

What conditions make the best spin for me?

AGE RANGE: 5-7 years

OVERVIEW

Using 'Izzy Jones's Quantum World' pupils meet the character of Izzy - a young girl trying to find her place in the world. In her search for finding the place that allows her to be her best, the story subtly illustrates how important it is for quantum researchers to find the conditions that best suit their experiments. Pupils observe how factors (variables) around them affects their results. They get physically involved in spinning and experiencing how it feels when they change one condition (type of footwear) and then another. Pupils explore how different things they put on their feet changes the way they perform their spin. This enquiry develops foundational understandings of 'variables' - something that can be changed in an experiment and their effects.



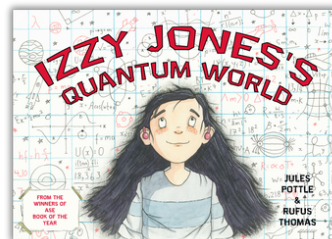
LEARNING OBJECTIVES

- Experience how a change has an affect
- Develop understanding of the term 'variable'

WORKING SCIENTIFICALLY



- Perform a simple test
- Observe closely, using simple equipment
- Use their observations & ideas to suggest answers to questions



KEY WORDS

- variable
- change
- effect

RESOURCES (groups of 3-4)

A variety of things to put on feet, e.g.

- socks: cotton, bed, trampoline (grip)
- outdoor shoes
- indoor shoes, pumps (ask pupils to bring a few pairs from home if they can)
- an open space/hall

TO SUPPORT TEACHING

- [Izzy Jones story read video](#)
- [5-7 Great Quantum World Video](#)
- Book: '[Izzy Jones's Great Quantum World](#)', by Jules Pottle, ISBN:9781739939939 (optional)
- [5-7 Great Science Prediction Prompts](#)
- [5-7 Conclusion Creators](#)

The [Careers Chat](#) resources give pupils time to learn more about research scientists, Maddy and Jess, as well as author Jules Pottle!



Maddy's Video Chat



Jess's Video Chat



Jules's Video Chat

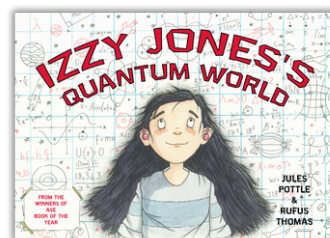


Step-by-step guide

Read Jules Pottle's story *Izzy Jones's Quantum World* or watch the [story read video](#).



1. In the story, Izzy is trying to perform her perfect spin. Ask pupils to spot what affected her when she was spinning. Explain that some of the conditions around Izzy affected her performance - what were they? Explain that we can change parts of our science investigations and see what effect that has. We use the word **'variable'** to describe something we change and measure.



2. Pupils will work in pairs to investigate the question, **'What conditions make the best spin for me?'**

Explain that they will be spinning around and investigating how changing their footwear (socks and shoes) affects them. To elicit what they think, support them by asking them to develop a prediction.

Examples could be:

> *I think that the fluffy socks will make me spin faster*

> *Because I wear pumps instead of socks my spin will be slower*

> *I think that the grippier socks will make me wobble about less when I spin*

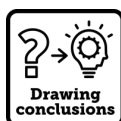
To create a class prediction use the **5-7 Great Science Prediction Prompt**.



3. Pupils work in pairs to select at least 3 different pairs of shoes or socks that they will use. Ask them to decide where they will do their investigation - perhaps they could use the school hall, playground, carpet area, tile, grass area etc. Explain that wherever they choose should stay the same when they change the footwear. This is important because they must only make **one** change at a time.



4. Give instructions that pupils will have time to perform their spins. They should do a spin (twizzing round) in all three pairs of socks/shoes. To record their results they can put their pairs of socks/shoes in rank order for which condition created their 'best' spin - good, better or best. This could simply be in labelled piles or best-worst order. (Take a photo if you wish to record this).



5. Compare the results between groups/class and identify any patterns.

Ask pupils to draw a simple conclusion, using the [5-7 Conclusion Creator](#)

E.g.

I changed fluffy socks to grippy socks.

I found out that my spin was the best with fluffy socks. ***I think this was because*** they're soft and were slippy on the wooden floor. When I changed to grippy socks, I couldn't spin so well.



6. Encourage pupils to share their observations. They could jot a note to Izzy to explain what they found, or compare their results with another class in school. If you share on social media, tag us with @GreatSciShare

www.greatscienceshare.org

DISCLAIMER: This activity sheet was written for The Great Science Share for Schools. The author(s) and the Great Science Share for Schools are not liable for the actions or activity of any persons who use this resource or in any of the suggested further resources. We assume no liability with regard to injuries or damage to property that may occur as a result of using this information. These activities are designed to be carried out by pupils working with an adult. The adult is fully responsible for ensuring the activity is carried out safely. You can access further Health & Safety guidance from CLEAPSS www.cleapss.org.uk and SSERC

www.sserc.org.uk

(c) Copyright 2023 The University of Manchester

Good

Better

Best

Great Quantum World

Great
Science
Share
for SCHOOLS

How does the environment affect how a paper spinner falls?

