



Experimenting With Friction With *Star Wars*® Droidworks®

Curriculum Connection: "All students should develop an understanding of motions and forces." *National Science Education Standards*

Lesson Plan (Grades 5-8):

Use the topic of sports to discuss the topic of friction. You might compare athletic conditions several decades ago to conditions now, and discuss how these changes have enhanced performance. Encourage the students to explore both sides of the issue: situations where less friction is desired and situations where more friction would be needed. Discuss ways an athlete can achieve the preferred amount.

Examples --

- Ice skating/Ice hockey
- Bobsledding
- Car racing
- Yacht racing

Ask your students to consider the impact friction can have on performance, and how this would translate to robots.

Have your students pair up in groups of two or three. Have each group play *Star Wars DroidWorks, Training Mission 1*. Encourage students to share responsibilities while working on *Training Mission 1* (with a failed attempt have students change responsibilities, remind students that working as a team tends to yield more desirable results).

Ask students to use the InDex to learn more about friction. Have them use the Observation feature and note how the materials used affect the amount of friction. Require that students write down the reasoning that they used when selecting the materials to build the droid.

When all the groups have completed *Training Mission 1*, discuss the mission with your students. Ask them to describe the steps they took to complete the mission using some of the following questions.

- _ What did you need to consider in building your droid for this mission?
- _ Did you need to try building more than one droid before you could successfully complete the mission?
- _ What did you learn from your first try or tries that helped you improve your design?
- _ Suppose you were asked to write special instructions or "cheats" for others using **DroidWorks**. In terms of friction, what would you suggest they consider when designing the droid (take into account droid characteristics as they relate to the terrain found in *Training Mission 1*).
- _ Based on this mission, what can you say about the best materials for tires for:
 - icy roads
 - Rough terrain
 - Steep inclines

For Your Students:

Set up a small slope in the classroom. Look for materials having different surface types:

- Astro turf
- Linoleum
- Glass
- Metal

Using these materials, vary the surface of the slope.

Use toys with varying types of wheels to test student theories. Have your students brainstorm other factors/characteristics of the toys that may influence rate of movement (weight, axle type, width of tires, etc....),

Ask the teams to make predictions about which toys will travel the furthest, fastest, and or straightest on the different surfaces and write these predictions down. Teams should then test their predictions.

After completing their tests, have two groups combine and make the same predictions about the other groups' cars based on what they have learned from their own experimentation. Ask teams to document how many of their predictions were correct. Have them speculate which characteristics of the toys may have been responsible for the predictions that were wrong.

Have students compare the time it takes to stop moving, distance traveled, and ability to stay online. Have the students set up an experiment to predict which toy will travel the furthest based on the qualities discussed. Have students record their observations, and write a conclusion about what they've learned.

(Thanks to educator Eric Thiel for helping brainstorm teaching ideas for our products.)