11-14 Weight

Prerequisites

Students should have already completed the **Forces** sheet

The Main Points

- **Mass** (m) measures the 'amount of stuff' in **kilograms** (kg) or **grams** (g).
    - The mass is more formally defined in our sheets on motion.
    - The higher the mass, the harder it is to change an object's motion.
- **Weight** (W) is the force of gravity which pulls masses together.
    - Weights measured in the classroom are the gravitational forces pulling objects towards the Earth.
- As weight is a **force**, it is measured in **newtons** (N).
- Something's weight depends on
    - Its **mass** (m) in kilograms
    - The strength of gravity in that place,
        - which is called the **gravitational field strength** (g),
        - and is measured in N/kg
- **Weight = mass x gravitational field strength** (or **W = mg**)
- On the Earth, at the surface, g = 10N/kg, so
    - weight in newtons = mass in kilograms x 10 = mass in grams / 100
    - mass in kilograms = weight in newtons / 10
    - many apples weigh about 1N as they have masses of about 0.1kg = 100g

Teacher Quarter Briefing

- Introduction: https://youtu.be/x4m5co5iCDo
- Practice: https://isaacphysics.org/gameboards#itsp_teach_weight
- Review: https://youtu.be/1sDhuPMIAW0
- If you want to go further, please see the 'Force and Acceleration' materials

Class Question Notes

The worksheet can be printed either in full, or in cloze text form (where the red text is missing, and students can complete these blank spaces after class discussion). The online version of the notes requires the appropriate text to be dragged to the right place in the sentences.

Shallow learning gradient online assignment - q1,2,4,5,6,8,9,10,11,16
Steeper learning gradient online assignment - q2,3,7,10,11,12,13,14,15,17,18

1. Students choose whether each statement is referring to weight or mass.
2. Students may need to be reminded how to convert grams to kilograms. They then plot a graph on axes provided and read off weights and masses from the graph.
3. Students are given the mass of sugar loaded onto a cargo ship in Brazil, and are told that the strength of Earth's gravity is different in the UK. They comment on the likely mass and weight of the sugar after the ship arrives in the UK..
4. Students practise arithmetic to get ready to work out weights from masses.
5. Students practise arithmetic to get ready to work out masses from weights.
6. Having been given the formulae for working out weight from mass on Earth and Mars, students have to choose whether 1kg will be heavier on Earth or Mars.
7. Following on from q6, students state on which planet the gravity is stronger & give a reason.
8. Students work out weights from masses on Earth and Mars given a framework:

Work out these weights using the equations:

(a) 5 kg cat on Earth

weight (N)	=	mass (kg)	×	10
	=	5	×	10

(b) 4000 kg elephant on Mars

weight (N)	=	mass (kg)	×	3
	=	4000	×	3

9. Students work out masses from weights on Earth and Mars given a framework.
10. Students work out weights from masses without the framework.
11. Students work out masses in kg from weights in N without the framework.
12. Students work out masses in g from weights in N without the framework.

Your approach with the next questions depends on whether you want students to work out weights and masses on other planets by 'common sense' first and then learn the equation, or to learn the equation and then apply it to situations on other planets. If you want them to get a feel for the calculations first, then do the questions in order. However if you want them to learn then practise the equation, we suggest you work on the questions in the order q16, q17, q18, q14, q15. The data they need is given just above q13.

13. Students work out the weight from the mass on different planets. Online, in the last two parts, the student needs to choose the correct unit from a list.
14. Students work out the mass from the weight on different planets. Online, in the last two parts, the student needs to choose the correct unit from a list.
15. Students become more familiar with the term 'gravitational field strength'. For example, on the Moon, each kilogram weighs 1.7N, which means that on the moon the gravitational field strength g = 1.7 N/kg (newtons for each kilogram). No calculation is needed in this question.
16. Students write and rearrange the word equation: Weight = mass x g
17. Students write and rearrange the symbolic equation: W = mg
18. Students calculate gravitational field strengths g = W/m from data.

Homework Question Notes

These questions have a very similar form to the questions in the class task, so students can refer back to their earlier answers to help.

Shallow learning gradient online assignment - q1,2,3,4,5,6,7,8,9
Steeper learning gradient online assignment - q1,2,7,10,11,12,13,14,15,16

1. Students state whether each statement describes mass or weight.
2. Students comment on mass and weight on the Moon compared to Earth.
3. Students practise arithmetic to get ready to work out weights from masses.
4. Students practise arithmetic to get ready to work out masses from weights.
5. Students work out weights given data and a formula framework.
6. Students work out masses given data and a formula framework.
7. Students state the rules for working out weight in newtons on Earth when given masses in kilograms or grams.
8. Students work out weights from masses (in kg and g).
9. Students work out masses in kg from weights.
10. Students work out masses in g from weights on Earth.
11. Students revise the word equation Weight = mass x g and rearrange it
12. Students revise the symbolic equation W=mg and rearrange it
13. Students work out g from data about a 52kg mass on a planet.
14. Students calculate weights from masses using values of g looked up in a table.
15. Students calculate masses from weights using values of g looked up in a table.
16. Students plot a graph of weight (in kN, where 1kN = 1000N) against mass in kg for some heavy objects, and use this to work out the gravitational field strength by dividing weight by mass for one of the points on the line. You may wish to ask students which point to choose - the further it is from the origin, the more accurately it can be read.

Extension questions from ‘Step Up to GCSE Physics’:
https://isaacphysics.org/gameboards#step_up_phys_11_b1