

Annette Phillips
Elective 5: Modifying for Levels of Inquiry
Physical Science in Motion

Resource

Straw Rocket Activity (Can include lesson on Newton's Law 2)

https://www.nasa.gov/pdf/265386main_Adventures_In_Rocket_Science.pdf

*The mission part of the activity and lesson on Newton's Law 2 is partly from DOD STARBASE curriculum, and adjusted by the instructors.

Lesson information

Students will apply knowledge of Newton's second law, by manipulating variables to complete a mission. Students can also apply knowledge of Newton's law one and three to the Straw Rocket mission.

Physics content: covers Newton's laws, specifically focusing on Law 2. Force is equal to mass times acceleration.

This is the breakdown of the activity that STARBASE uses:

The Straw Rocket activity uses straws that have been modified with paper fins, a launcher, and erasers. Using straw rockets, the students manipulate the variables of mass and force to investigate and reinforce Newton's 1st, 2nd, and 3rd Laws. The data collected will be utilized for either a formal or informal analysis of the results.

- Students will discover what $F=MA$ stands for, and the difference between mass and weight. The teacher will provide examples of what happens to acceleration when mass is changed or when force is changed. Students will learn that mass and acceleration have an inverse relationship and force and acceleration have a direct relationship.
- The teacher will explain the straw rocket mission. Students will have three straw rockets: one with two erasers on the end, one with one eraser and one without.
- The team will measure the mass of the straw rocket by itself and with the erasers. The teacher will show the straw rocket launcher and give students a desired angle (to keep a constant-45°). The teacher will also show students how to use the launcher and how to document the force (it is marked in centimeters).
- The mission: Successfully land a straw rocket from the moon, into the landing dock on Earth. The students will measure the distance of the landing dock to the launcher. The students will record the amount of force and mass used for each launch to determine the best strategy.
- The students will explore whether manipulating mass or force would best serve their purposes. It is done outside, so there is some discussion about wind and whether they think a lighter object or an object with more mass would be less likely to be affected by it.

- The students will also measure (in meters) the distance the straw rocket lands each time.
- The students will talk about their experiences in the straw rocket mission. Each “reporter” at the table will discuss how their table manipulated mass or force (or both) to try to achieve their goal. The idea is that each group will have attempted a combination of both. The teacher could also take it a step further and use the maximum mass and show how they needed to increase force a little more to achieve the desired acceleration.
- Discuss that increased acceleration was observed by observing and recording the distance of the straw rocket. Discuss velocity as well as the rate of motion in a particular direction. Students will discuss how they observed all three of Newton’s laws at play on the the Straw Rocket Mission.

Pros of the resource

- The NASA activity is part of an entire unit of work on rocketry. I love that the resource includes information about the construction of rockets and forces of flight: drag, thrust, gravity etc.
- NASA resources are user friendly and can be adjusted.
- There are a lot of ideas to choose from and each lesson helps reinforce Newton’s laws of motion. It incorporates mathematics as well as science.
- I included the breakdown of the activity from STARBASE, only because it is an easy breakdown of Newton’s Law 2. Also, all three of Newton’s laws can be applied to this activity.

Cons of the resource

- If I am looking at the unit as a whole, it is a lot of activities, and sometimes too many could equal a loss of the main concepts.
- I would have liked to see NASA include more reading comprehension and writing prompts with their work to make it more multidisciplinary.
- The mission I included from STARBASE is good, however the teacher has to point out to students the idea that acceleration does not necessarily equal distance. Also, depending on where the mission is completed, there are a lot of outside factors that could affect the outcome.
- Students could get lost in the fun of the activity and not get the point if the teacher or instructor is not careful.

Levels of Inquiry

Level 1: Confirmation-students confirm a principal through an activity in which the results are known in advance. We have modified this activity as a demonstration only after we have

exposed the students to Newton's Law 1-3. This level isn't ideal, but is helpful for lower performing classes and helps solidify the concepts for them.

Level 2: Structured Inquiry-Students investigate a teacher-presented questions through a prescribed procedure. This we use if the class has to be "rushed" through the activity, because of a shortened week or the pacing of the students. We have one launcher in the center of the class and the students work together in teams to get the straw rocket in a landing dock. One person per group comes up to test their force or change the mass.

Level 3: Guided inquiry-Students investigate a teacher presented question using student designed/selected procedures. We have a modified guided inquiry of this activity that we used with classes that are moving along at a nice pace and are middle to high performing for the majority. Students receive a landing dock, a launcher, straw rockets and a measuring tape. They have to think about the angle of the launcher, the force they need to use and decide whether to manipulate mass or force. The group collects data and make conclusions based on their data. Students have information on Newton's laws of motion however, and already have a basic understanding of $Force=MA$.

Level 4: Open Inquiry-Students investigate topic related questions that are formulated through student designed selected procedures. We do not have enough time with the students to work at this level, however if we did have flexibility, we could adjust this activity as an opener for Law 2. I would have launchers and straw rockets set up as well as the landing dock (at a certain position). I would inform the students about what can be manipulated (erasers, angle of launch, force) and let them know they have to figure out how to land the straw rockets in the landing dock and answer questions about the relationship between mass, acceleration (distance), force.

