my students.

One major motivation stems from the urgent need to preserve cultural knowledge. Indigenous technologies — such as traditional irrigation systems, weaving patterns, and housing structures — are not just cultural artifacts; they are ingenious, sustainable designs developed through centuries of lived experience and deep knowledge of the environment. These technologies offer valuable insights into mathematics, particularly geometry. For example, traditional basket weaving incorporates symmetry, tessellation, and pattern recognition. Students will explore these mathematical elements while also connecting to their cultural heritage.

Another driving factor is the challenge that Indigenous communities face regarding environmental sustainability and access to resources. For instance, students from Dishchii'bikoh have observed firsthand the difficulties of growing crops in the rocky, arid conditions of northern Arizona. Through the unit, they will analyze sustainable agricultural practices, such as raised bed gardening and water catchment systems, and use geometry to model, design, and optimize solutions.

As a math educator with nearly two decades of experience at Dishchii'bikoh Community School, I bring a deep respect and commitment to Indigenous education, cultural responsiveness, and community collaboration. While I possess strong content knowledge in Geometry and STEM curriculum development, I recognize that my cultural knowledge of Indigenous traditions, especially those specific to White Mountain Apache communities, is limited. I approach this work with humility and openness.

To address this gap, I draw on the community's funds of knowledge — the stories, skills, practices, and lived experiences of students, families, and Elders. Collaborating with local cultural leaders, inviting community members to speak about traditional technologies, and encouraging students to share family stories and ancestral knowledge are key elements of this curriculum. These strategies elevate culturally sustaining practices and shift the power dynamic of learning to include Indigenous voices as authoritative sources.

By implementing this curriculum, I aim to build bridges between academic geometry and Indigenous knowledge systems, creating space for students to see themselves as capable mathematicians, designers, and change makers.

Instructional Guide

Unit Title: Geometry in the Circle of Innovation

Grade Level: 10th Grade
Subject: Geometry
Timeframe: 6 weeks
Theme: Empowering Indigenous Students through Geometry, Technology, and Cultural Knowledge

Unit Purpose

The purpose of this unit is to:

1. Enable students to **understand and apply key geometric concepts** including points, lines, planes, angles, polygons, congruence, similarity, transformations, and measurement.
2. Promote **critical thinking and problem-solving** through culturally relevant projects that integrate Indigenous knowledge with modern technology.
3. Develop students' **digital literacy and innovation skills** using tools like GeoGebra, Tinkercad, Google Earth, and 3D printing.
4. Foster **awareness of the connections between mathematics, culture, and community innovation**, preparing students for real-world applications.

Content Overview

Week	**Focus/Content**
Week 1	Foundations of Geometry: points, lines, planes, angles; digital modeling with GeoGebra; symmetry and cultural patterns
Week 2	Polygons: triangles, quadrilaterals, and other polygons; classification; properties; Tinkercad modeling
Week 3	Congruence and Similarity: triangles and polygons; scaling; design applications in cultural and technological projects
Week 4	Transformations and Coordinate Geometry: reflections, rotations, translations, dilations; plotting coordinates; mapping with Google Earth

Week	Focus/Content
Week 5	Measurement: perimeter, area, surface area, volume; integration with 3D modeling and printing; precise calculations for innovation designs
Week 6	Geometric Proofs and Final Innovation Project: applying proofs, presenting 3D or digital models, reflecting on geometry, technology, and cultural integration

Cultural and Modern Technologies Integration

Category	Examples & Purpose
Cultural Technologies	- Geometric patterns in Apache textiles, beadwork, and architecture - Community structures and culturally relevant designs - Storytelling through geometry and spatial arrangements
Modern Technologies	- **GeoGebra**: 2D modeling, dynamic geometry, transformations - **Tinkercad/CAD**: 3D modeling, scaling, measurement, digital prototyping - **Google Earth**: Coordinate plotting, mapping community/cultural sites, measuring distances and slopes - **3D Printing**: Physical realization of student designs, creating tangible models

Purpose: Students experience the **fusion of traditional knowledge with modern technology**, allowing culturally grounded, hands-on, and digital learning.

