

## “Rice Powered” Engine Classroom Activity

Related You Tube Videos available at <http://particularconcepts.com>

### Objective

For all ages: To discover how dry rice, sand, gravel, etc. (particulates) produce work by moving a cup with a pile of rice.

For older students: To discuss the forces of particulates; and if the Ancient Egyptians moved Obelisks this way.

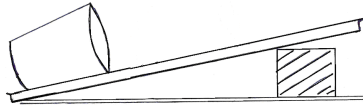
### MATERIALS for each team -----

- about 1 cup of water (*for instructor only*)
- a watertight bowl (*for instructor only*)
- 2 pitchers: one to pour water (*for instructor only*), the other to pour rice (*for the team*)
- paper cup
- one gallon of dry rice
- jelly roll pan (a cookie sheet with raised edges)
- block, book, box, or other 1 to 2 inch object to support one end of the pan
- another cup or scoop to return the rice to the pitcher
- broom and dust pan (or canister vacuum) to clean up when done

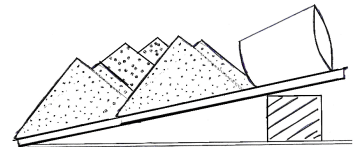
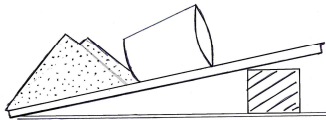
### PROCEDURE -----

1. Introduce the unique qualities of particulates by asking students the following questions, followed by a demonstration:
    - Can you pour water? (Pour water into the bowl)
    - *Yes*
    - Can you pour rice? (Pour rice on the jelly roll pan)
    - *Yes*
    - Did the water make a pile? (Pour water again)
    - *No*
    - Did the rice make a pile? (Pour rice again).
    - *Yes*
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2. Clear away the water, and put the rice back into the DRY pitcher.
3. Set the jelly roll pan, cup, and book as shown in the following illustration:



4. Pour the rice behind the cup, moving the cup up the jelly roll pan, as illustrated:



5. Set up jelly-pan and cup work areas on tables or on the floor. Go over “no throwing rice” rules before handing out the rice and pitchers, and have the students move their own cups
6. Stop the activity after a given amount of time. Ask each team to describe what they did, and what worked, and what did not (for example, pouring the rice in front of the cup would not move the cup forward).
7. For older students, ask and discuss whether this could have moved Ancient Egyptian Obelisks (for further application, refer to the “Holey Tower”, “In the Groove”, “Coefficient of Friction” and “Turning Tower” activities

## ACTIVITY ANSWER-----

### About the “Rice Powered Engine”

Students use the force of rice, sand, gravel, etc. (particulates) to move the cup up hill. If, after completing this activity, older students (or adults) are unfamiliar with the forces of particulates, run a mini-lesson with the following terms and information:

solid particulate    angle-of-repose    gravity    density    Rankine

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A **solid particulate** -- in the case of this new application of physics -- is ANY discrete item that can be piled: rice, gravel, sand, leaves, grain, etc. However, the more common definition is a small discrete mass of solid matter that remains individually dispersed (usually referred to in atmospheric or water pollutants). This more common definition does not apply in this activity, unless you can take the particulate out of the water or air.

The **angle-of-repose** is the angle that a pile of solid particulate naturally “gravitates” to when it forms a pile (dry sand has a different angle-of-repose than gravel: dry sand forms a lower pile than gravel).

**Gravity** is the constant force in the direction of the center of the earth. When a particulate exceeds its natural **angle-of-repose**, the gravitational force turns all the individual particulates in the pile until the pile reaches its preferred angle-of-repose. The particulates will keep on turning as you add more particulate to the pile. With each “turn”, the force of gravity is changed from vertical to (mainly) horizontal. This force is what moves the cup.

**Density** is the compactness of any material. The greater the density, the greater the weight of the same volume of material.

**Rankine** is for William Macquorn Rankine (better known for his Thermodynamic work). Rankine formulary is what quantifies the force a particulate has, when its angle-of-repose is exceeded. The force is dependent on the **density** of the particulate as well as its **angle-of-repose**. The greater the density, and the lower the angle of repose, the greater the “particular” force. For a full explanation, refer to the “Rankine Unchained” Activity.

## STANDARDS -----

National Science Education Standards

Grades PK-8/9-12

Standard B: Physical Science—Motions and Forces

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