AGE RANGE: 7-11 years

OVERVIEW

Using 'Izzy Jones's Quantum World' pupils meet the character of Izzy - a young girl trying to find her place in the world. In her search for finding the place that allows her to be her best, the story subtly illustrates how important it is for quantum researchers to control the variables in the environment around the atoms they are working with. This is so that they can get the best performance to create new materials. In this enquiry, pupils investigate ways that they can control environmental variables and how this can affect the performance of paper spinners whilst also reinforcing their understanding of independent and dependent variables.

LEARNING OBJECTIVES

- Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
- Identify the effects of air resistance that can act between moving surfaces

WORKING SCIENTIFICALLY



- Set up a simple practical comparative enquiry
- Report and present findings, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms.
- Identify differences, similarities or changes related to simple scientific ideas and processes

RESOURCES (groups of 3-4)

- paper spinner templates
- different materials to make spinner from e.g. paper, card, tracing paper etc.
- scissors
- paper clips
- metre ruler
- hairdryer/fan (dependent on variable selected by the class)

TO SUPPORT TEACHING

- [7-11 Great Quantum World video](#)
- [Book: 'Izzy Jones's Great Quantum World', by Jules Pottle, ISBN:9781739939939 \(optional\)](#)
- [Izzy Jones story read video](#)
- [Brian Cox video](#)

KEY WORDS

- **variables**
- **independent**
- **dependent**
- **control**

The [Careers Chat](#) resources give pupils time to learn more about research scientists, Maddy and Jess, as well as author Jules Pottle!



Maddy's Video Chat



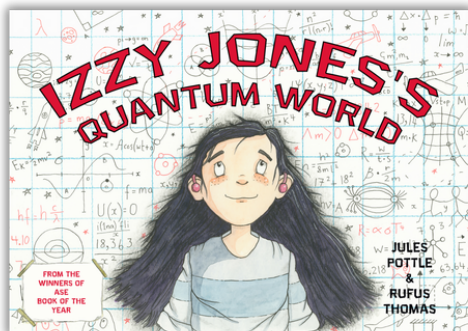
Jess's Video Chat



Jules's Video Chat

Step-by-step guide

Read Jules Pottle's story *Izzy Jones's Quantum World* or watch the [story read video](#).



1. Play the [7-11 Great Quantum World](#) video with Maddy, Jess and Jules to introduce the enquiry. Provide a variety of different sized templates and materials for each pupil to make one paper spinner - give them free choice over which material/size they use. In groups of 3-4, give pupils 10 mins 'exploring' time to drop their spinners, trying to get them to land on a marked spot on the floor.



2. Engage in a class discussion about what they noticed.

- *Did the paper spinners always land on the marked spot?*
- *Did they always land in the same place?*
- *Did everyone's spinners take the same amount of time to fall?*



3. Pupils to list as many **independent variables** and **dependent variables** as they can. Ask pupils if they have identified any environmental factors that are difficult to control on their list. (*for example, where they conduct the investigation*)

Independent variable

The one you choose to change

- size of spinner
- material it's made from

Dependent variable

The one you choose to measure

- distance from landing spot
- time taken to fall

NB: Pupils will find it easier to list variables linked to the properties of the spinner. However, in science, there are also environmental factors which can affect results. Support pupils to consider these, identifying the environmental factors that affect the spinner, mainly air movement.



4. By watching the [Brian Cox video](#), where he explains the affect of limiting air movement, ask the pupils to identify the independent variable. Develop understanding of this key word.

Note: In the video the environment that the experiment was done in had the air removed, hence creating a vacuum. This affected how quickly the bowling ball and feathers fell.



[Brian Cox Video](#)



5. Brainstorm ideas of environmental factors that could affect the results of dropping their spinners and how you could change these e.g. air flow, location (inside/outside), room temperature etc. As a class/in groups, decide which environmental variable the pupils will choose to investigate. The [Question Wonder](#) resource from the [Great Science Toolkit](#) can support pupils to form an enquiry question.



Pupils investigate whatever environmental variable they choose but for the purposes of this enquiry. Below are some suggestions where the air flow is controlled using a hairdryer or fan.



6. Choose one spinner type for all groups to use. Pupils drop the spinner three times from the same height, trying to land it on a marked cross on the floor. Measure the distance from the cross to the where the spinner landed (cm). Record results in an appropriate table. Repeat the investigation a second time but this time with a hairdryer directed at the drop zone. Pictures of the landing points could be marked with chalk and an aerial photograph taken.