***Teaching Strategies and Sequence (6 Weeks*)**

Week 1: Foundations of Geometry & Digital Exploration

Teaching Strategies:

- **Direct instruction**: Introduce points, lines, planes, angles, and notation.
- **Modeling with GeoGebra**: Show how to construct elements digitally.
- **Cultural connection discussion**: Identify geometric patterns in Apache art.
- **Interactive exploration**: Students manipulate points/lines digitally.

Sequence:

1. Introduce geometric elements on paper and digitally.
2. Explore symmetry and angles in cultural patterns.
3. Assign digital exercises in GeoGebra.
4. Reflective journaling on cultural and technological observations.

Week 2: Polygons and Properties

Teaching Strategies:

- **Hands-on construction**: Use sticks, straws, or cardboard to construct polygons.
- **Digital modeling**: Use Tinkercad to create polygons.
- **Collaborative learning**: Work in groups to explore properties.
- **Inquiry-based questions**: How do properties of polygons affect design and innovation?

Sequence:

1. Classify triangles and quadrilaterals.
2. Construct polygons physically and digitally.
3. Explore polygon properties (angles, sides, diagonals).
4. Apply polygons in preliminary design sketches.

Week 3: Congruence, Similarity, and Scale

Teaching Strategies:

- **Demonstration**: Show congruence (SSS, SAS, ASA, AAS) and similarity (AA, SAS, SSS) digitally and on paper.
- **Guided practice**: Students manipulate shapes in GeoGebra and Tinkercad.
- **Project-based learning**: Begin innovation project with scaled, congruent, and similar shapes.

Sequence:

1. Teach congruence and similarity concepts.
2. Apply scaling in Tinkercad models.
3. Students start designing cultural or technological objects.
4. Peer feedback and iteration on design.

Week 4: Transformations and Coordinate Geometry

Teaching Strategies:

- **Direct instruction & modeling**: Introduce reflections, rotations, translations, dilations.
- **Technology integration**: Plot points and transformations in GeoGebra; map spaces with Google Earth.
- **Collaborative exploration**: Apply transformations to design prototypes.

Sequence:

1. Teach transformations using GeoGebra.
2. Students plot coordinates for models and calculate distances/slopes.
3. Integrate transformations into design projects.
4. Peer review and revision.

Week 5: Measurement and 3D Modeling

Teaching Strategies:

- **Hands-on calculations**: Measure perimeter, area, surface area, and volume.
- **Digital application**: Use Tinkercad to validate measurements in 3D.
- **3D printing**: Prepare models for printing; discuss scaling and material limitations.

Sequence:

1. Review measurement formulas.
2. Apply to student-designed 3D models.
3. Begin 3D printing or create physical prototypes.
4. Reflection on accuracy, scaling, and real-world application.

Week 6: Geometric Proofs and Final Project Presentation

Teaching Strategies:

- **Model proofs**: Two-column and paragraph proofs for congruence, similarity, or transformations.
- **Project-based learning**: Complete innovation project with all geometric, technological, and cultural elements.
- **Presentation & reflection**: Students present projects; reflect on learning.

Sequence:

1. Construct geometric proofs for project components.
2. Complete final 3D or digital models.
3. Prepare presentations (slides, models, cultural context).
4. Showcase projects and submit reflections.

Summary

Key Integration Points:

- **Cultural knowledge** informs design choices, patterns, and geometry in the innovation projects.
- **Technology** (GeoGebra, Tinkercad, Google Earth, 3D printing) allows visualization, measurement, scaling, and real-world application.
- **Project-based and collaborative strategies** foster creativity, critical thinking, and empowerment.
- **Sequence** moves from foundations → polygons → congruence/similarity → transformations → measurement → proofs/final project.

Purpose

The unit's primary goal is to empower students to use geometric principles to explore, preserve, and innovate using both traditional Indigenous knowledge and modern technology. It reinforces critical thinking, spatial reasoning, and mathematical modeling in culturally meaningful contexts.

