How Big? How Far?

Overview

In science we often make models of the things that we study. We need these models for many reasons including that the real object is too big or too small for us to use. One problem we encounter is that as soon as we make a model, the model is not exactly like the real object. The Giant Moon map is a Mollweide projection of the surface of the Moon. There are many kinds of map projections. The Mollweide was chosen in order to minimize distortion at the poles. It is important to remember that any map is a flat object that shows the features of a ball. The size of the object is only part of creating a model of a system. We are also concerned with its size relative to other parts of the system as well as the scale distances. A good model helps scientists learn new things.

Engagement

A globe is a scale model of a spherical object. A map is a flat representation of a globe. When you try to represent something spherical on a flat surface there will be distortion. Many different map projections have been created to minimize this distortion. Find examples of different kinds of map projections in order to discover how they are used.

Exploration

Take the Lunar Pro globe, or any moon globe, and orient the globe to the Mollweide Moon map projection as you stand on the Giant Moon Map. Identify locations on the globe and the corresponding location on the flat map.

Explanation

- How big would a Moon globe need to be in order to have a one-to-one size relationship with the flat map, Mollweide projection? Develop a mathematical strategy, determine the size necessary, and prepare to explain how you did your calculations.
- If the Moon were the size you just calculated, how big would an Earth globe need to be in order to be in scale to the Moon globe? Develop a mathematical strategy, determine the size necessary, and prepare to explain how you did your calculations.
- Given the Moon and Earth the size you have calculated, what is the scale distance between them?

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Extension

- Create a scale Earth/Moon system that accounts for scale size, scale distance, and movement.
- Prepare a diagram to explain your strategies, the scale size, the scale distance and the movement of the Moon in relation to the Earth.

Evaluation

A rubric has been prepared to assist the teacher in evaluating the project.This rubric is based on revised NCTM standards.

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Exemplars® Classic 5-Level Math Rubric

	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Novice	No strategy is chosen, or a strategy is chosen that will not lead to a solution. Little or no evidence of engagement in the task present.	Arguments are made with no mathematical basis. No correct reasoning nor justification for reasoning is present.	No awareness of audience or purpose is communicated. or Little or no communication of an approach is evident or Everyday, familiar language is used to communicate ideas.	No connections are made.	No attempt is made to construct a mathematical representation.
Apprentice	A partially correct strategy is chosen, or a correct strategy for only solving part of the task is chosen. Evidence of drawing on some previous knowledge is present, showing some relevant engagement in the task.	Arguments are made with some mathematical basis. Some correct reasoning or justification for reasoning is present with trial and error, or unsystematic trying of several cases.	Some awareness of audience or purpose is communicated, and may take place in the form of paraphrasing of the task. or Some communication of an approach is evident through verbal/written accounts and explanations, use of diagrams or objects, writing, and using mathematical symbols. or Some formal math language is used, and examples are provided to communicate ideas. Note: The following are not assessed: • Numbers and their names (i.e., 5, five, etc.) • Verbs	Some attempt to relate the task to other subjects or to own interests and experiences is made.	An attempt is made to construct a mathematical representation to record and communicate problem solving.

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			(i.e., counted, divided, etc.) • Generic symbols (+, –, ×, ÷, =)		
Practitioner	A correct strategy is chosen based on mathematical situation in the task. Planning or monitoring of strategy is evident. Evidence of solidifying prior knowledge and applying it to the problem solving situation is present. Note: The Practitioner must achieve a correct answer.	Arguments are constructed with adequate mathematical basis. A systematic approach and/or justification of correct reasoning is present. This will lead to connections.	A sense of audience or purpose is communicated. and/or Communication of an approach is evident through a methodical, organized, coherent sequenced and labeled response. Formal math language is used throughout the solution to share and clarify ideas. Note: The following are not assessed: • Numbers and their names (i.e., 5, five, etc.) • Verbs (i.e., counted, divided, etc.) • Generic symbols (+, –, ×, ÷, =)	Mathematical connections or observations are recognized. Some examples may include, but are not limited to: • clarification of the task. • exploration of mathematical phenomenon. • noting patterns, structures and regularities.	An appropriate and accurate mathematical representation(s) is constructed and refined to solve problems or portray solutions.
Expert	An efficient strategy is chosen and progress towards a solution is evaluated. Adjustments in strategy, if necessary, are made along the way, and/or alternative strategies are considered. Evidence of	Deductive arguments are used to justify decisions and may result in formal proofs. Evidence is used to justify and support decisions made and conclusions reached. This will lead to connections.	A sense of audience and purpose is communicated. and/or Communication at the Practitioner level is achieved, and communication of argument is supported by mathematical properties. Precise math language and symbolic notation	Mathematical connections or observations are used to extend the solution to other mathematics or to a deeper understanding of mathematics. Some examples may include, but are not limited to: • testing and accepting or rejecting of a	An abstract or symbolic mathematical representation(s) is constructed to analyze relationships, and to clarify or interpret phenomenon.

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	analyzing the situation in mathematical terms, and extending prior knowledge is present. Note: The Expert must achieve a correct answer.		are used to consolidate math thinking and to communicate ideas. Note: The following are not assessed: • Numbers and their names (i.e., 5, five, etc.) • Verbs (i.e., counted, divided, etc.) • Generic symbols (+, –, ×, ÷, =)	hypothesis or conjecture. • explanation of phenomenon. • generalizing and extending the solution to other cases.	