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# THINKING SCIENTIFICALLY LESSON 1: DOING EXPERIMENTS!

## To join in bring:

Play doh or blu tack, cotton, scissors, pencil paper ruler stopwatch (really not essential!).

## Thanks for paying my wages!

**It's the only way I can do this job!**

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  - presenting observations and other data using appropriate methods
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- interconverting units
- using an appropriate number of significant figures in calculations.

# Title: Does the length of a pendulum affect the speed of its swing?

Title describes exactly what you investigated so people can find your results

## Hypothesis

Circle what you think is true! Doesn't matter if your hypothesis is wrong.

My hypothesis is that the shorter a pendulum is, the faster / slower it will swing.

## Method

Improve this method when I say!

We put a blob of play doh on the end of a long string. We lifted the play doh until it was level with the top of the string and let it go. At the same time we started a stopwatch, and counted how many times the pendulum swung in one minute. We repeated this twice more. We then repeated the experiment for medium and short lengths of string. We had a lot of fun doing this experiment.

**The "Oh so you've finished and you're bored are you?" challenge.**
After writing the title I realised it actually wasn't very good! I can make it better by adding one word. **3. Why isn't it a great title?**

**4. Add a word to improve it!**

## Table of Results

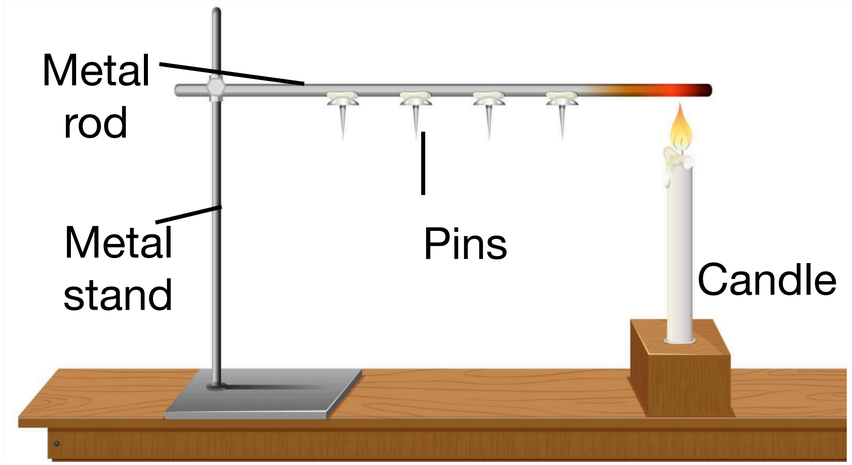
| Length of pendulum (cm) | Swings per minute 1st try | Swings per minute 2nd try | Swings per minute 3rd try | Average (the 3 tries added together then divided by 3) |
|---|---|---|---|---|
| 30 | | | | |
| 20 | | | | |
| 10 | | | | |
| 5? | | | | |

## Conclusion

The data shows that the longer the pendulum, the more / fewer swings it did per minute.
My hypothesis was correct / incorrect. The data suggests that that the shorter a pendulum is, the faster / slower it will swing.

# GCSE questions!

1) A student investigates how heat travels through a metal rod. They set up this experiment on a table:




They write one way they could hurt themselves during the experiment, and how they will stay safe.

*"A pin could fall onto my hand. I won't put my hands directly underneath the pins".*

State *one* other way they could hurt themselves *and* how to avoid this injury. (2)

**Summary question!**

You are teaching someone what the scientific method is. Put these steps in the right order, and explain what each means in your own words:

| Number | What it means |
|---|---|
| ____ Method | |
| ____ Title | |
| ____ Conclusion | |
| ____ Hypothesis | |
| ____ Results | |

# Do it yourself!

Now you've carried out an experiment I'd like you to use the same equipment to investigate:

## How does the weight* of a pendulum affect the speed of its swing?

You can almost repeat the experiment we just did, but keep the length of the pendulum the same and change the amount of play doh.

Write your hypothesis, your *own* method (use mine as a guide if you like!) and draw your own table of results. After you've written a conclusion, look up the science online and see if you were right!

I'll talk about it next lesson

(If you've got a good set of scales you could time how a pendulum swings for blobs of play doh that weight a different number of grams. If not, you could just measure a "very small blob, small blob, medium blob and large blob"!

| Mass of pendulum | Swings per minute 1st try | Swings per minute 2nd try | Swings per minute 3rd try | Average |
|---|---|---|---|---|
| V small | | | | |
| Small | | | | |
| Medium | | | | |
| Large | | | | |

*Proper science word here is 'mass' but it doesn't matter at all. If you've interested look out for the iGCSE lesson on 'weight vs mass' I'll do in a few weeks.

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# THINKING SCIENTIFICALLY LESSON 3: MEASURING!

(THERE IS NO LESSON 2, SEE WEBSITE FOR DETAILS!)

## To join in bring:

Glass of water, small piece of sellotape, ruler, A4 paper.

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**Theatre of History of Science!**
**Match the name of the unit to the description.**

Cubit (44cm)

About 4000m²

A mile

Fathom (1.8m)

Yard (91cm)

Inch (2.5cm)

Foot (30cm)

3 barleycorns end to end!

