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Geometric Reasoning

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UbD- Geometric Reasoning

(About 13 class days)

Stage 1 – Desired Results

Established Goals

G.3.D *Use inductive reasoning to formulate conjecture*

G.3.E *Use deductive reasoning to prove a statement*

G.3.B. *Use logical reasoning to prove statements are true and counterexamples to disprove statements that are false*

G.2.B. *Make conjectures about angles, lines, polygons, circles, and three-dimensional figures and determine the validity of the conjectures*

G.5.B. *Use numeric and geometric patterns to make generalizations about geometric properties, including …angle relationships in polygons and solids*

G.3.A. *Determine the validity of a conditional statement, its converse, inverse, and contrapositive*

Transfer

Students will independently use their learning to…

Use logical reasoning in problem solving for school related disciplines.
Use logical reasoning in problem solving in their own lives.

Meaning

Understandings

Students will understand that….

There are mathematical ways of thinking that can be applied outside of math class.

Proving something means knowing without a doubt it is true and having the justification to back it up.

Logical reasoning is a tool you can use to build confidence and support for your beliefs.

Correct reasoning is the universal language of truth and facts.

Essential Questions

How can you use your own experiences to make sense of the world?

How do you know when you are right?

How can you convince others that your conclusions are correct?

Acquisition

Knowledge

Students will know…

- The difference between inductive and deductive reasoning
- The difference between valid and invalid reasoning

Vocabulary:

- Inductive Reasoning
- Deductive Reasoning
- Proof
- Hypothesis
- Conclusion
- Conditional Statement
- Biconditional Statement
- Valid/Invalid
- True/False
- Given/ Therefore
- Justification
- Evidence
- Logic
- Conjecture
- Counterexample
- Theorem

Skills

Students will be able to…

- Use inductive reasoning to identify and continue patterns
- Determine if a (bi)conditional statement is true or false
- Write and manipulate conditional statements
- Find a counterexample to disprove a statement
- Support any argument with justification
- Write/complete a geometric proof

	• Postulate • Converse • Inverse • Contrapositive	

Stage 2 – Evidence

CODE (M or T)	**Evaluative Criteria** (for rubric)	
Transfer	Accuracy based on rubric	Performance Task(s) *Students will demonstrate meaning-making and transfer by…* <u>Fairy Tale Debate</u> Students will be in groups of four to six, and each group will choose a fairy tale (Hansel & Gretel, Three Little Pigs, etc).Then groups will then divide into two sides: the protagonists and the antagonists. In a debate in front of the class, each side must then make a case for why the character was justified in acting the way they did. Debates must include essential aspects of logic and reasoning as outlined in the rubric. (See rubric below.)
Meaning	Completion & Accuracy Completion Completion Accuracy	--- Other Evidence (e.g., formative) Class assignments Warm-ups Exit slips Two tests (Standards-based grading- material is divided into "topics" and graded on 1-5 scale. Each topic is tested twice with highest grade in the gradebook.)

Stage 3 – Learning Plan

CODE (A, M, T)	Pre-Assessment *How will you check students' prior knowledge, skill levels, and potential misconceptions?* Before the unit, students will be asked to respond to the essential questions for the unit.	
A & M	**Learning Activities** **<u>Day 1: Concept Attainment</u>** **Anticipatory Set (15 min):** Pairs of students will be given iPads/netbooks and directed to the website http://www.plastelina.net/ Then, students will click on the "Cannibals & Missionaries" Game. Pairs of students will be given time to try to transport the cannibals and missionaries to the other side of the river without any being eaten. The class will have a conversation about the thought process that students went through in trying to solve the game. Then, the teacher will introduce the idea of logic and reasoning as a mathematical tool if the	Progress Monitoring