If time allows you could investigate different options here e.g. move the hairdryer further away from the drop zone etc. Alternatively, pupils could carry out the investigation in different places/spaces e.g. inside and outside.



7. Collate class results. Through discussion compare what happened in the two different environments by analysing the results. Use the [7-11 interpreting data skills starter video](#) to support.



8. What do pupils notice? Is the spread of data different in the two tests? What does this tell you about the importance of controlling the environment? Link what the pupils have discovered (environmental variables) back to the book and work of quantum scientists who are also trying to control the environment to ensure it does not affect the results of their investigations.



9. Pupils could create a poster to share with others to explain how they have worked like quantum scientists and how they now know why controlling the environment is important when carrying out investigations. Share on social media by tagging us on X @GreatSciShare.

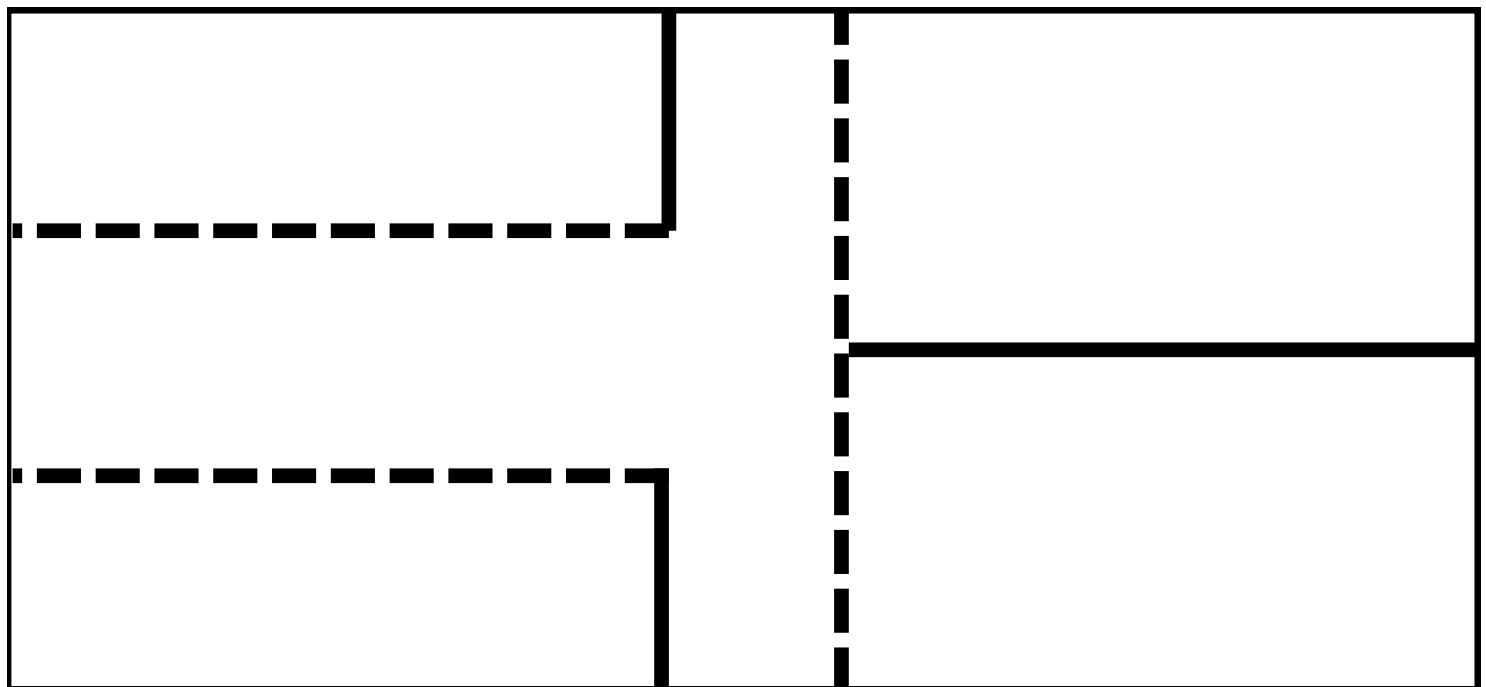