A man's foot

A man's forearm

A man's outstretched arms

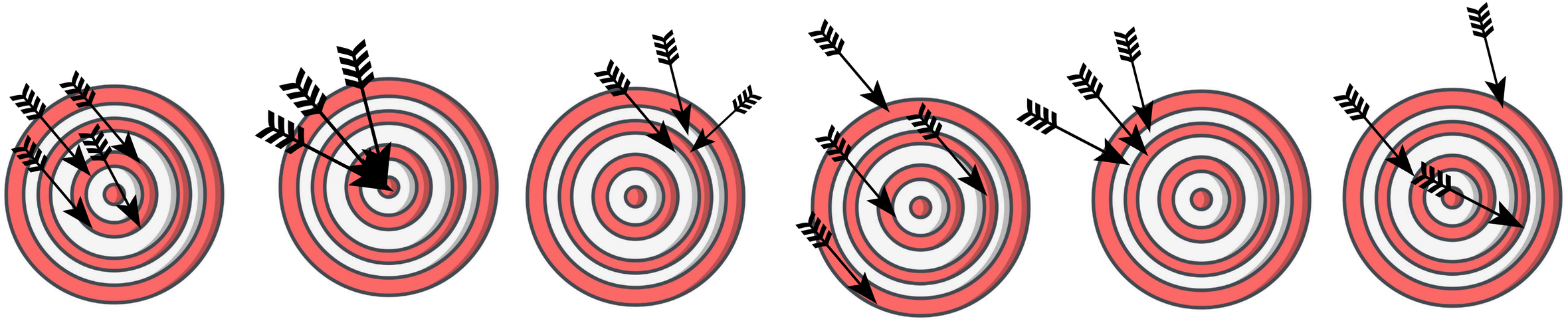
Amount of land an oxen could pull in one day

1000 double steps

A king's nose to his thumb

**Why isn't this a great way to measure things?**

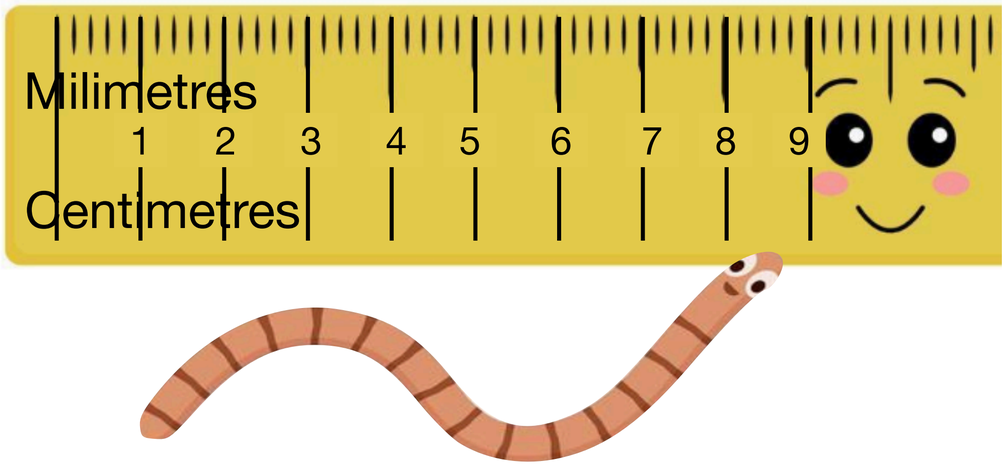
**In each case, say whether the archer has been accurate, precise, neither, or both. Add words like ‘quite’ and ‘very’ if you like!**



# GCSE questions!

1) A student measures the length of their pet worm as shown below. They decide it is 9cm long.

Suggest **3** things the student could do to make their measurement more accurate, without getting a new ruler.




## Summary question!

1) Explain the difference between accuracy and precision in your own words!

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# THINKING SCIENTIFICALLY LESSON 4:SCIENTIFIC MODELS!

## To join in bring:

Plastic pot (eg yogurt pot / marg tub) that an adult has poked a hole in the side of! Washing up bowl. Large jug / glass water. Pencil & paper.

## Thanks for paying my wages!

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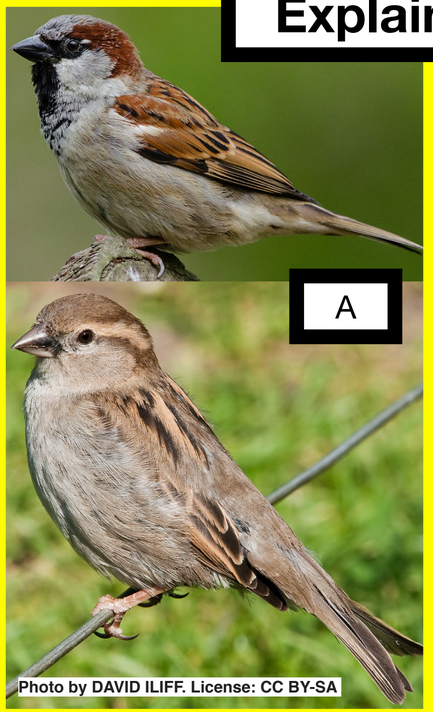
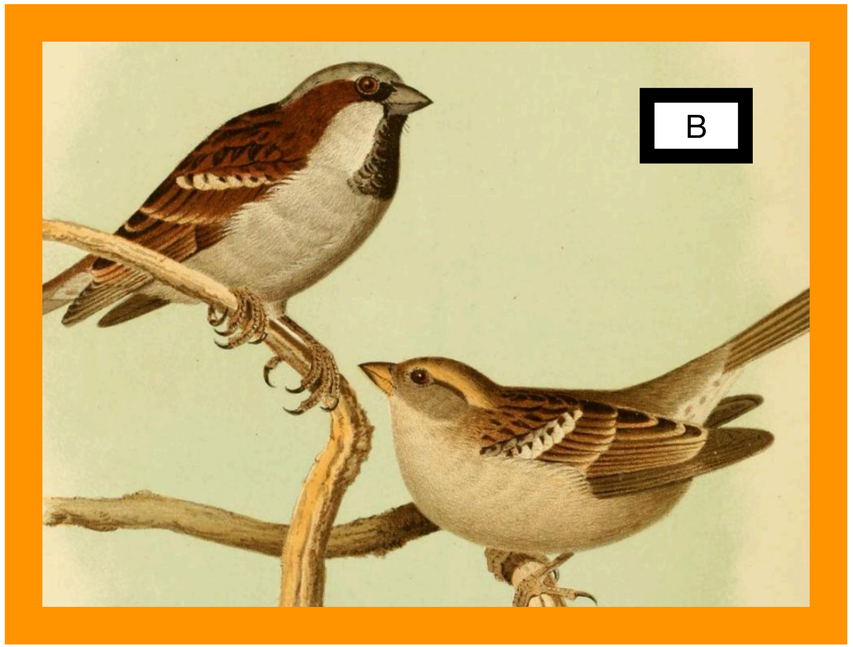
You want to know the difference between male and female house sparrows.
**Explain** which pair of images you'd use, and why you wouldn't use the others!





