**Subject area/course**: Science/Physics

**Grade level/band**: 11-12

**Task source**: Educational Policy Improvement Center (EPIC)

**Archaeological Imaging**

**STUDENT INSTRUCTIONS**

1. **Task context**:

Recently, a small hidden chamber has been discovered in the Great Pyramid of Giza in Egypt. The hidden chamber is located near the capstone of the pyramid. The chamber was discovered when a hidden entrance was revealed in an airshaft that led from the King’s chamber to the outside of the pyramid.

Your research advisor has secured a grant to use Ground Penetrating Radar (GPR) on other pyramids in the hopes of determining if there are other previously undiscovered chambers. Ground Penetrating Radar is a nondestructive method that uses electromagnetic radiation to image the subsurface. This technique can detect objects, voids, changes in material, and cracks in the sub terrain. Due to concerns for the preservation of the pyramid, your expedition leader has decided to take a GPR system and push the system up the side of the pyramid as he climbs alongside it. Your job is to design the housing for this device. You may construct the containing vessel in any way that you wish, but the object should slide against the side of the pyramid. You will need to select one of the Egyptian pyramids and research the materials that cover the side of the pyramid. Your research advisor reminds you to review Newton’s Second Law of Motion before you begin to design the GPR housing. What force will be required to push this scientific apparatus up the side of the pyramid your advisor has chosen to investigate? Is this feasible?

Assume all GPR systems will work equally well for this application, but mass should be considered in your selection. The difficulty in your task is in determining a way to get the GPR unit up the sides of the pyramid that you choose to investigate. The Egyptian government has made it clear that you are to be minimally invasive to the structure of the pyramid when moving the GPR unit along its surface. Your research advisor suggests using a housing on the GPR unit such that you can push the device up the side of the pyramid. Another option would be to use a pulley system to hoist the GPR unit up the side of the pyramid. In both scenarios, the GPR housing must be in contact with the pyramid at all times.

1. **Final product**:

After researching GPR systems and proposing a housing design and method by which to move the system up the face of the pyramid you have chosen to investigate, formulate a hypothesis about the feasibility of your proposal. Collaborating with others in your group, you should discuss various plausible solutions. Individually, using coefficients of friction tables and the Internet, identify information you must know to solve this problem and conduct a research project examining if your proposed method will work. Write a 3-page paper that explains your procedures and results and confirms or rejects your hypothesis, using evidence from the application of Newton’s Laws coupled with real world data to support your findings.

Your final paper should:

* Include free body diagrams that illustrate your results
* Describe any limitations of the study
* Use discipline-specific vocabulary
* Include in-text citation and a Works Cited page using MLA format or another style that your teacher selects

Alternatively, with permission from your teacher, you may choose to present your finding to the class, choosing several of the most feasible options and then model and design the structures to prove their validity.

**Additional Information**

1. **Knowledge and skills you will need to demonstrate on this task:**

* Understanding of Newton’s Laws of Motion
* Ability to draw a free body diagram

1. **Materials needed:**

* You will need to access the Internet in order to research various aspects of this problem, including the dimensions of the pyramid you choose to investigate
* Introductory physics texts

1. **Time requirements:**

This task will take approximately 3-4 hours. Your teacher will provide details regarding your timeline and due dates.

1. **Scoring:**

Your work will be scored using the College and Career Ready (CCR) Task Bank Scoring Rubric. You should make sure you are familiar with the language that describes the expectations for proficient performance.