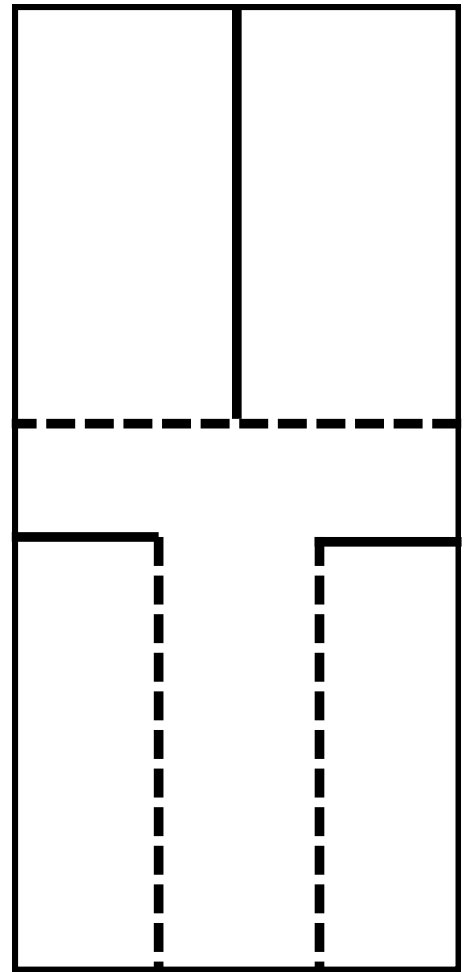
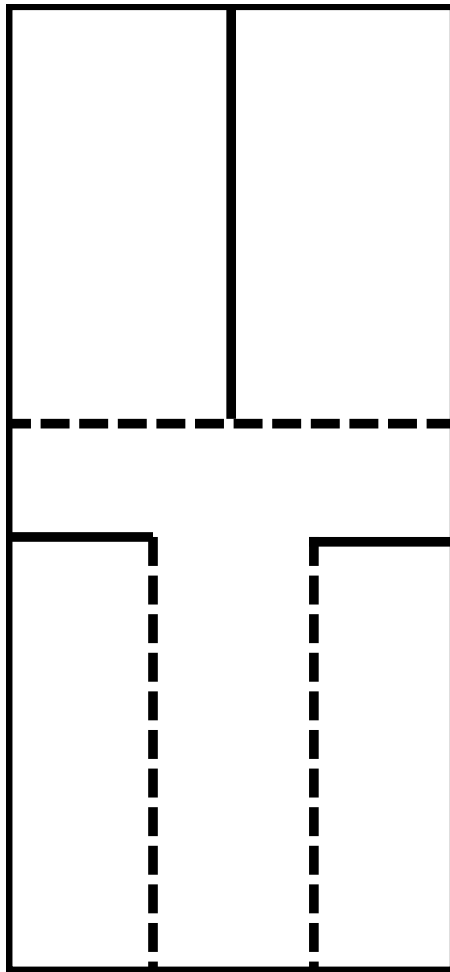
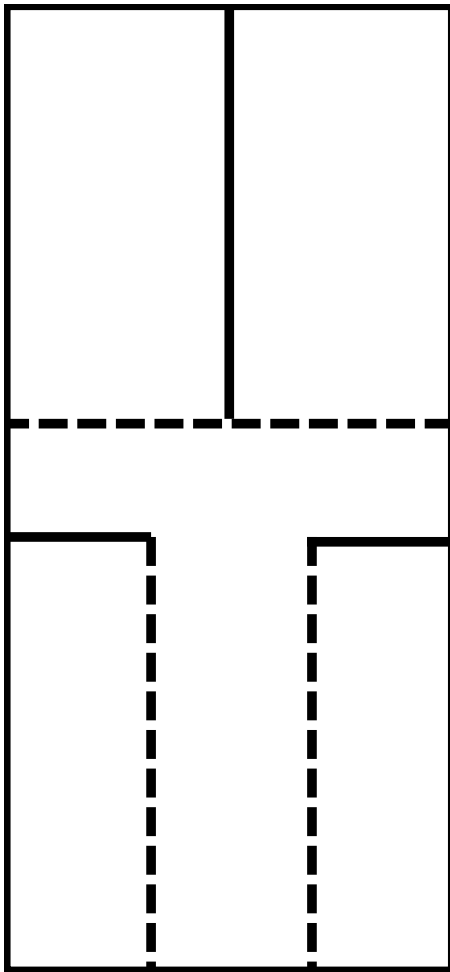
EXTEND THE LEARNING!

Use the Talk Prompts in the quantum-linked [Great Question Ponder](#) as part of science and oracy development.



Spinner template

Instructions: cut the solid lines, fold the dotted lines



Great Quantum World

Great
Science
Share
for SCHOOLS



What does data tell us about the impact of variables on an investigation?

AGE RANGE: 11-14 years

OVERVIEW

Using 'Izzy Jones's Quantum World' pupils meet the character of Izzy - a young girl trying to find her place in the world. In her search for finding the place that allows her to be her best, the story subtly illustrates how important it is for quantum researchers to control the variables in the environment around the atoms they are working with. This is so that they can get the best performance to create new materials. In this enquiry, pupils investigate how environmental variables affect the performance of paper spinners. They analyse a range of data to draw conclusions, identify anomalous results and the impact of different variables.

