Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

Space Flight – Escaping earth's gravity

Learning Objectives

Lesson Plan

Slide	Topic	Description	Time
1	Introduction	Introduction to escaping gravity.	3
2	Recap	Recap of module 7.	4
3	Activity 1	Throwing an object upwards.	5
4-5	Understanding gravitational force through the activity	Summarising findings from the activity to see how force.	12
6	Condition for beating gravity	Force condition for beating gravity and going upwards.	3
7	Gravity vs height	Chart of how gravity varies with height.	6
8 - 10	Class Discussion	How to overcome gravity and reach space?	10
11	Escape Velocity	What is escape velocity? How much is it?	7
12	Home assignment		3
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Power point Example

NEUROHEADWAY

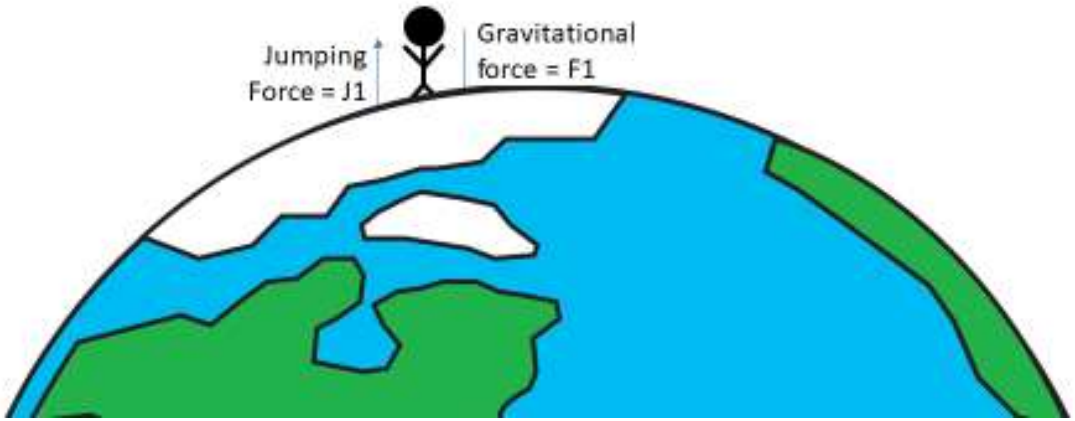
Neuroscience Into Education

Activity 1
Jump high
Throw an object
straight up

The force is strong!

From the activity we observed that as we jump, gravitational forces pulls us back down

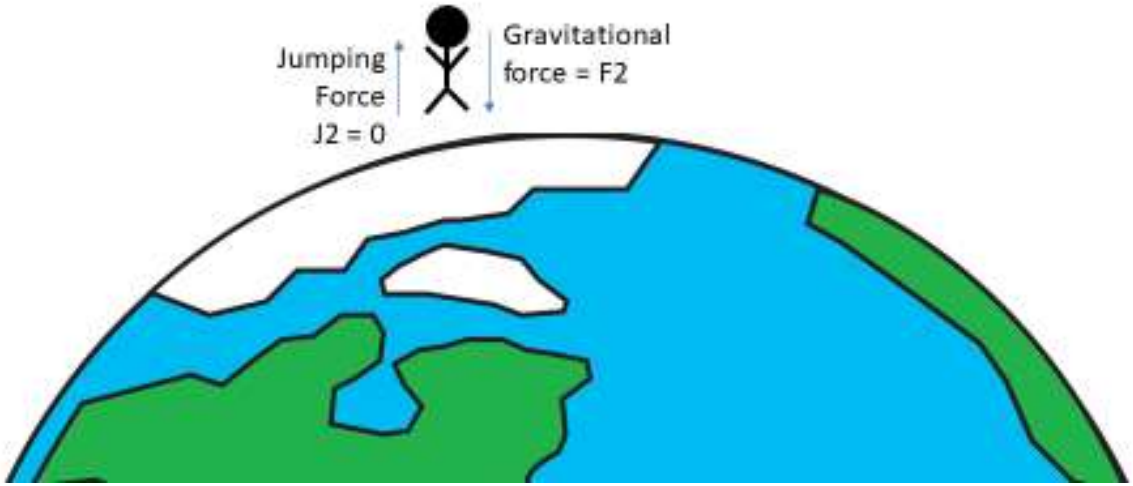
J1 > F1



The forces is strong!

From the activity we observed that as we jump, gravitational forces pulls us back down

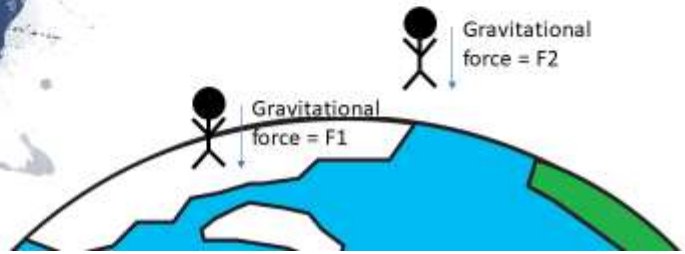
$J2 < F2$



If you recall previous module, we note an interesting observation here.

