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 kilograms = weight in newtons / 10

Teacher Quarter Briefing

- Introduction: https://youtu.be/z3-1e4bnk-I
- Practice: https://isaacphysics.org/gameboards#teach_quart_weight
- Review: https://youtu.be/dG2txfYbbh4
- 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.

1. 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.
2. Students practise working out weights in newtons from masses in kilograms or grams on Earth where g=10N/kg. With the masses in grams, students can either convert to kilograms first (30g = 0.03kg, so W = 0.3N) or can first work out that 100g weighs 1N so to convert masses in grams to weights in newtons, you divide by 100.
3. Students practise working out masses from weights in newtons on Earth where g=10N/kg.
4. Students practise working out masses in grams from weights in newtons on Earth.

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 q8, q9, q5, q6, q7, q10. The data they need is given just above q5.

5. 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.
6. 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.
7. 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.
8. Students write and rearrange the word equation: Weight = mass x g
9. Students write and rearrange the symbolic equation: W = mg
10. 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. Questions 1-4 are all about weights on the surface of the Earth, where g=10N/kg. Questions 5-6 revise the equation W=mg in word and symbolic form. Questions 7-9 get students to practise the equation W=mg in situations where g is not 10N/kg. Question 10 involves a graph. Students plot a graph of weight against mass using data, fit a best fit line, and work out the value of the gravitational field strength from one of the points on the line.

1. Students state the rules for working out weight in newtons on Earth when given masses in kilograms or grams.
2. Students convert masses (in kg and g) into weights on Earth in newtons.
3. Students convert weights on Earth in N into masses in kilograms
4. Students convert weights on Earth in N into masses in grams
5. Students revise the word equation Weight = mass x g and rearrange it
6. Students revise the symbolic equation W=mg and rearrange it
7. Students work out g from data about a 52kg mass on a planet.
8. Students calculate weights from masses using values of g looked up in a table.
9. Students calculate masses from weights using values of g looked up in a table.
10. 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