Content Overview

- Geometry topics: Angles, Symmetry, Tessellations, Area, Perimeter, Scale Drawing, Surface Area, Volume
- Cultural technologies: Traditional structures, basket weaving, irrigation systems
- Modern technologies: GeoGebra, Tinkercad, Google Earth, 3D printing

Culturally Sustaining Practices

Culturally sustaining pedagogy (Paris & Alim, 2017) undergirds the unit by positioning Indigenous culture as a vital and dynamic source of learning. Activities incorporate community assets, validate Indigenous STEM practices (Lomawaima & McCarty, 2006), and promote critical consciousness.

Classroom norms emphasize relational accountability and respect, drawing on Indigenous epistemologies (Brayboy et al., 2012). Student voice and collaboration are central, allowing learners to shape the content and direction of projects.

Teaching Plan

Unit Title: Geometry in the Circle of Innovation

Grade Level: 10th Grade
Subject: Geometry
Timeframe: 6 weeks
Theme: Integrating geometry, technology, and Indigenous knowledge for innovation and empowerment

Unit Goals:

1. Understand and apply geometric concepts (points, lines, planes, angles, polygons, congruence, similarity, transformations, and measurement).
2. Use digital tools (GeoGebra, Tinkercad, Google Earth, 3D printing) to model, visualize, and explore geometric structures.
3. Connect Indigenous cultural knowledge and technological innovation to geometric reasoning.
4. Solve real-world and culturally relevant problems using geometry and technology.

Standards Alignment:

- **G-CO:** Congruence, transformations, proofs
- **G-SRT:** Similarity, right triangles, trigonometry
- **G-GPE:** Coordinate geometry
- **G-MG/G-GMD:** Modeling with geometry, measurement of 2D/3D shapes

Week 1: Foundations of Geometry & Digital Tools

Focus: Points, Lines, Planes, Angles; Introduction to Digital Geometry

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 1	Introduce points, lines, planes, angles; notation	Students draw points, lines, angles on paper; identify them in classroom structures	Graph paper, rulers, colored pencils	Exit ticket: Draw and label 3 points, 2 lines, 1 plane, 1 angle
Day 2	Demonstrate GeoGebra for creating points, lines, and angles	Students replicate Day 1 activity digitally; move points to see changes dynamically	Computers/tablets, GeoGebra	Teacher observation: Correct use of GeoGebra

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 3	Introduce angle types (acute, obtuse, right, straight)	Students classify angles in Apache art patterns; create digital representations	GeoGebra, images of Indigenous art	Formative: Angle classification worksheet
Day 4	Discuss relationships between angles (complementary, supplementary, vertical, adjacent)	Students solve problems digitally and on paper; identify angles in cultural patterns	GeoGebra, paper, rulers	Exit ticket: Identify angle relationships
Day 5	Reflection: Geometry in technology and culture	Students journal examples of geometry in everyday technology and Indigenous innovation	Journals, computers/tablets	Reflection check

Week 2: Polygons and Properties

Focus: Polygons, Triangles, Quadrilaterals, and Classification

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 6	Review polygon definitions, sides, angles; introduce Tinkercad for digital modeling	Students create polygons digitally; measure sides and angles	Computers/tablets, Tinkercad	Exit ticket: Identify polygon types
Day 7	Discuss triangle types and properties; introduce triangle inequality	Students build triangles physically and digitally; classify by sides and angles	Sticks, straws, Tinkercad	Formative: Triangle classification check
Day 8	Introduce quadrilaterals; properties and classification	Students construct quadrilaterals in Tinkercad; identify properties	Tinkercad, rulers	Worksheet: Quadrilateral properties
Day 9	Introduce polygons in innovation design	Students design a cultural or	Tinkercad, design sketches	Peer review of designs

Day	Teacher Input	Activities	Materials/Tech	Assessment
		technological object using polygons		
Day 10	Review polygons and integrate GeoGebra	Students model polygons with dynamic software and analyze angles/sides	GeoGebra, Tinkercad	Quiz: Polygons, triangles, quadrilaterals

