# Student and Teacher Question and Answers

# Kwadropus—Propulsion

1. We are developing the ' tentacle duster' project. me and my partner have asked around, and have no idea how to simulate microgravity. the water method, while common, won't work because of our circuits. we don't want to expose them to water for obvious reasons. we would gladly accept any help on this issue. we were hoping by chance that you would have an idea about how to fix this issue.

For the propulsion, I recommend hanging your propulsion equipment from a string along with 10 kg of weight. Point your thrust horizontal. When your system is on it will push your propulsion system and your weight. The angle will tell you how much force your system produces relative to the suggested mass of the robot.

Check with your physics teacher for calculating the force using the angle of the string.

2. The other important questions that came up after talking students working on the propulsion lab is the 10 kg force, which you changed to 2 kg on another section of your PowerPoint. The students did not understand why they need to test the propulsion system for this force?

It should just be 10 kg. I'll fix it.
The purpose of the propulsion is only to push it back to wall when it is not holding onto a handrail or suctioned onto a panel. The initial robot may be as large as 2ft across and have a mass of 10kg. This large size robot is only to give students room to design. The system needs to be able to push 10kg of robot mass. I don't want the students to be confined by space when they are trying to figure out the mechanics. Once we have an idea of how the robot works and what kind of arms we want, it can be made smaller. The Kwadropus that flies to a space station will probably be smaller—something like 12" across and have a mass of around 3-5 kg.

3. Also I want to make sure they understand what the propulsion ~~arm~~ is to do. Is it only needed to propel the robot back to the wall of the space station if it gets loose and is flying around. Yes. Does it need to control the movement of the robot when it is on a wall, or is that the purpose of the suction cups? Not when it is on the wall, that is the job of the suction cups and mobility arms.

Propulsion is not an arm but some other method (not grabbing) of pushing the robot back to the wall. An octopus uses muscles to push water out and jet away from a predator. The kwadropus will use some kind of propulsion to push itself back to the rack front.

4. Another question arose about the size of the robot. The PowerPoint seems to have a diameter of 2 feet. Can the size of the duster arm and the propulsion arm be a lot smaller? I showed the students the google map of the ISS and it appears a large robot would not be able to move to dust between all the things of the walls?

I expect what ever robot flies, it will be smaller but this is a demonstration robot first. This will not be for the ISS—there are too many things that will get in the way. This robot is for a modern space station that isn't built yet.

The students are welcome to make the duster arm or mobility arms any size that makes sense for their thinking and budget. It needs to be large enough to show operation and that it can be scaled to an appropriate size for grabbing a handrail or other objects. The duster needs to be large enough to be able to remove and hold dust so the robot can complete its task within a reasonable time.

5. Are we able to use electricity, specifically ionic wind for the propulsion device of the kwadropus robot. We're trying to figure out if it is safe to use as well so if we can get your thoughts on this ionic wind idea we have we would greatly appreciate it.

Although I think this is a really cool idea, I'm skeptical about using high voltage on the ISS. Sparks are possible ignition source. What kind of temperatures are you expecting? Most things on the ISS are made to be non-flammable but human hair and some of the dust is pretty flammable.

The sparks need to be kept contained. How loud is it? Can it be kept relatively quiet?

I am expecting that the first Kwadropus we make will be around 24" in diameter so that you can make your component the size you want for demonstrations of how it works. I don't want you to worry about size right now, I want to see your ideas for functionality. Eventually I expect that the Kwadropus robot we send to a future space station will need to be around 12" in diameter so it can clean in smaller nooks and crannies. I don't need you to design for this yet but keep it in mind as you develop your prototypes.