LEARNING OBJECTIVES

- Model how air resistance affects the moving objects

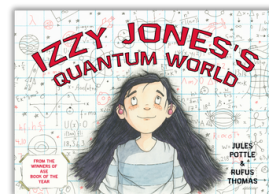
WORKING SCIENTIFICALLY



- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- Present reasoned explanations, including explaining data in relation to predictions and hypotheses
- Evaluate data, showing awareness of potential sources of random and systematic error

RESOURCES (per pair)

- paper spinner template and paper
- scissors
- paper clips
- metre ruler



KEY WORDS

- environmental control variables
- experimental control variables

TO SUPPORT TEACHING

- [11-14 Great Quantum World Video](#)
- [Izzy Jones story read video](#)
- [Book: 'Izzy Jones's Great Quantum World', by Jules Pottle, ISBN:9781739939939 \(optional\)](#)
- Sample data sets

The [Careers Chat](#) resources give pupils time to learn more about research scientists, Maddy and Jess, as well as author Jules Pottle!



Maddy's Video Chat



Jess's Video Chat



Jules's Video Chat

Step-by-step guide

Read Jules Pottle's story *Izzy Jones's Quantum World* or watch the [story read video](#).



1. Watch the [11-14 Great Quantum World](#) video
2. Elicit what the pupils recognise as being variables that Izzy was able to control and what was out of her control? Re-listen to the story and ask them to jot a short list, before sharing with a larger group of 3-4 pupils.

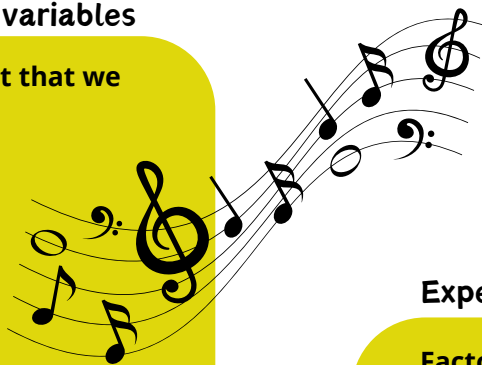
Ask the pupils to match their ideas to two headings:

Environmental control variables

Factors in the environment that we find difficult to control.

In the story, this could be:

- the position of the clock
- window opening
- wall coverings
- floor surface
- music
- air temperature
- pigeons



Experimental control variables

Factors in the experiment that we can control.

In the story, this could be:

- rate of breathing
- controlled movements
- eye movements
- angle of plane
- launch



3. Explain that the pupils are going to investigate the question:
What environmental factors affect the landing of a spinner?

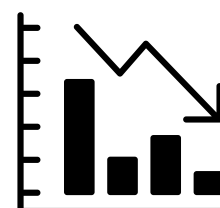
Working individually or in pairs pupils should make a spinner (template provided). Ask them to discuss a plan for this investigation. They will need to consider where they will undertake the investigation, how they will measure and record results, how they will analyse their results etc.

Help: If needed explain that spinners can be dropped in any environment (indoor/outdoor). Use a floor target to drop the spinner towards. Pupils measure the distance the spinner falls away from a target on the floor. They can change the environment to explore its impact. Take repeat readings and explore patterns in data using bar graphs. Standardised changes in the environment can be produced using a hair dryer on different speed settings.



4. Challenge the pupils to apply what they have observed during their exploration time to the data analysis task. Here, pupils analyse and annotate the data provided in the [Sample Data Sets](#). Quantum scientists are required to analyse a wide range of data in graphical form, and in this way, pupils should identify:

- **what patterns they notice**
- **if the variable changed was environmental or experimental**
- **if there are any anomalous results and what could be the cause of them**
- **whether there is any evidence of human error, lack of control of other variables**



Sample Data Tables



5. Ask pupils to summarise whether they think environmental or experimental variables are easier to control and how they would achieve this in future:

- experimental as you can measure the changes i.e. the length of the wings
- environmental is difficult to control as it depends on external factors, e.g. wind

Relate these considerations back to the book, reinforcing the fact that scientific endeavour requires logical reasoning and resilience. Quantum scientists persevere for many hours, days, weeks and months to control the environmental conditions in order to enable their equipment and atoms to achieve the best performance to make new materials. This work is ongoing!

Encourage pupils to make a 60 second reel or social media video about their enquiry. Upload onto Instagram, Facebook or an appropriate stream. If using X, tag @GreatSciShare



The Data Sets explained

Data set 1 shows an **experimental control variable** with results that have a small range and there is an **anomalous result** on trial 5 as it is significantly larger than the other results.