Week 3: Congruence, Similarity, and Scale Models

Focus: Triangle Congruence, Similarity, Scaling

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 11	Review congruence criteria (SSS, SAS, ASA, AAS)	Students test triangle congruence digitally and physically	GeoGebra, sticks	Exit ticket: Identify congruence
Day 12	Discuss similarity (AA, SAS, SSS)	Students scale triangles in Tinkercad or GeoGebra; calculate side ratios	Tinkercad, GeoGebra	Formative: Similarity problem set
Day 13	Application in design	Students create a scaled object (lamp, structure, device) showing similarity	Tinkercad, cardboard/straws	Teacher observation
Day 14	Integrate 3D modeling	Students begin digital 3D model of project using Tinkercad	Computers/tablets, Tinkercad	Formative: Model progress check
Day 15	Reflection and peer feedback	Students present model sketches; peers comment on congruence and similarity	Tinkercad, projector	Peer review rubric

Week 4: Transformations and Coordinate Geometry

Focus: Reflections, Rotations, Translations, Dilations; Coordinate Geometry

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 16	Introduce transformations and coordinate plane concepts	Students perform reflections, rotations, translations on GeoGebra	GeoGebra	Exit ticket: Transformation identification
Day 17	Discuss dilations and similarity transformations	Students apply dilations to their design projects digitally	GeoGebra, Tinkercad	Teacher observation
Day 18	Distance, midpoint, slope in coordinate geometry	Students calculate distances, midpoints, and slopes in project models	GeoGebra, calculators	Exit ticket: Coordinate calculations
Day 19	Real-world application using Google Earth	Students map community or cultural sites; identify shapes, angles, distances	Computers, Google Earth	Formative: Mapping accuracy check
Day 20	Peer review and refine transformations	Students adjust digital designs based on feedback	GeoGebra, Tinkercad	Peer rubric check

Week 5: Measurement, Surface Area, and Volume

Focus: Area, Perimeter, Surface Area, Volume; Integrating 3D Printing

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 21	Review formulas for area, perimeter, surface area, and volume	Students calculate measurements of project shapes	Rulers, calculators, GeoGebra	Exit ticket: Measurement problems
Day 22	Measurement applied to 3D models	Students measure Tinkercad 3D designs;	Tinkercad, calculators	Teacher observation

Day	Teacher Input	Activities	Materials/Tech	Assessment
		calculate surface area and volume		
Day 23	Prepare 3D print files	Students refine 3D models for printing; check measurements	Tinkercad, 3D printer	Formative check: Print-ready models
Day 24	Optional 3D printing	Students begin printing models; continue digital refinement	3D printer, Tinkercad	Observation: Model completeness
Day 25	Reflection on geometric measurement	Students journal about accuracy of measurements and design improvements	Journals, computers	Reflection rubric

Week 6: Geometric Proofs, Innovation Showcase, and Reflection

Focus: Proofs, Justification, Final Presentations

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 26	Introduce two-column and paragraph geometric proofs	Students create proofs for congruence, similarity, or transformation in projects	Graph paper, computers	Teacher observation
Day 27	Apply proofs to final project	Students justify design choices mathematically and digitally	Tinkercad, GeoGebra	Formative check
Day 28	Peer review and final edits	Students present models; peers provide feedback	Projector, tablets	Peer review rubric
Day 29	Final showcase	Students present 3D-printed or digital models; explain geometry, technology, and cultural relevance	3D prints, Tinkercad, GeoGebra	Summative rubric: creativity, accuracy, technology integration

Day	Teacher Input	Activities	Materials/Tech	Assessment
Day 30	Reflection and evaluation	Students write reflection connecting geometry, innovation, and Indigenous knowledge	Journals, computers	Reflection rubric

Innovative Materials & Technology:

- **GeoGebra:** 2D constructions, transformations, coordinate geometry
- **Tinkercad/CAD Software:** 3D modeling for scaled structures and designs
- **Google Earth:** Mapping community and cultural sites, identifying shapes
- **3D Printing:** Physical prototypes of student projects
- **Hands-on Materials:** Cardboard, clay, sticks, straws for model-building
- **Digital Presentation Tools:** Google Slides, Canva for project showcase

