1 Instructors Guide

2 Students' Task

A group of students, tethered together by strings, imagine themselves to be floating freely in outerspace. Their task is to devise a method to reach a food cache some distance from their group.

3 Props/Equipment

- Several pieces of string (enough to connect each pair of team members), each approximately 5 ft in length.
- You can suggest in your course schedule or syllabus that students bring a space suit to class. Those students who respond to the prompt "Who brought a space suit to class," can be rewarded for their dilligence by being chosen to play the game. This gives you a good idea of who is reading the course materials.

4 Introduction

A group of five students are chosen to participate in a game of Survivor, set in beautiful, sunny outerspace. These students are brought to the front of the class and thethered together in a group. In order to survive, they must reach a food cache placed about 20 ft from their group. The whole class is given the task of devising a method by which the students can reach the food cache without losing any members of the group.

Rules:

- Newton's Laws hold.
- Each person must stay tethered to the group by at least one string.
- You have no free masses to throw or other propulsion devices. (You can tell them this rule AFTER they propose a solution that involves ejecting a person or an air canister. They need to learn that, in the work world, their boss may not appreciate impractical or immoral solutions to problems.)

5 Student Conversations

The goal of this activity is to get the students discussing the concept of center-of-mass and the consequences of the laws of conservation and angular momentum.

Many (surprisingly many!!!) students will propose scenarios that violate conservation of either linear or angular momentum. This is a good example of how many students at this level are not used to using reasoning based on the laws of physics. While a few students may call out these conservation laws, if the instructor ignores them, they will vary rarely follow through with an explanation of why these laws are relevant.

Students often get distracted by the details of the procedure they will carry out, e.g., how will they initiate propulsion to spread out the group. It is important to ultimately refocus the discussion onto the constraints on their motion implied by the conservation laws.

Eventually, they should reach the conclusion that they cannot change the center-of-mass of the group. By stringing themselves out in one-dimension makes the longest shape. By putting the heaviest group members on the side opposite the food allows the lightest members on the side near to food cache to extend out the maximum amount.

An interesting solution that is occasionally brought up by students is to wait for the gravitational attraction between them and the food to bring the food to them. Calculating the time it will take for the food to reach them by gravitational attraction alone might make an interesting homework problem.

6 Wrap-up

This activity naturally leads into a formal derivation and discussion of center-of-mass and the conservation laws.

Watch the classroom dynamics as you do this activity. Depending on how the classroom dynamics work out, this activity can form a good basis for a class discussion about equity: examining whose ideas were taken up by the class, who felt comfortable calling out answers, etc. At a minimum, make sure to publicly acknowledge the students that had quietly expressed good ideas that were ignored by the class or by you. Also make sure to avoid any fat shaming of the heaviest member of the group.