	students did not bring it up on their own. *Idea generated from a lesson by Melanie Davidson; Lee High School; San Antonio, TX	
	Concept Attainment (15 min): Students will be told beforehand that there are two different types of reasoning. Groups of students will be given a set of statements and asked to try to categorize the statements into the two different types of reasoning by looking for similarities. Once they have all of their statements into two groups, groups will be asked to write down what they believe characterizes each group. Finally, each group will have to create one additional example that would fit into each category.	Check student's categories
	Debrief (15 min) As a class, students will define what characterizes each group, and check their answers with other groups. The teacher will then name each group as inductive reasoning and deductive reasoning. Then, as an application/practice, the teacher will show a clip of Sherlock (Series 1, Episode 1: A Study in Pink 18:00 min- 21:00 min) and have students identify different examples of inductive and deductive reasoning	Student Handout for Sherlock Holmes Practice
A	**<u>Day 2: Direct Instruction</u>** **Anticipatory Set (8 min):** A warm-up will be on the board where students will be asked to draw the next item in a geometric pattern. Then, they will have to decide if they used inductive or deductive reasoning to find the answer. **Presentation of New Material (15 min):** Today the class will focus on inductive reasoning. Yesterday, the class saw how inductive reasoning could be seen outside of class such as in the movie Sherlock Holmes. Today, we will discover what it looks like inside of the context of geometry.	
	Students will then take notes on using inductive reasoning to complete patterns, formulate conjectures (including writing an algebraic rule for different geometrical patterns), and using counterexamples to disprove statements.	Check and grade student work
A	**Guided Practice/Individual Practice (27 min)** Students will work with a partner to answer questions regarding inductive reasoning.	
	<u>Day 3: Direct Instruction/Inductive</u> **Anticipatory Set (5 min):** The warm-up will be a picture of a funny Venn diagram. Students will be asked to write a few sentences describing what they can conclude from the Venn diagram. **Presentation of New Material (10 min):** In sharing student descriptions from the warm-up, the teacher will introduce the idea of a conditional statement and its different pieces (hypothesis & conclusion). The teacher will demonstrate how to write a conditional statement using a Venn diagram.	Grade work in notebook
	Guided/Individual Practice (15 min): Students will choose a Venn	

A	diagram from the selection offered by Ms. Baxter. They will have to write three *true* conditional statements, underline the hypothesis once and the conclusion twice. *__enrichment__: for faster students, the teacher will hand them a set of conditional statements and ask them to draw the Venn diagram that would go along with it. **Concept Formation (10 min):** The teacher will give the students a list of conditional statements (now not related to a Venn diagram). Each group will be in charge of deciding whether or not 4 conditional statements are true or false. If it is false, the students should think of a counterexample. **Interpretation of Data (10 minutes):** Once groups are done with their conditional statements, they will write their responses on the board. Then the class will begin the process of using their data to determine the significance of the following vocabulary words: converse, inverse, contrapositive. Also, discovering the relationship of their truth values.	Discussion of group's answers
T & M	**<u>Day 4: Inductive Continued</u>** **Application/ Warm-up (10 min):** Students will be given four conditional statements and asked to determine the validity of each one. If they deem one false, they also need to provide a counterexample. **STATION 1 (15 min): Law of Syllogism** Students will complete a short handout on the law of syllogism. This handout will introduce the topic using the story "If you give a mouse a cookie." It will ask students to make conclusions given an example of the law of syllogism. Last, it will ask students to create their own silly syllogism. *Idea generated from a lesson by Melanie Davidson; Lee High School; San Antonio, TX. **STATION 2 (15 min): Biconditional Statement** Students will read brief notes about biconditional statements. Then they will be asked to determine if certain biconditional statements are true. Last, they will be asked to write a biconditional statement of their own given certain conditional statements. **Review:** Short review over material that will be on tomorrow's test.	Check student work in notebook for both stations Grade Test
T & M	**<u>Day 5: Test and Fairy Tale Debate Intro</u>** Students will take a test over old material and new material. New material will include: **Inductive & Deductive Reasoning (Test 1):** the difference the two, identifying patterns & conjectures, and finding counterexamples **Conditional Statements (Test 1):** Determining the truth value of a conditional statement (or biconditional statement), law of syllogism, and writing conditional statements from Venn diagrams. After the test, the teacher will introduce the Fairy Tale Debate Project and show a completed example to help students brainstorm.	Circulate & Check for under-standing
	<u>Day 6: Work Day</u>	

