Follow this link to find the video *Mission 1 – Newton in Space* by ESA:

http://goo.gl/rK7Ne4

Watch it from the beginning to 5'56", then say if these statements are TRUE or FALSE.

1. Newton got hit on the head by an orange. T F
2. Newton called "gravity" the force acting on any falling object. T F
3. On board of the ISS, gravity has no effect. T F
4. When Pedro blows on the ball, it moves because of the force of his breath. T F
5. Alexander changes the ball's direction with his hand. T F
6. Each object in motion or at rest remains in that state unless a force is applied to it. T F
7. The combination of speed and direction is what we call velocity. T F
8. Inertia is the tendency of a body to remain at rest until a force is applied to it. T F
9. Acceleration is the rate of change in speed. T F
10. When the skateboard hits the pillar it stops, but the apple keeps moving because the skateboard applies a force on it. T F

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Watch it from 5'56" to 10'10", then complete the sentences choosing the word which best fits each gap.

1. Supporting a man with one hand is easy in a .... environment. If we try it on ..... it is not so easy. This is the difference between .... and weight.

2. Mass is the amount of ..... in an object, while weight is caused by gravity ..... on the object.

3. Things with more ..... move more slowly. The second law establishes a connection between force, mass and ..... If you apply the same force to objects of ..... mass, they will ..... differently.

4. Magnets can ..... each other. The skate carrying the ..... travels slower.

5. Newton's second law states that force is ..... to mass and acceleration. The greater the mass, the ..... the object will accelerate, when the ..... force is applied.

6. Newton's laws are easy to ..... on the ISS, but on Earth there are some factors which influence things. One of these factors is ..... Different ..... create different types of friction.

7. A flat page ..... more air resistance than a crumpled one.

8. If the experiment were ..... in a vacuum, the two sheets ..... land at the same time.

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Watch it from 10'10" to the end, then complete the following tasks.

1. Write the statement of the third law of motion.

.....

.....

2. Describe one of the experiments carried out in the video to demonstrate this law, and the applications of the third law shown in the video.
3. Complete Claudie Haigneré's statement: *Being a scientist means* .....

.....

4. Discuss Haigneré's statement with your classmates, comparing and contrasting different points of view.

Working in pairs, carry out the PhET simulations *Forces and Motion: Basics*. Start by clicking on this link and then on the play arrow:

https://goo.gl/gszUcK

A Net force

1. Click on the sim *Net Force*: you will see a wagon that can be pulled by the players of two teams.
2. Arrange an unbalanced tug-of-war by placing only one player on the rope (move one of the blue men on the rope using your mouse).
3. Click the *Go* button, wait 2 seconds and click the *Pause* button. At this point, the wagon is moving to the left and the blue team is winning.
4. Place one or more players of the other team on the rope so that the two teams are balanced (the net force is zero).
5. While the action remains paused, **predict** what will happen when the action resumes with the newly balanced teams.
6. Click the *Go* button, wait 2 seconds then click the *Pause* button. **Observe** what is happening. Is the wagon still or is it moving in one direction? What should you do to let the wagon move to the right?
7. Use the Law of Inertia to **explain** why this happens.

B Motion

1. Click on the sim *Motion*: in the control panel (top right of the screen) the Force checkbox should already be selected; tick the Speed checkbox to activate the speedometer. Then set the girl on the skateboard (move her with your mouse) and use maximum Applied Force to get her up to speed as rapidly as possible.
2. What happens when she reaches maximum speed?
3. Now apply a maximum force in the **opposite** direction until the pusher falls again. What happens during this push?
4. Take the girl off the skateboard and load the skateboard with two crates and the refrigerator. Repeat the maximum force one way, then the other way. What was different this time, and why?
5. Could you guess a way to find the mass of the parcel?

C Acceleration

1. Click on the sim *Acceleration*: in the control panel (top right of the screen) set Friction to None and activate Forces: Values, Masses, Speed, and Acceleration (tick the checkboxes).
2. Set one 50-kg crate on the track. Set the Applied Force to 250 N. Take note of the acceleration, before the crate reaches maximum velocity.
3. (i) What change in the arrangement would **double** the acceleration? (ii) How could you **halve** the acceleration ***without*** changing the Applied Force?
4. Apply the changes you guessed and record your observation of what really happens.
5. Add two 50-kg crates to the track. Set the Applied Force to 250 N. Register the acceleration.
6. Make changes to the arrangement so that the acceleration will **quadruple**. Describe the changes.
7. What happens to the acceleration when you (i) double the force? (ii) double the mass? (iii) halve the mass? (iv) double the force and halve the mass? Explain.
8. Reflecting on your observations, complete the sentence with the words *directly/inversely*:

Force and acceleration are ..... proportional; force and mass are ..... proportional; acceleration and mass are ..... proportional.