Data set 2 shows an **environmental control variable** with results that show the distance from the target increased outside. The range of data for inside is small compared to the data outside which has a much wider spread. There is an **anomalous result** on trial 3 for inside as the number is larger than the rest of the results.

Data set 3 shows **environmental control variables**. The conditions the data was collected in on each day can be identified as:
 Monday - outdoors, cloudy
 Tuesday - outdoors, rainy
 Wednesday - indoors
 Thursday - outdoors, windy



EXTEND THE LEARNING!

Use the Talk Prompts in the Quantum-linked **Great Question Ponder** as part of science and oracy development.

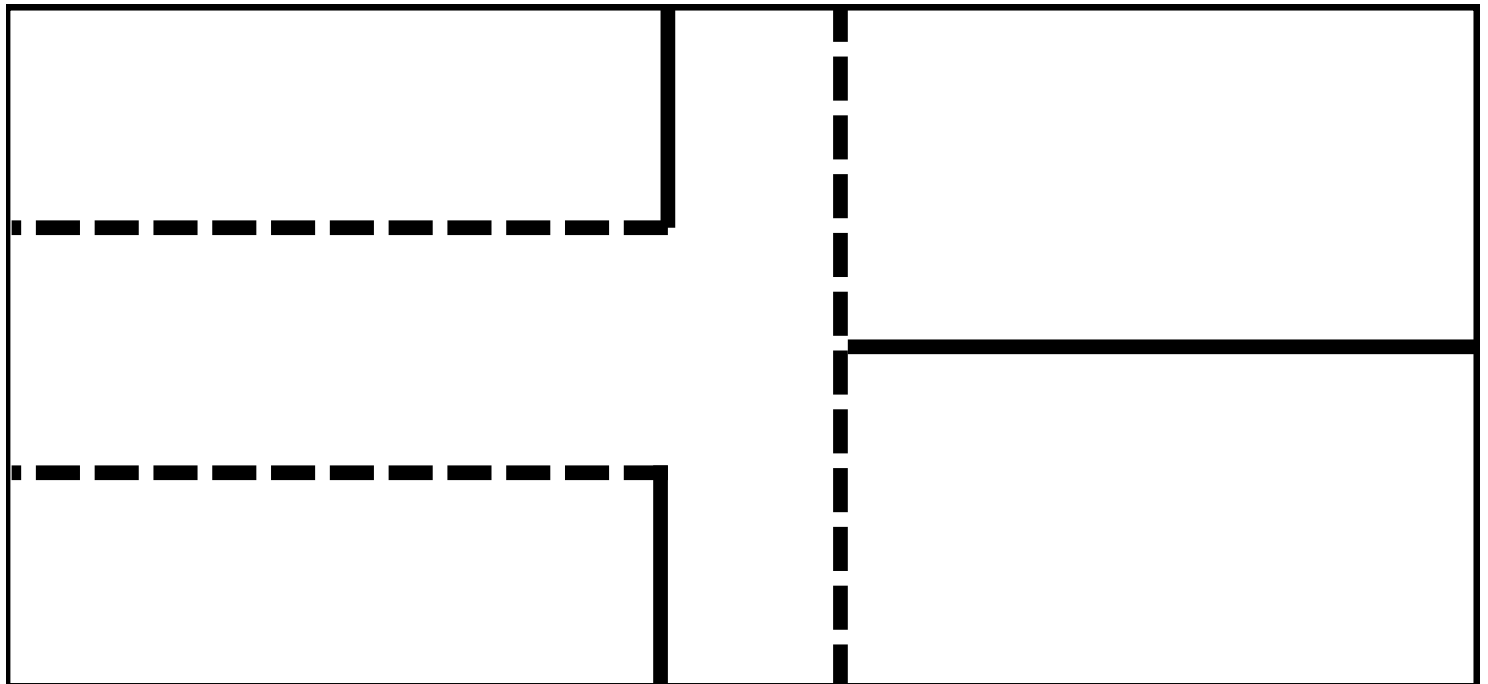
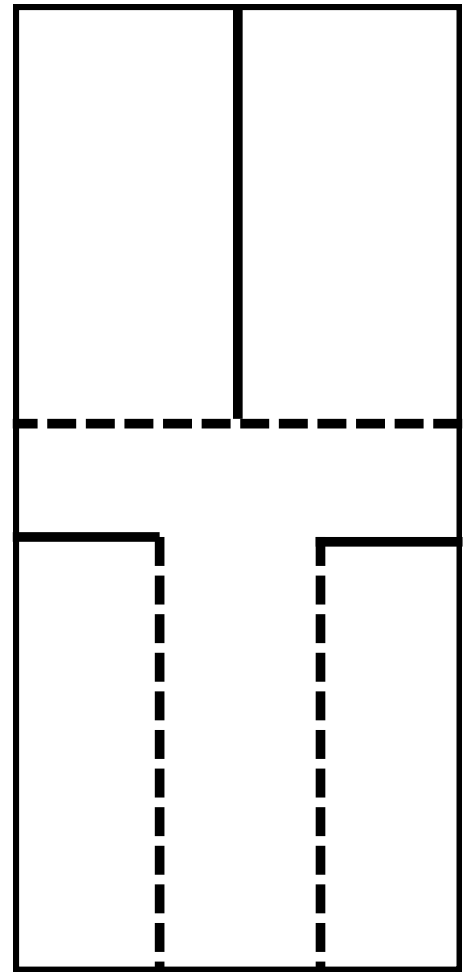
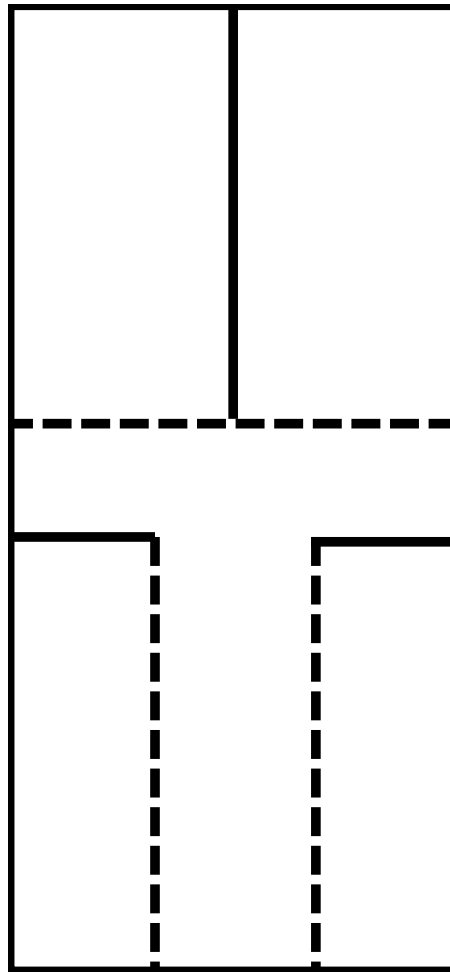
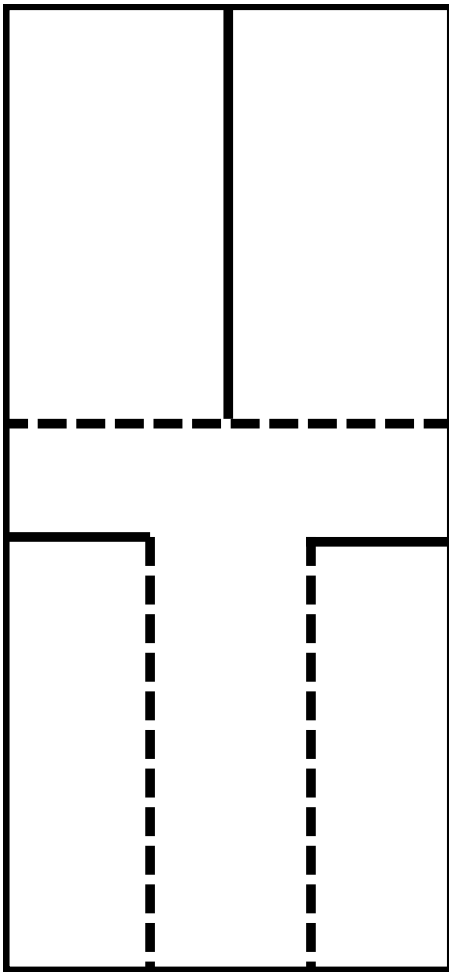