Assessment Summary:

- **Formative:** Daily exit tickets, worksheets, observations, peer feedback
- **Summative:** Quizzes on polygons, transformations, coordinate geometry, measurement, similarity/congruence; final 3D innovation project
- **Reflection:** Journals on technology, geometry, and Indigenous cultural connections

Student Project Guide: Geometry in the Circle of Innovation

Project Title: Innovating Geometry: Designing with Technology and Culture

Objective:
Design a **3D or digital model of an innovative structure or object** that incorporates **geometric principles**, **technology**, and **Indigenous cultural elements**. Justify all geometric choices through **proofs, calculations, and transformations**.

Project Requirements:

1. **Geometric Concepts:**
    - Include **points, lines, planes, angles, polygons, congruence, similarity, and transformations** in your design.
    - Demonstrate **measurements**: perimeter, area, surface area, volume (if applicable).
    - Apply **coordinate geometry** for placements, distances, midpoints, or slopes.
2. **Technology Integration:**
    - Use **GeoGebra** for 2D modeling and transformations.
    - Use **Tinkercad or CAD software** for 3D modeling of your structure.

    - Optional: Use **Google Earth** to map locations or spaces related to your design.
    - Optional: **3D print** your model or create a physical prototype with materials like cardboard, clay, or sticks.
3. **Cultural Integration:**
    - Include elements inspired by **Indigenous knowledge, Apache art, or cultural structures**.
    - Explain the cultural significance in your project presentation or reflection.
4. **Mathematical Justification:**
    - Provide **geometric proofs**: congruence, similarity, or transformation properties.
    - Include calculations for **angles, lengths, perimeters, areas, surface area, or volume** as applicable.
    - Clearly label all geometric components in your model.
5. **Presentation:**
    - Submit a **digital or physical model**.
    - Prepare a **short presentation (3–5 minutes)** explaining:
        - The geometric concepts used
        - Technology integration
        - Cultural inspiration
        - Real-world application

Project Timeline:

- **Week 3:** Begin preliminary sketches and explore GeoGebra/Tinkercad.
- **Week 4:** Start digital 3D modeling; apply transformations and similarity/congruence.
- **Week 5:** Complete measurements, calculations, and prepare 3D print or physical model.
- **Week 6:** Peer review, finalize model, and prepare presentation/reflection.

Grading Rubric: Geometry in the Circle of Innovation Project

Criteria	Excellent (4 pts)	Proficient (3 pts)	Developing (2 pts)	Beginning (1 pt)
Geometric Accuracy	All geometric concepts (points, lines, planes, angles, polygons, congruence, similarity, transformations) are correctly applied and clearly labeled	Most geometric concepts correctly applied with minor errors	Some geometric concepts applied; errors affect understanding	Few or incorrect geometric concepts; unclear or missing labels

Criteria	Excellent (4 pts)	Proficient (3 pts)	Developing (2 pts)	Beginning (1 pt)
Technology Integration	Project uses 2+ tools (GeoGebra, Tinkercad, Google Earth, 3D printing) effectively to enhance design	Project uses 1–2 tools appropriately with minor issues	Project uses technology minimally; some aspects unclear	Project lacks technology integration or is incomplete
Cultural Connection	Design strongly reflects Indigenous knowledge or cultural elements; explanation clear and meaningful	Design includes cultural elements; explanation adequate	Cultural elements minimal; explanation unclear	No clear cultural connection or explanation
Mathematical Justification	All calculations, measurements, and proofs are correct and well-explained	Most calculations/proofs are correct; minor errors	Some calculations/proofs correct; explanation limited	Calculations/proofs incorrect, incomplete, or missing
Creativity & Innovation	Design is highly creative, original, and innovative	Design shows creativity; somewhat original	Design shows limited creativity; predictable	Design lacks creativity or effort
Presentation & Communication	Clear, organized, professional; explains geometry, technology, and culture effectively	Presentation clear; covers most elements	Presentation partially clear; missing some elements	Presentation unclear, disorganized, or incomplete
Reflection	Thoughtful reflection connecting geometry, technology, and culture; insights evident	Reflection adequate; connects most elements	Reflection limited; superficial connection	Reflection missing or does not connect concepts

Total Points: 28

Grade Scale:

- 26–28 = A
- 22–25 = B
- 18–21 = C
- 14–17 = D
- Below 14 = F

Teacher Notes:

- Encourage students to **iterate designs digitally** before final 3D printing or building.
- Emphasize **mathematical reasoning** alongside creativity.
- Allow collaboration but require **individual reflection**.
- Provide **checkpoints weekly** for sketches, digital models, and calculations.

