**Lesson 1: Ask a question**

**Aims**

To ensure students understand what they will be doing over the 6 week period

To understand how to phrase and ask a scientific question

To develop a hypothesis that can be tested in the following weeks

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| Time | Learning activities | Resources |
| Preparation0-10 mins 10-2020-2525-35 35-4045-55 55-60 | Put out evaluation sheets on the desks with pensStarter: * evaluation sheets on table to complete as they come in. (teacher evaluation sheet too)
* Collect in parent consent forms
* Students to write name on sticky label and wear

Intro: Why are we all here? **POWERPOINT*** Intro slide: introduce self and colleagues.
* Over the next 6 weeks we will be helping you to carry out your own scientific research project (in groups) that you will present at a science fair in John of Gaunt school on the 25th November, and then at a science festival called Bath Taps into Science in March.
* At this festival you will explain your research to younger students in year 5 & 6 (aged 9 -11).
* Who has heard of Bath Taps into science? Who has been to a science festival before?
* [VIDEO]
* As you can see there are lots of people presenting their research, researchers at the university, local companies and also school students like you. We have invited year 5 & 6 to come along so you will be explain and demonstrating your research to these younger students
* Poster boards
* Crest awards

Activity 1: Scientific method activity **WORKBOOK AND POWERPOINT*** Groups of 5 – hand out cog activity; give 30 seconds to put the cogs in correct order
* Explain correct order and explain this is what we’ll be doing over the next few weeks
* Show correct order on power point and **hand out workbook** so they can fill out the correct order

Activity 2: Brainstorm ideas on A3 paper* **Work in groups (groups of 5 or 6; can be the same groups as activity 1)**
* Important it is something you are all interested in
* Brainstorm worksheet
* See completed brainstorm worksheet for help on power point

Activity 3: Ask a question **POWERPOINT & WORKSHEET*** Example questions on PowerPoint
* Research your question: WORKSHEET to take home – fill out table and bring in to next session.

Activity 3: Construct a hypothesis **WORKSHEET*** Define hypothesis
* Write 2-3 hypotheses based on their question

Plenary * Cogs – whoever completes the order the quickest wins a prize
* Questions and prizes (what is a hypothesis? What is the next stage of the process?)
* Research your question/hypothesis for homework **WORKSHEET**
* **Don’t take your books home**
 | * Pens
* Sticky labels
* Work books
* Welcome PowerPoint on memory stick
* Scientific Method activity (cogs)
* Prizes: bugs
* **A3 paper and coloured pens/pencils**
* **Research question at home – worksheet**
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Lesson 2: Experimental design

**Aims**

To understand what a fair test is

To understand the different variables in their experiment: independent, dependent and control

To use their knowledge to design their own fair test

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| Time | Learning activities | Resources |
| 0-1010-2525-3535-4040 - 5555-60 | **Starter**: Remind about project, put research question into workbook. Attach research work sheet into book – staples?Construct a hypothesis **PAGE in workbook*** Look at melting chocolate example (power point slide) - explain
* Write a hypothesis based on their question

**Activity 1**: Fair test introduction* Lay different sizes, shapes, types of paper on table
* Ask them to make a paper airplane
* Test paper airplanes: see which one is the ‘best’
* Ask them which one is the best and why.
* Is this one the best because it’s the biggest/nicest looking flew the furthest/flew the highest? Before we did the experiment we didn’t define what ‘best’ was, **it is important to have a specific question you can test before you do your experiment.**
* Everyone pick up a plane and now ask the question: **who can through their paper airplane the furthest?** All throw.
* Pick up plane that flew the furthest vs one that did not fly as far and ask them why, consider: weight/texture of material, wing shape, size. Write differences on board
* The aim was to see who can throw it the furthest – was this a fair test? Why not? Everyone received different materials, planes were made differently– write up differences on the board
* All of these things you can change are called variables. To ensure that your test is fair you must change only one variable at a time, whilst keeping all the others the same.
* What would you do to make the airplane test fair? Same size, shape and type paper etc. Make sure these factors were the same, make sure they are controlled – called control variables
* There are 2 other types of variables: the thing we want to measure (**dependent variable**) and the thing we want to change (**independent variable**). Measure: distance. Change: in this experiment we changed size, paper, and weight all at once! So we can’t tell whether it was the size or type of paper that made this plane fly the furthest. So it is important to change one thing at a time.

**Activity 2**: Identify variables in own experiments **WORKSHEET*** Define all variables and fair test in book
* Ask them to identify the different variables in their experiment and group them into independent, dependent and control.

**Activity 3**: Design an experiment worksheet* Each group to write their own methods, keeping in mind the variables they have just identified – list of materials and a protocol
* Should be like a recipe, someone else should be able to follow/replicate it – reference Great British Bake off technical challenge…

**Staff at this point – go round and support groups with planning, COLLECT AN EQUIPMENT LIST FROM EACH GROUP****Plenary*** Where are we in the scientific method cog wheel?
* Quiz: what is a control/dependent/independent variable, what is the next step? Bugs for prizes
* **For the next session bring in the items you will need to conduct your experiment.**
 | * Different shapes, sizes and types of paper
* Glue
* Pens and paper
* Variable worksheet
* Experimental methods worksheet
* Poster making equipment
* Stapler
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**Lesson 3: Data collection**

**Aims**

To learn how to record data for their experiment

To create a results table

To begin collecting or planning how to collect data

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| Time | Learning activities | Resources |
| 0-55-1515-2020-2525-5555-60 | Starter: Reminder from last week* What do we call changes in experiments? (variables)
* What are the three types?(Control, independent, dependent) – **power point slides to remind**
* Need to have a way to record results when doing an experiment so that you don’t forget it all
* Show **tables slide**, explain column headers and the standard layout. Refer back to melting chocolate and airplane examples to clarify and identify examples of dependent and independent
* Show the **independent variable on the left hand** side of the table and the **dependant variable on the right hand** side
* Was it each one a fair test? Was everything else controlled?

Quick introduction to graphs – different styles – whizz through slides, we will think about this more next time.**Activity 2** – complete method in workbooks**Activity 2**: create a table for own experiments in workbooks* Emphasise where each variable sits in the table
* Design table if haven’t got equipment for experiments

**Activity 4**: collect data – give out equipment to the groups* Collect data in the classroom
* Or think about your group will need to collect data outside the classroom
* Take photos of students collecting data to go on poster boards – need to ask teachers beforehand. Can’t take photos
* **Collect a list of things WP can buy so they can do their experiments the following week**
* Consider taking photos the experiments in progress, of students but could take photos of experiments on phones

Plenary – CLEAR UP* If time - Groups to explain to the rest of group what their question is and how they are testing it (with help of ambassadors)
* **What to bring next session**
* If time: Each group to say what they are doing to do between now and next session
 | * Pens, pencils and paper
* **Rulers, rubbers**
* Poster making equipment
* Experiment equipment as ordered last week
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Lesson 4: Data analysis

**Aims**

To understand the different ways there are to display data

To make figures using their data

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| Time | Learning activities |  |
| 0-1515-2525-5555-60 | Starter: Liquid nitrogen show ANDREWActivity 1: Data analysis **PUZZLE and POWERPOINT*** Work in groups to complete a graph puzzles; x axis, y axis, axes labels, chart title
* At the end ask them to identify the independent and dependent variables on the graph. Explain how each of the variables on the table also fits onto the graph

Activity 2: analyse data they have collected* Ambassadors to help with this
* Remind students about spacing numbers evenly on each axis

Back up activity: for those who have finished – think about how to draw conclusionsMaking posterPlenary* What have you learnt today? Prizes
* What is the next stage? Where have we got to so far? What do we need to do next?
* What are you going to do before the next session?
 | * Poster making equipment
* Graph paper
* Rulers
* Pencils
* Rubbers
* Glue
* Coloured pencils
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Lesson 5: Conclusions and poster board

**Aims**

To learn how to draw conclusions from their data

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| Time | Learning activities | Resources |
| 0-1010-1515-5050- 60 | Activity 1: Conclusion questions **WORKBOOK*** Work in research group to work through Decide what your conclusion is – can you make one or not? How could you make your experiment better next time?

Activity 2: Graph making information* Work through power point slides to explain different types of graph

Activity 3: Make your poster board* Explain: poster board will help you present research at the festival, presenting alongside academics and people from industry, the audience will be year 5&6
* Each person takes one section: title, question and hypothesis, method, results (table and graph), conclusion, evaluation
* Use images on poster board slides to show examples of good presentations
* Make poster boards – audience is other KS3 students, primary school students and families and friends
* At same time tell us which equipment you will need to be replenished for Saturday (collect list from each group)

Plenary ESSENTIAL **INFORMATION SHEET*** Remind time, location of science fair – meet 9.30 am, starts 10 am, finishes 12 am, can leave at 12.30 after clearing up
* Bring any of your own equipment (weather monitor?) experiment so younger students can have a go – could record further data at the fair
* We will bring all the display materials and practical equipment – you just bring yourself, in uniform and your family/friends
 | * Pens
* Poster making equipment
* Graph paper
* Squared paper
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