www.greatscienceshare.org

DISCLAIMER: This activity sheet was written for The Great Science Share for Schools. The author(s) and the Great Science Share for Schools are not liable for the actions or activity of any persons who use this resource or in any of the suggested further resources. We assume no liability with regard to injuries or damage to property that may occur as a result of using this information. These activities are designed to be carried out by pupils working with an adult. The adult is fully responsible for ensuring the activity is carried out safely. You can access further Health & Safety guidance from CLEAPSS www.cleapss.org.uk and SSERC www.sserc.org.uk

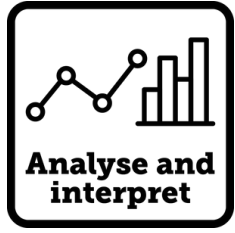
Spinner template

Cut the solid lines, fold the dotted lines



What pattern does this data show?

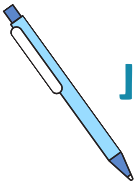
Data Set 1



Trial		1	2	3	4	5
Distance from target (cm)	Paper	2	1	2	0	2
	Card	1	1	0	2	18

Questions to ask about the data...

- Are there any patterns in the data?
- Is the variable an environmental or experimental? What makes you think that?
- Can you spot any anomalous results? What could have caused them?
- Is there any evidence of human error or lack of control of other variables?
- What type of graph would best represent this data set?



Put your thoughts here...

Questions we could investigate next are:



What pattern does this data show?

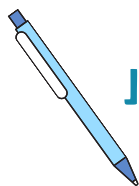
Data Set 2



Trial		1	2	3	4	5
Distance from target (cm)	Inside	6	8	23	7	6
	Outside	18	15	24	22	11

Questions to ask about the data...

- Are there any patterns in the data?
- Is the variable an environmental or experimental? What makes you think that?
- Can you spot any anomalous results? What could have caused them?
- Is there any evidence of human error or lack of control of other variables?
- What type of graph would best represent this data set?



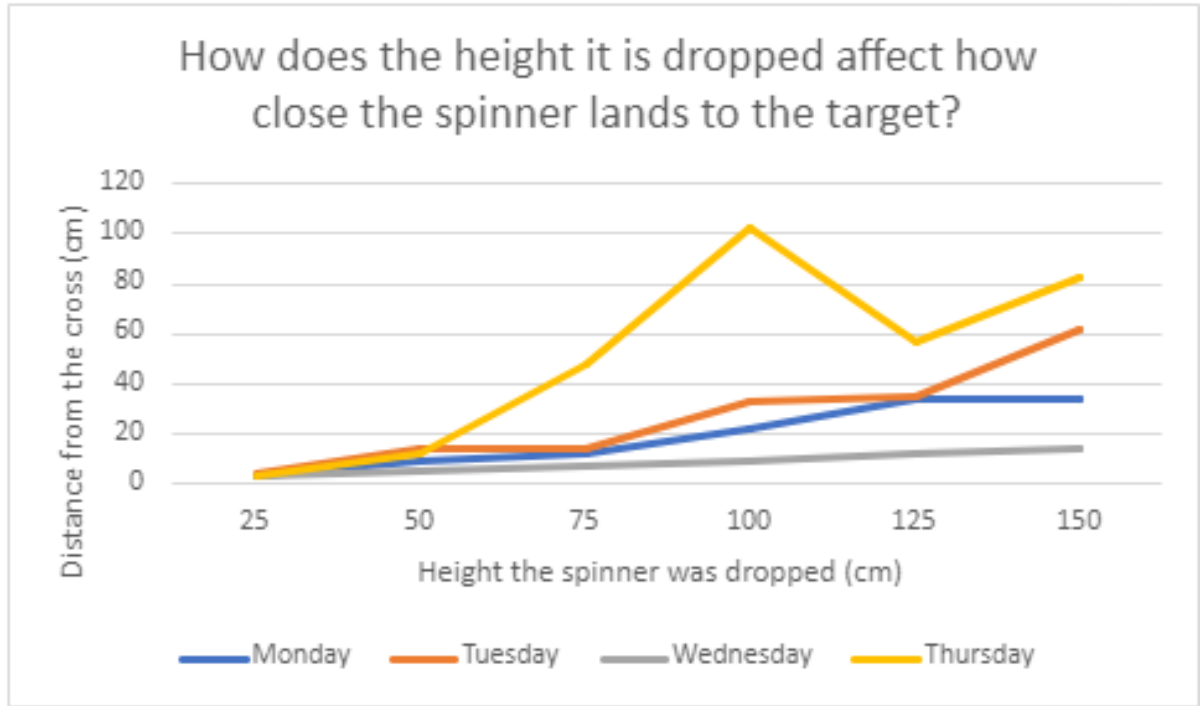
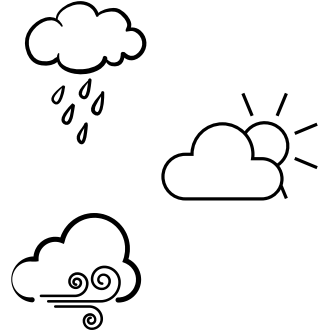
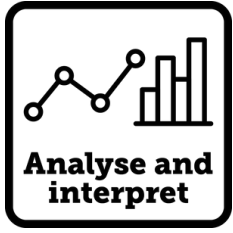
Put your thoughts here...

Questions we could investigate next are:



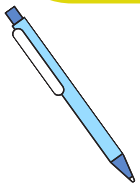
What pattern does this data show?

Data Set 3



Questions to ask about the data...

- Are there any patterns in the data?
- Can you spot any anomalous results? What could have caused them?
- What environmental conditions do you think each test was performed in. Consider if the investigation may have been performed indoors or outdoors – use the weather symbols to help you.



Put your thoughts here...

Questions we could investigate next are:

