GRAVITY

Objectives

KNOW

gravity is a force

gravity is always attractive (pull)

law of universal gravitation

units

extension: torsion scale, constant of universal gravitation (4^{th} ESO)

DO

gather experimental data

analyse experimental data

derive a mathematical model

apply law of universal gravitation to solve exercises

UNDERSTAND

changes in forces depend on mass and distance

motion of planets and satellites are caused by gravity

1. ENGAGE

We start the activity with an open question to discuss:

- Why doesn't the Moon fall down on us?

Probably the students know something about gravity, have heard something but they don't really understand the implications. We have already cover forces so we can direct their thinking to the effect of forces: does gravity produce a change of motion or a deformation?

- Clip: Peter Griffin Gravitational Pull

https://www.youtube.com/watch?v=MFcT4Hsx7VQ

Is it possible to have our own gravitational pull?

2nd question:

When you drop a rock from a cliff, which of the following happens?

- Only the rock falls to the Earth
- Only the Earth falls up to meet the rock
- The rock and the Earth fall towards each other

Discuss with a partner and propose an answer and explanation to the classroom.

After the discussion: five minute questions to be answer and collected in a piece of paper.

What is gravity?

Video: Ted-ED How to think about gravity

https://www.youtube.com/watch?v=lY3XV_GGV0M

Time for the activity: 30 minutes

2. EXPLORE

We are using lab simulations on the computers to work on gravity. After the discussion and the TED-Ed video some ideas should be happening in the class.

Give the students some time to explore alone the simulation. To try and change variables. To experiment the simulation and learn how it works.

Before we start there are some PRE-LAB activities reflected on the PreLab worksheet. By the end of the worksheet students should discuss the design of an experiment to demonstrate the relationship between the chosen variables. Help them define the dependent, independent and constant variable for each experiment.

Save 5-10 minutes to share the design, as it will be needed for the following exploring session.

Time for the activity: 20-30 minutes.

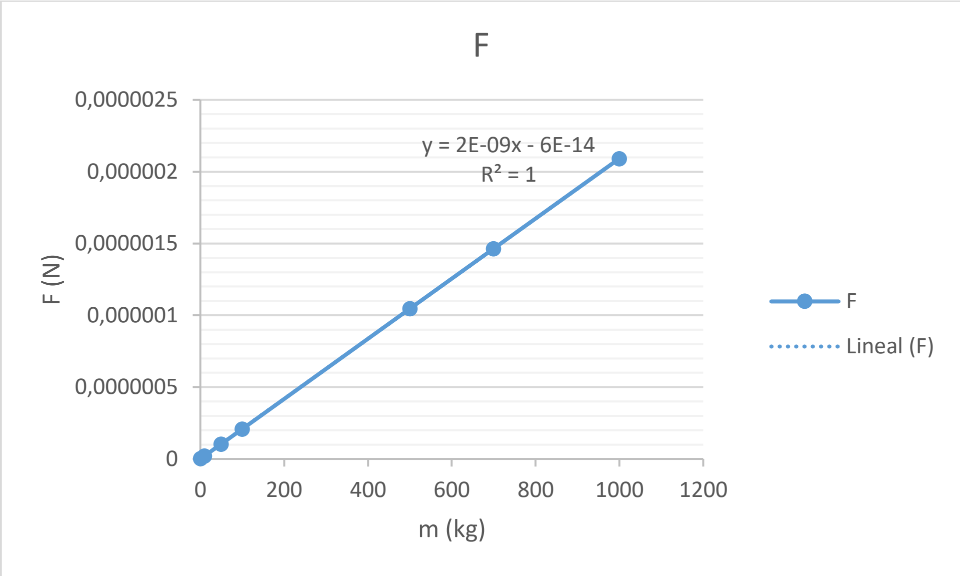
3. EXPLAIN AND ELABORATE

Lab simulation activities.

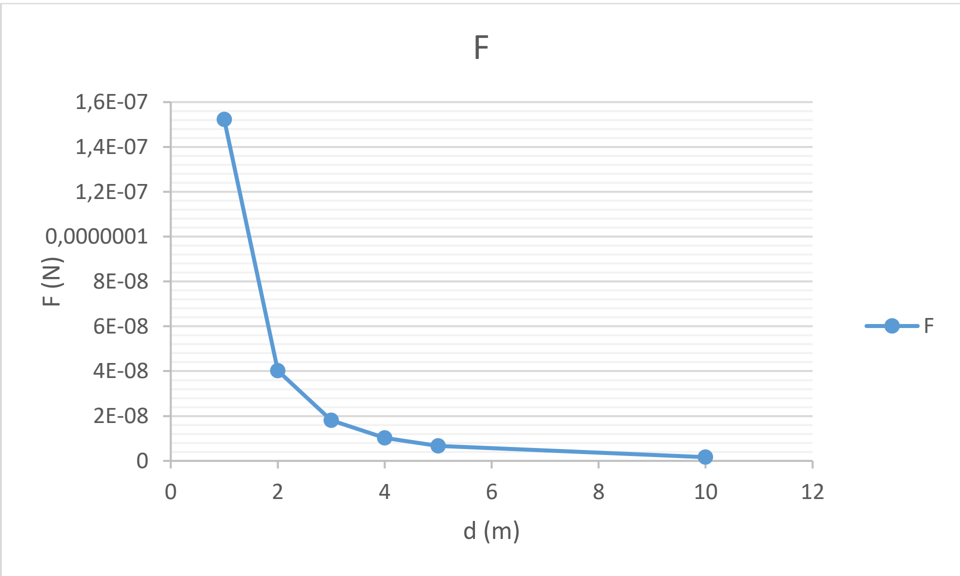
In the Lab Instructions the students will find just short guidance on their work.

From this moment on they should be allowed to carry on their experiments alone. Get data and present them in graphs. By the end of a period (50 min), the students should have done all the experiments and representations (they can use excel). They should have discover that the size of the object doesn't change the force and have two representations: Force against mass and Force against distance that should look like the graphs below.

Force against mass



Force against distance



Developing a mathematical method

From the representations above, students can develop a mathematical method combining both relationships.

They will probably find by their own the relationship between mass and force, which is a direct direction that can be adjusted easily to a straight line equation:

F (N) = km(kg); where k is a constant that involves all other variables and it's the slope of the line.

The relationship between distance and force is more complicated, but can be adjusted to a equation of the type:

$F (N) = k / d^2$

Our students will probably need help from us to find this equation. They can calculate the value k by substituting their data directly.

By the end they should combine both equations in the form:

$F (N) = km/d^2$

which is a previous form of the law of Universal Gravitation. After this activities, where we develop the mathematical model, the explain and elaborate phases continue with a GRAVITY WORKSHEET to make sure the students understand the concepts involved.