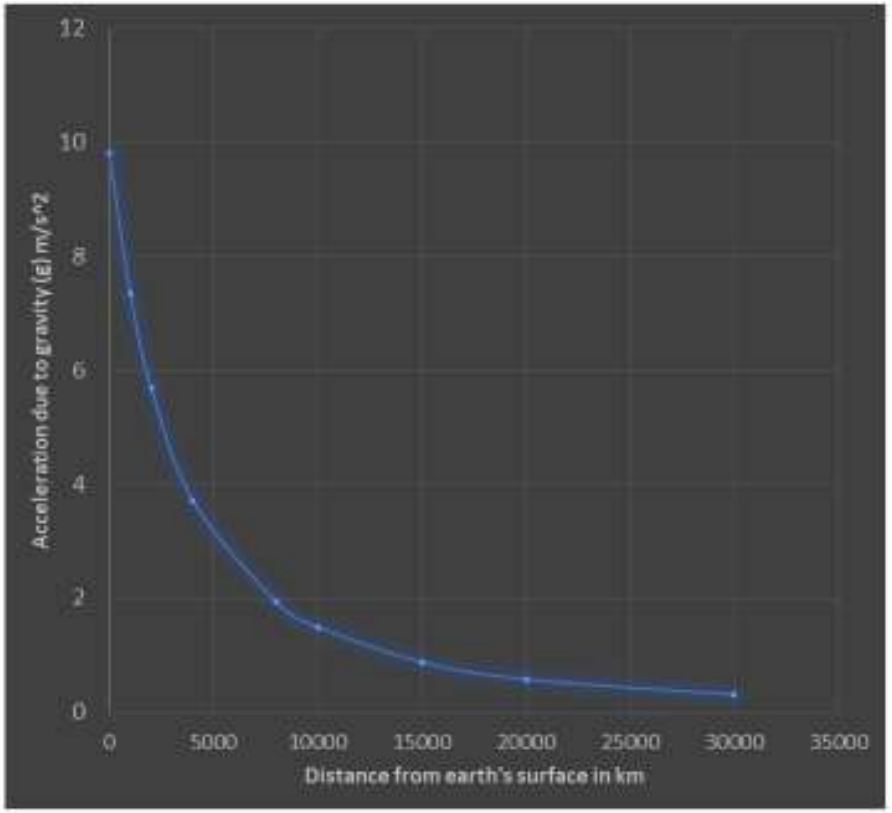
$F2 < F1$

In other words, as we move away from the Earth's surface, the gravitational force decreases!



How much does gravitational force decrease?

We observe that gravity decreases rapidly as we go higher



Teachers Evaluation and Handouts

Slide 1

We learnt about the nature of gravity. Can we use this to our advantage in escaping into outer space? The picture here shows the trail of a space shuttle after lift-off. Observe the path, it does not appear very straight. As the rocket goes straight up, the earth below continues to rotate. This is what we observe.

Let us see how we can escape Earth's gravitational field.

Slide 2

Same as in slide

Slide 3

Procedure

1. Try to jump up. You will notice gravity keeps pulling you back down.

2. Now take a paper ball and throw up. It goes a certain distance and comes back down.

3. Try throwing the paper ball harder. It goes further up but eventually comes back down.

Let us try to see what is happening in the activity. Let us see the role of gravity in the process.

Slide 4 - 5

Initially, we apply a force to jump. Let's call this jumping force.

We go up as jumping force is greater than the gravitational force 'F1'.

F1 < J1

When we are in the air, the jumping force becomes zero, but the gravitational forces 'F2' still remains. Here, we observe F2 > J2

We naturally tend to move towards the force that is higher. In the first case, jumping force was higher and in the second case gravitational force is higher.

A point to note here, while jumping force becomes zero as soon as we leave the ground, the gravitational force remains there through out.

Another point to note here is that gravitational force F2 is smaller than F1. As we learnt in the previous module, as we go higher, we move away from earth and the gravity becomes lower and lower.

Slide 6

From this we can conclude that we will go up, if we can maintain a jumping force such that it is always greater than gravitational force.

We call this jumping force as 'Thrust'. As we saw in module 6, thrust in rockets is provided by booster rockets that burn fuel to go up.

Slide 7

Let us see how much does gravity decrease as we move away from Earth.

From the chart we see that at about 2642 km, the gravitational force become half.

It becomes one fourth at about 6400 km.

Discussion

Can the gravity become zero?

If we can maintain a constant upward force greater than the gravitational force, we can overcome it and reach space.

Slide

Teacher may discuss strategies with students on how to overcome gravity and reach space.

Since gravitational force also depends on mass. Is it advantageous for the rocket to reduce mass as it goes up. This can be seen when rockets eject parts after lift off.

If we can maintain a constant upward force greater than the gravitational force, we can overcome it and reach space.

Slide 9

From the figure we can figure out the need for booster rockets.

As gravitational force is strongest near Earth's surface, the constant force required is very large.

Slide 10

shows different stages where parts of the space ship are ejected to reduce mass. This helps reduce the gravitational force further.

Once the booster rockets are depleted, they are dropped. These land with parachutes so that they may be used again.

Later, the external tank is dropped once the fuel is exhausted.

Note that it is interesting to see that most of the fuel is spent just in escaping earth's gravitational force.

Slide 11

Recall the activity where you threw a paper ball upwards.

We observed that as we increase the force, the ball went higher and higher.

In other words, when we throw the ball, we are giving it a speed.

Is there an initial force with which we throw that can take the ball into space?

There is!

It is called escape velocity. It is 11.2 km per second. If you can throw the ball at that velocity, it will reach space if there is no drag due to air.

It is interesting to note that the escape velocity depends on mass of earth and distance from centre of earth. However, we cannot change the mass of the planet, but we can try to increase the distance as much as possible. If you throw the rock from the top of a mountain, it will require a lower escape velocity than when you throw from your room.

Slide 12

Home Assignment – Calculate escape velocity on moon using the given information.

Slide 13

Summary section same as in slide.

Slide 14

Intro to next module - Space Flight – Parts of a space shuttle