Student Project Checklist & Submission Template
Project Title: ____________________________

Student Name: ____________________________
Date Submitted: ____________________________

Part 1: Preliminary Sketches

- ☐ Hand-drawn sketches of design ideas
- ☐ Labeled **points, lines, planes, angles, and polygons**
- ☐ Indicate **triangles, quadrilaterals, or other polygons used**
- ☐ Identify **congruence and similarity relationships**

Teacher Tip: Take a photo or scan your sketches for digital submission.

Sketches Attached: ☐ Yes ☐ No

Part 2: Digital 2D Model (GeoGebra/Desmos)

- ☐ Points, lines, and angles represented digitally
- ☐ Polygons constructed and labeled
- ☐ Transformations (reflections, rotations, translations, dilations) applied

- ☐ Screenshot(s) of your digital model included

Teacher Tip: Make sure all labels are clear in the screenshot.

Screenshots Attached: ☐ Yes ☐ No

Part 3: 3D Model (Tinkercad or CAD Software)

- ☐ 3D model reflects design concept
- ☐ Includes polygons, congruence, similarity, and transformations
- ☐ Measurements calculated (perimeter, area, surface area, volume)
- ☐ Screenshots of multiple views of the 3D model
- ☐ Optional: 3D-printed model attached or photographed

Teacher Tip: Check dimensions before printing; include scale if physical model.

Screenshots/3D Print Attached: ☐ Yes ☐ No

Part 4: Coordinate Geometry

- ☐ Key points plotted on coordinate plane
- ☐ Distances, midpoints, and slopes calculated
- ☐ Label points clearly on model or diagram

Teacher Tip: Use GeoGebra or graph paper; include formulas and calculations.

Calculations Attached: ☐ Yes ☐ No

Part 5: Geometric Proofs

- ☐ Two-column or paragraph proofs included
- ☐ Justify congruence, similarity, or transformations used in the design
- ☐ All steps clearly explained

Teacher Tip: Reference specific sides, angles, or polygons from your model.

Proof Attached: ☐ Yes ☐ No

Part 6: Cultural Connection

- ☐ Explain how your design reflects **Indigenous knowledge, Apache culture, or community inspiration**
- ☐ Include images or references if applicable
- ☐ Discuss cultural significance of geometric patterns or structures

Teacher Tip: Be specific about patterns, shapes, or cultural elements used.

Cultural Connection Attached: ☐ Yes ☐ No

Part 7: Reflection

- ☐ Describe how **geometry influenced your design**
- ☐ Explain **how technology helped visualize or create the model**
- ☐ Share insights about **connections between math, innovation, and Indigenous culture**

Teacher Tip: Write 1–2 paragraphs; include personal learning and design challenges.

Reflection Attached: ☐ Yes ☐ No

Part 8: Final Presentation

- ☐ Digital presentation (Google Slides, Canva, or similar) prepared
- ☐ Includes sketches, digital model screenshots, 3D model images, proofs, calculations, and cultural notes
- ☐ Practice 3–5 minute oral presentation to class

Teacher Tip: Include captions on all slides for clarity.

Presentation Ready: ☐ Yes ☐ No

Submission Checklist Summary

Component	Completed (☑)	Notes
Preliminary Sketches	☐	
Digital 2D Model	☐	

Component	Completed (☑)	Notes
3D Model	☐	
Coordinate Geometry	☐	
Geometric Proofs	☐	
Cultural Connection	☐	
Reflection	☐	
Presentation	☐	

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