I would/wouldn't use A, because…

I would/wouldn't use B, because…

I would/wouldn't use C, because…

**Your friend sends you this secret report - by NASA! - discussing an aircraft they have designed that can fly over a “flat, non rotating earth”. This is a REAL document.**

NASA
Reference
Publication
1207

1988

Derivation and Definition
of a Linear Aircraft Model

Eugene L. Duke,
Robert F. Antoniewicz,
and Keith D. Krambeer
*Ames Research Center*
*Dryden Flight Research Facility*
*Edwards, California*

## INTRODUCTION

The need for linear models of aircraft for the analysis of vehicle dynamics and control law design is well known. These models are widely used, not only for computer applications but also for quick approximations and desk calculations. Whereas the use of these models is well understood and well documented, their derivation is not. The lack of documentation and, occasionally, understanding of the derivation of linear models is a hindrance to communication, training, and application.

This report details the development of the linear model of a rigid aircraft of constant mass, flying over a flat, nonrotating earth. This model consists of a state equation and an observation (or measurement) equation. The system equations have been broadly formulated to accommodate a wide variety of applications.

**Your friend says this is proof that Earth is flat, and NASA and other organisations are trying to hide the truth. How do you respond?**

I disagree / agree with my friend

Because…

NOTE: THIS IS A PRERECORDED LESSON THAT WILL GO ON YOUTUBE AND FACEBOOK WHEN I'VE FINISHED IT!

Objectives!

# THINKING SCIENTIFICALLY LESSON 5: LOOKING THINGS UP ONLINE!

**To join in bring:**

A device that you can do research online with. ADULTS MAY WANT TO SUPERVISE YOUNGER CHILDREN!

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**You want to know if monkeys make good pets.** Which of these would you trust (T), which wouldn't you bother to read (WB), and which would you read but then do more research (MR)?

A study on *Monkeys as Pets* published in a good scientific journal forty years ago

A 1972 textbook called *Keeping Exotic Animals*

A study on Monkeys as Pets published in an online scientific journal you can't find any information about

A website selling pet monkeys

A newspaper article about monkeys as pets

A blog on the website of a company that makes dog baskets

The Wikipedia page "Pet Monkey"

A blog written by the monkey expert at Newcastle University

A 2019 book on pets

A 'Question and Answer' website where someone has asked "Do monkeys make good pets" and someone saying they're the monkey expert at Manchester University has replied.

A Facebook comment about pet monkeys that has 200 likes.

**You want to know if monkeys make good pets.** Which of these would you trust (T), which wouldn't you bother to read (WB), and which would you read but then do more research (MR)?

WB Too old

…y on *Monkeys as Pets* published in a good scientific journal forty years ago

WB Too old

…972 textbook called *Keeping Exotic Animals*

WB Not trustworthy

…udy on Monkeys as Pets published in an online scientific journal you can't find any information about

MR

…blog on the website of a company that makes dog baskets

WB Not trustworthy

A… selling …onkeys

MR

…wspaper article about monkeys as pets

The Wikipedia page "Pet Mon…

MR

T

A blog written by t… monkey expert a… Newcastle Univer…

MR

WB Too vague

…019 book on pets

WB Not trustworthy

A… tion and Answer' website where s… as asked "Do monkeys make good p… and someone saying they're the monkey expert at Manchester University has replied.

MR

…Facebook comment about pet monkeys that has 200 likes.

# Think!

Are they trying to sell you something?

In the article or elsewhere on the website.

Are they twisting the truth to make it more entertaining?

Do they just want to get your attention so they get one ‘click’?

How old is the source?

Have they said where they get their information from?

If it’s Wikipedia, CLICK THAT NUMBER and see if the source is trustworthy!

**1. You hear a story that a shark tank broke in a science museum and there were sharks swimming around at the bottom of the escalators!**

You want to blog about the story. Use the internet to check if it's true.

What you searched: _____

Details of story:

**2. You get a message from your uncle. He's not very confident using the internet. He says:**

"I've heard that houseplants purify air. Can you give me some advice? What type of house plant should I get to make the air in my house cleaner?

What you searched: _____

(Did you have to make other searches? If so what where they?) _____

_____

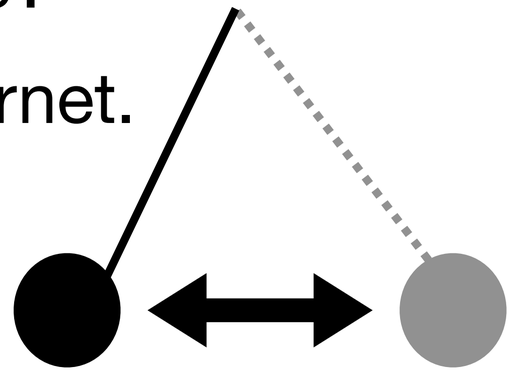
_____

Your advice to your uncle:

**3. You’re doing some GCSE physics questions. You get to the question**

What factors affect a pendulum’s swing rate?

And get stuck. Look up the answer on the internet.



What you searched: _____

(Did you have to make other searches? If so what where they?) _____

_____

A pendulum is basically a ball on a string. Its swing rate means how fast it swings. But you don’t need to know much about that to look up the answer!

What factors DO affect a pendulum’s swing rate?!

**Now try looking up the answers to these. Do them one by one and listen to the answers, then move onto the next one and see if you get better!**

4. Do pigeons spread disease?

5. Does eating chocolate protect you from sunburn?

6.

**Weirdly difficult!!**

a. Which city in Norfolk has the most people living in it?

b. How many people live there?