	The teacher will help students create a document in their google drive. Then she allow students time to work on their fairy tale debate persuasive speech. **<u>Day 7: Work Day/Presentation Day</u>** **Warm-up**: Students will share a few examples that they have so far in order to help others generate ideas. Then students will be given more time to work on their fairy tale debate speeches.	Listen to and Grade Speeches
T & M	Towards the end of class, if most students are done, the class may begin delivering their speeches. The class will act as a jury and vote on who is guilty and who is innocent. Innocent character pictures will be placed on a picture of a dream island, guilty character pictures will be placed in a picture of a jail. (It should be stated that innocent/guilty characters will not affect a student's grade, only the logic they used in their argument).	Discussion based check for under-standing
	<u>Day 8: Direct Instruction</u> Students will finish their fairy tale debate speeches. After the speeches, the teacher will lead a debrief where students get to describe what was easy and challenging about the experience. Also, the teacher will bring back the essential questions for the unit and ask students to respond now that they are almost done with the logic and reasoning chapter. Now that students have practiced using reasoning to prove their characters' innocence, we will try to transfer that learning into how to prove a mathematical statement is true.	
A	**Presentation of New Material:** The teacher will show a picture on the board of lines and angles. She will let the students know that one angle is 60 degrees and ask the students to explain how they know a different angle is 120 degrees in a Think-Pair-Share. As students share out their explanations, the teacher will write what they are saying in a two-column style proof (I know… because…).	
	Depending on the amount of time left, the teacher will show one or two more proofs together, then she will begin guided practice.	Check student answers
	<u>Day 9: Direct Instruction Continued</u> **Warm-up/Presentation of New Material continued (10 min):** With the teacher's help, students will complete a geometric proof together.	Student work in notebooks
A & M	**Guided Practice (12 min):** Students will be given three completed proofs that are cut into steps and rearranged. Their job will be to rearrange the proof into the correct order. **Individual Practice (25 min):** Students will be asked to complete four geometric proofs individually. ***enrichment:** Students who finish early or who show they understand easily, will be given an example of a more technical geometry proof. Then they will be asked to try to solve one on their own/with a group.	Origami Paper Handout
	<u>Day 10: Direct Instruction Continued</u>	

A	**Warm-up (10 min):** Students will each be given a sheet of Origami Paper/ Patty paper. The teacher will help the students fold the paper in a specific way. She will also indicate to the students how to label specific angles in the paper. **Individual Practice (35 - 40 min):** Students will practice using two column proofs to prove the measure of every angle on the origami paper.	Grade Test
A	**<u>Day 11: Review & Test Day</u>** Students will spend time reviewing old material and preparing for the upcoming test. **Old Material:** **Inductive & Deductive Reasoning (Test 2)** **Conditional Statements (Test 2)** **New Material:** **Geometry Proofs (Test 1)**	
	<u>Day 12: Inductive</u> **Warm-up (5 min):** Students will complete a visualpatterns.org pattern completion and conjecture. **Concept Formation (5 min):** Students will be given a proof as a warm-up that has an algebra equation in it. As students work on solving the proof, they will probably get stuck when it comes to the reasoning behind solving the algebra equation. The teacher will lead a think-pair-share in which the students will brainstorm the exact reasons behind each step in an algebraic equation. **Interpretation of Data (10 min):** Students will be given a list of specific algebraic properties. They will be asked to look through the list and put a star next to ones that they remember and put a question mark next to ones that confuse them. The teacher will then ask the students if they have any questions about the ones with the question mark next to them. After this, the class will finish the proof from earlier together using the properties on the list. **Application of Principals (15 min):** The teacher will complete one more example with the class to check for understanding and help answer any questions. Then, students will be asked to use a white board and a marker to complete examples of these types of proofs with a partner. **Exit Slip (10 min):** Students will be asked to complete one example of these proofs on their own.	Check students annotation Circulate & check student work Grade exit slip
	<u>Day 13: Flex Day</u> Things usually don't go as planned, so the teacher should use this flex day anywhere in the unit where she feels the students need more time or practice. ***Note:** Geometry Proofs (Test 2) will occur in the midst of the new chapter.	