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# THINKING SCIENTIFICALLY LESSON 6: CLASSIFYING!

## To join in bring:

A selection of leaves, including blade of grass and/or plantain (common weed: picture on Facebook event listing!)

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Images by vecteezy.com

# Put these things found on Earth into three categories!

Gravity pulling you down to Earth

A worm

Chalk

Pulling a string

A fossil

A mushroom

The friction of your wellies stopping you from going down a slide

Concrete

Palm tree

Grain of sand

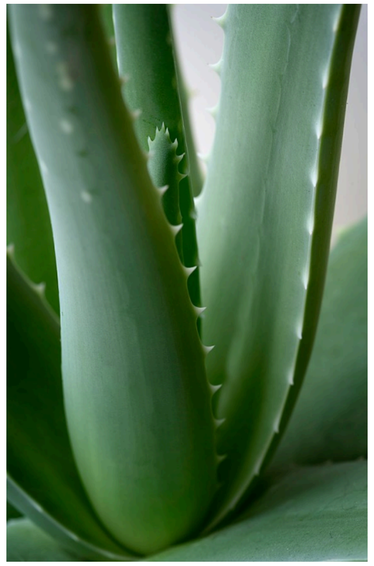
Bacteria

Volcanic rock

Two magnets pulling towards each other

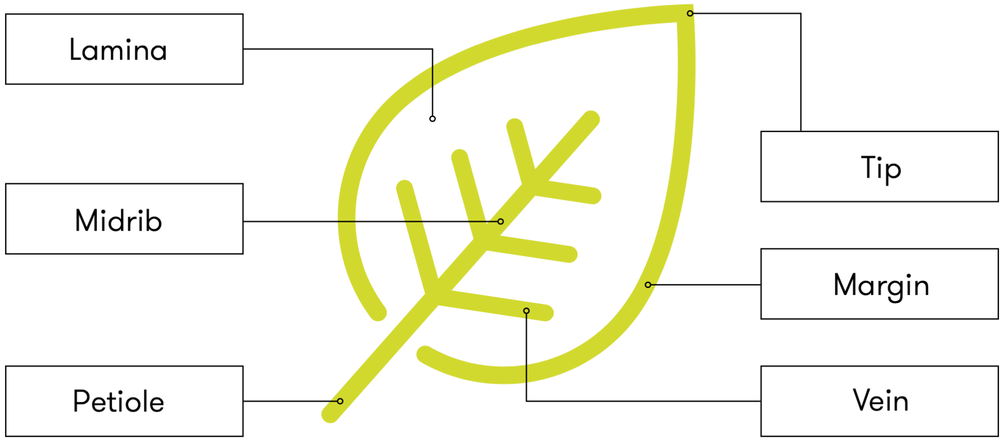
Spider

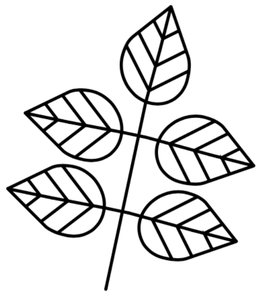
Air particles pushing against a parachute and making you fall slowly

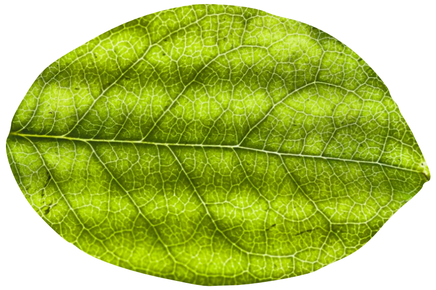


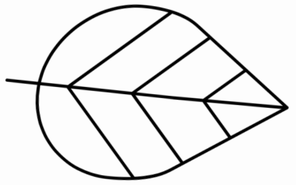
Cut out these leaves: how will you put them into two categories? If I then say you have three categories which ones would you take out?! Do this with any leaves you have collected too.

For example, you could put them in piles of ‘green’ and ‘not green’. Then if you had three categories you might take the red one out and make the categories ‘green, black and white and red’.



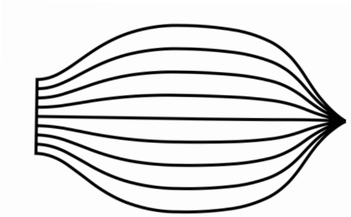




Now put your leaves into these categories.

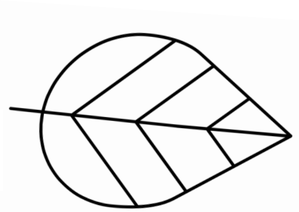
Monocots

Veins are parallel



Dicots

Veins are not parallel



| GROUP | EXAMPLE |
| --- | --- |
| Kingdom | Animal |
| Phylum | Chordata (Has backbone) |
| Class | Mammal (Has fur) |
| Order | Carnivora (eat other animals) |
| Family | Felidae (Muscly body, curved caws) |
| Genus | Panthera (Can roar!) |
| Species | Lion (Has a mane) |

Bird

Snail

Tiger

Lion

Cheetah

Plant

Sheep

Seal

Cow

Fish

Weasel

Zebra

1. Put these animals as low down the Linnaean system of classification as they can go.

(For example, a sheep is an animal that has a backbone and fur, but doesn't eat other animals).

2. Think of a sentence to help you remember this system! 7 words beginning with K, P, C, O, F, G & S!

# *Binomial names!*

*All italics*! First word capitalised!

*Panthera leo* (= Lion)

Genus name

*Panthera tigris* (= Tiger)

Species name

# GCSE questions!

1. Complete the sentence by choosing two words from the box.

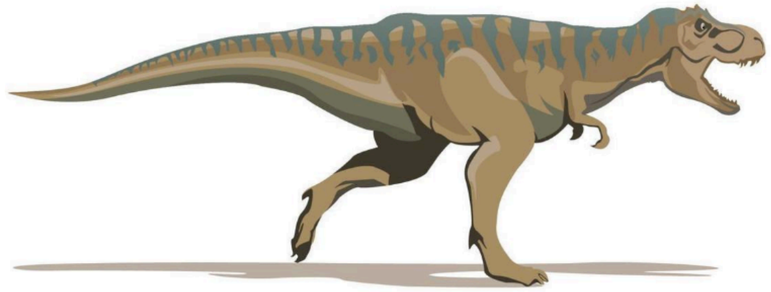
“A family is a group of similar organisms that

belong to the classification group below Order.

| Species | Animals | Order | Organisms | Kingdom |
|---|---|---|---|---|

2. Pictured is a famous dinosaur. Which letter shows the correct way to write its binomial name?

*A. Tyrannosaurus rex*
*B. tyrannosaurus rex*
C. tyrannosaurus rex
D. Tyrannosaurus *rex*



**Summary question!**

Write down three living things and explain why they are in the same category. You may want to use the words below to help you.

Eg. Lion, tiger, lioness.
- All in the Genus panthera

Kingdom- Phylum - Class- Order - Family - Genus - Species

Objectives!

Usually for Home Ed I pick topics that come up at science GCSE. 'Working Scientifically' is a bit different; children study it from Key Stage 2 - GCSE but it doesn't have its own section on exams; it's woven into all the other subjects. If you search "National Curriculum in England Science programmes of study key stages 1 and 2" and find the Department for Education's pdf, then search for 'working scientifically' in that pdf, you'll find the objectives they've listed separately for years 1-6. There's a separate pdf for Key Stage 4; I've copied those objectives here and will underline which ones we touch on each week. Seems to make sense to look to the highest level then edit as appropriate.

# THINKING SCIENTIFICALLY LESSON 7: GRAPHS!

**Last one before a week's break for half term! New topic starts 1st November!**

**To join in bring:** Plain paper, ruler, pencil.

**Thanks for paying my wages!**

**It's the only way I can do this job!**

Click 'sign up' on my Facebook Homepage or search 'Kofi Theatre of Science' to support me with £5+ a month and I'll send you very nice things to say thank you!

## 3. Analysis and evaluation

- applying the cycle of collecting, presenting and analysing data, including:
  - presenting observations and other data using appropriate methods
  - translating data from one form to another
  - carrying out and representing mathematical and statistical analysis
  - representing distributions of results and making estimations of uncertainty
  - interpreting observations and other data, including identifying patterns and trends, making inferences and drawing conclusions
  - presenting reasoned explanations, including relating data to hypotheses
  - being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error
- communicating the scientific rationale for investigations, including the methods used, the findings and reasoned conclusions, using paper-based and electronic reports and presentations.

## 4. Vocabulary, units, symbols and nomenclature

- developing their use of scientific vocabulary and nomenclature

# For each question, say which graph you think would be best to show the results.

**1. “What’s your supporter status?”**

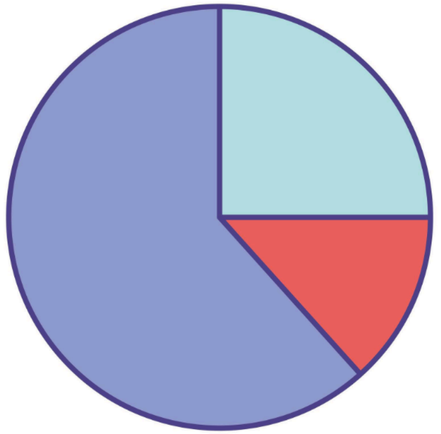
Supporting on Kofi
Supporting on Patreon
Have supported in the past
Don’t support with money

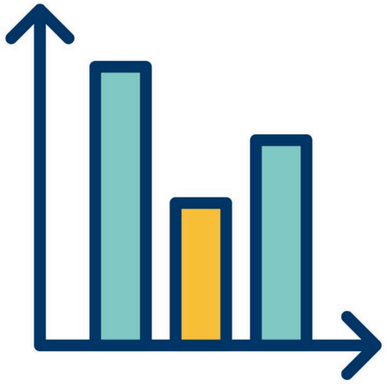
Clue: I wanted to know what *proportion* of my audience support me

**2. “What time works best for you for the lessons? Tick all that apply”**

Monday morning
Monday afternoon
Monday evening
Tuesday morning
Tuesday afternoon
Tuesday evening etc…

A: Pie chart

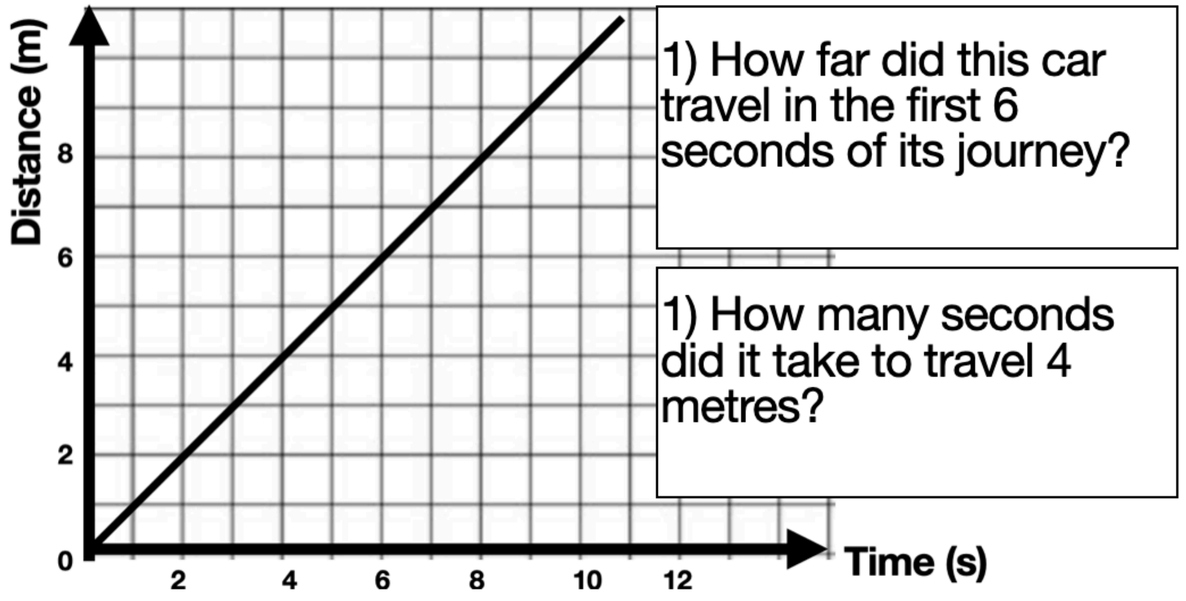




B: Bar chart

C: Line graph

## Straightforward questions

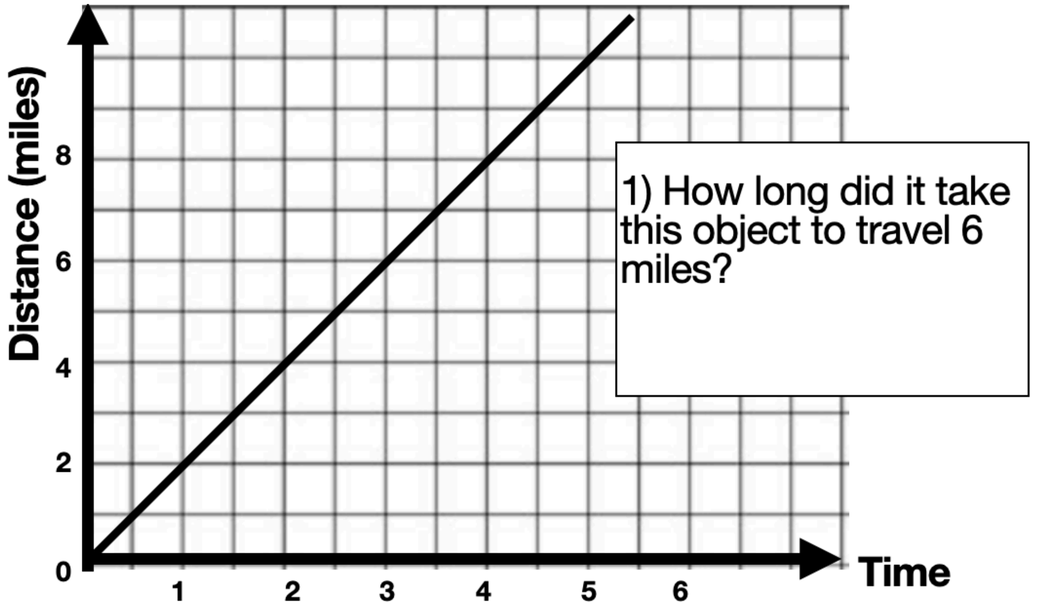



1) How far did this car travel in the first 6 seconds of its journey?

1) How many seconds did it take to travel 4 metres?

## Notes!

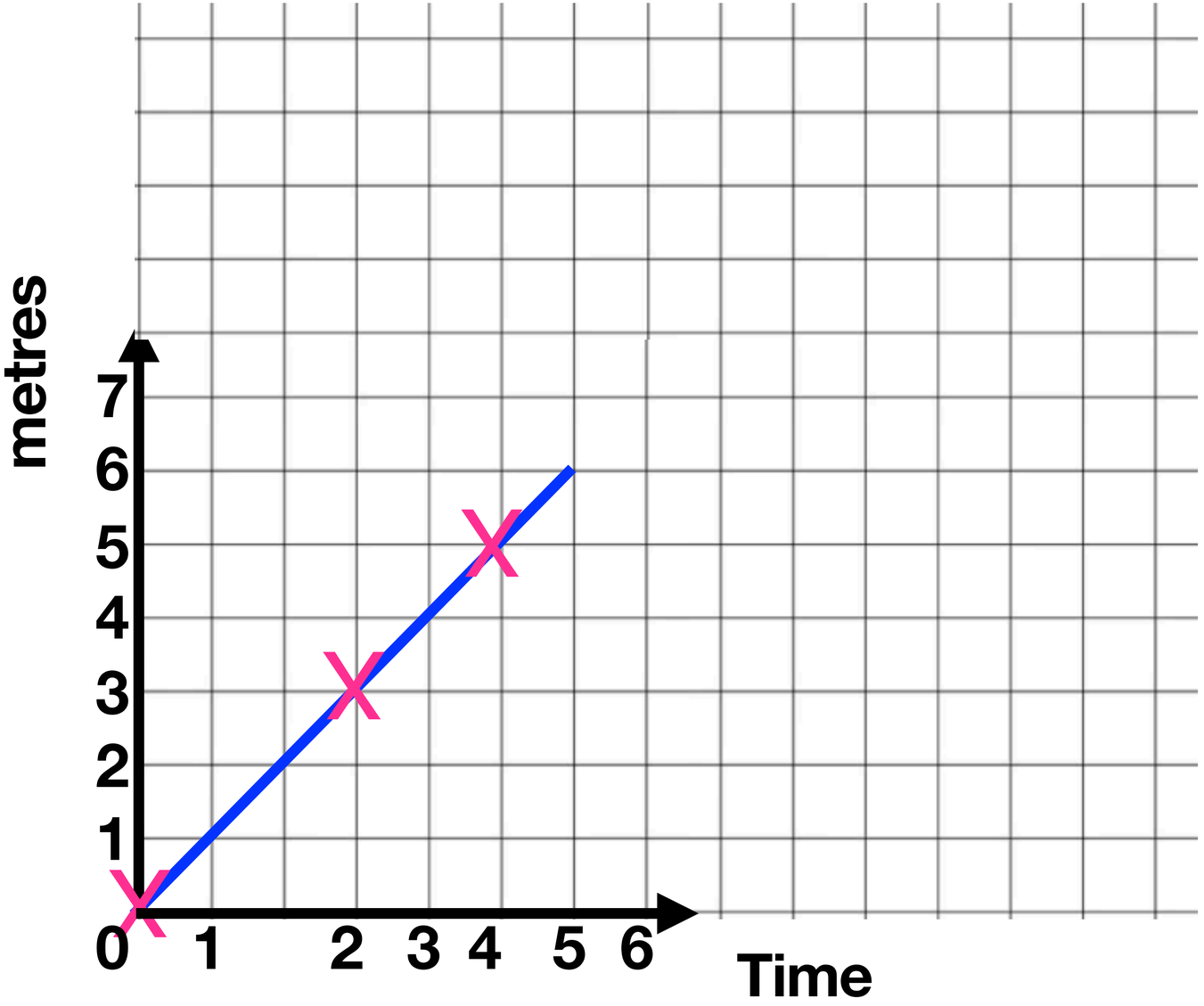
## Tricksy questions!



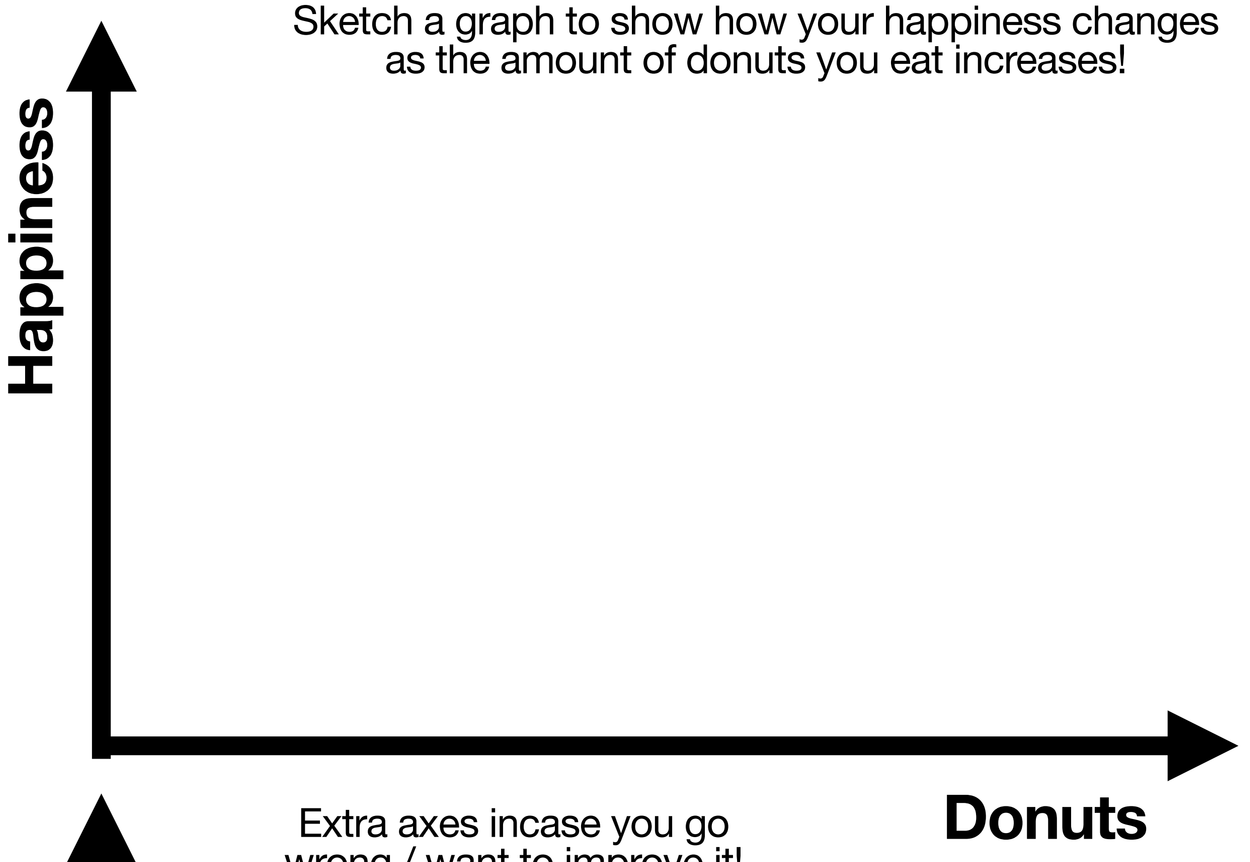

1) How long did it take this object to travel 6 miles?

2) Was the ball speeding up, slowing down, or moving at the same speed the whole time?

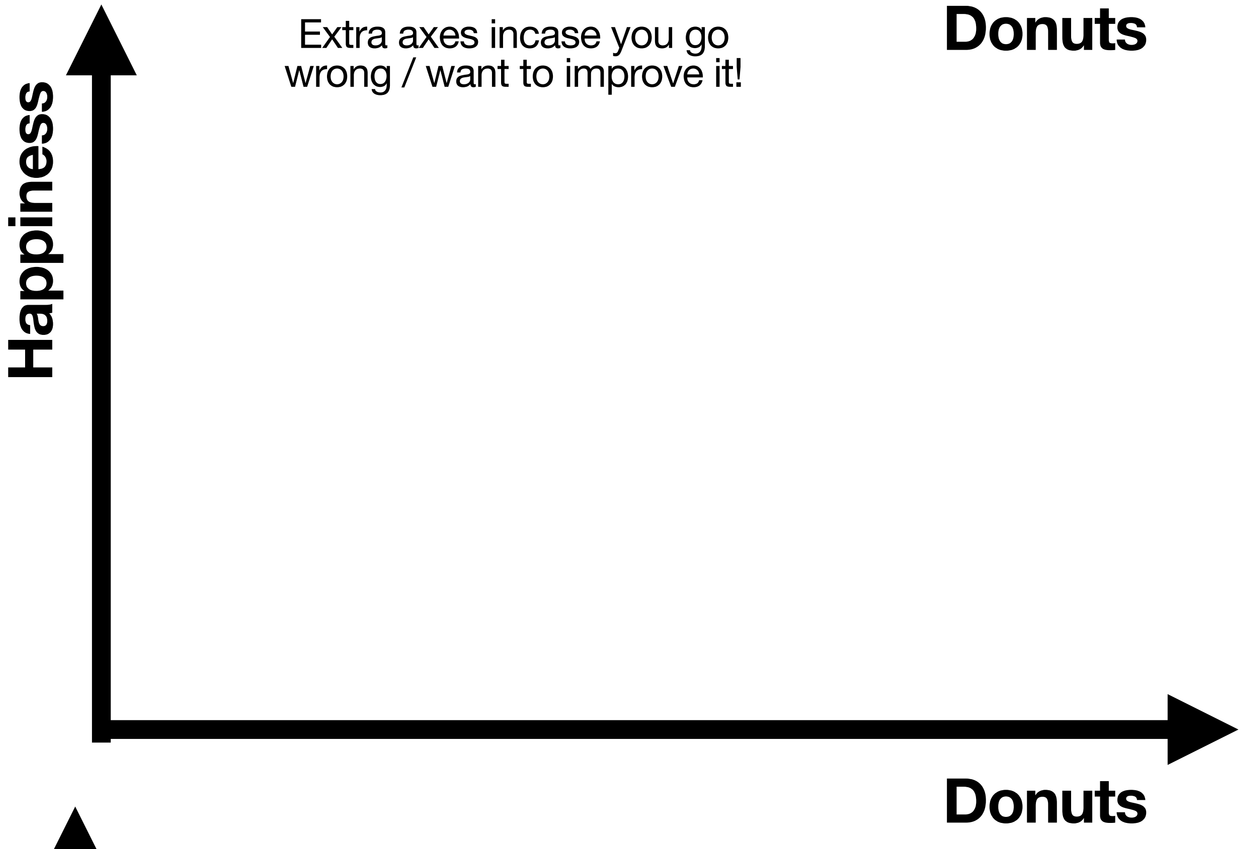
The person drawing this graph has made FOUR mistakes. Can you spot them all?

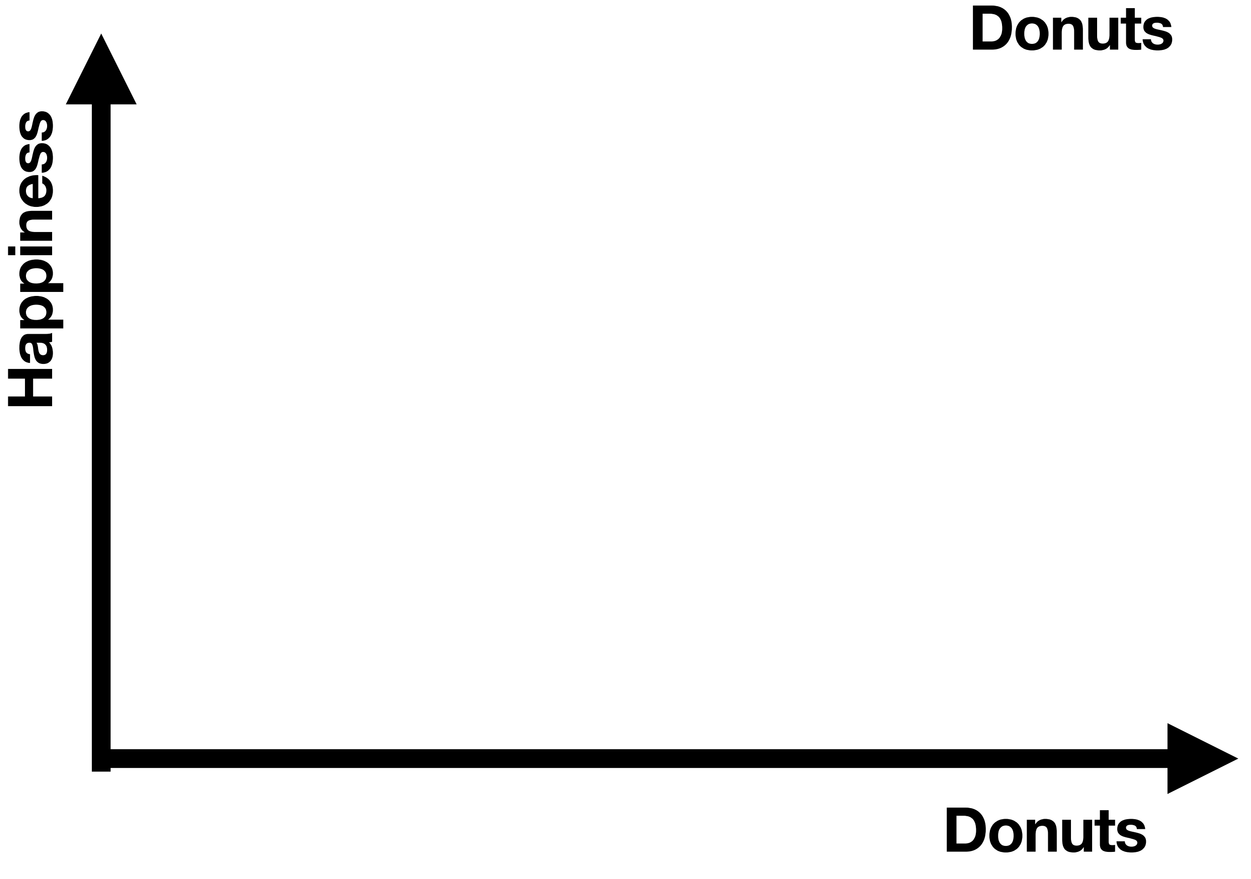


Sketch a graph to show how your happiness changes as the amount of donuts you eat increases!




Extra axes incase you go wrong / want to improve it!



Someone robbed a bank. A keen physicist sketched distance time graphs of five people in the area.

Match the names to the movement descriptions and find the criminal!