



Park Community School



Handbook



2025-2026

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Department Aims and Vision

The Science Department at Park Community School is both dynamic and enthusiastic. We offer inspiring learning through a broad range of teaching methods and a diverse curriculum. Students learn all three disciplines of science. The study of Biology fosters an appreciation for the complexity and interactions of the processes, systems, and diversity of the living world. The study of Chemistry develops pupils' approach to understanding the material world and its properties with an open and analytic mind. The study of Physics fosters curiosity and excitement about the physical world and develops powerful tools to understand the fundamentals and the connections between different phenomena. We aim for students to progress in both their substantive knowledge (the theory and understanding of the topic) but also their disciplinary skills, such as analysing data, planning experiments, evaluating models and theories and debating moral issues, which are abilities employers regard highly.

Students learn in the classroom, but also immerse themselves in the local area in terms of the wildlife of the site, the school farm and our local national park. This allows direct links to the curriculum and relevance to their own experiences whilst developing an understanding of science and extending opportunities to directly apply their knowledge.

Park Community School is fortunate to hold excellent community and business links. The Science Department has partnership projects with a range of organisations, including the Life lab in conjunction with Southampton University. We also have great contacts at the Big Bang at School which provides great opportunities and experiences. We also work closely with Winchester College, which are often able to support our students with extra opportunities not widely available.

Additionally, the Science Department also holds some excellent links with organisations such as Solent LEP and STEM Portsmouth, which give students opportunities to hear and learn about career opportunities in science through trips and speakers that come to the school. The teaching staff have a passion for science and an overwhelming desire to share their knowledge with the future generations of Scientists. We are very proud to see so many of them go on to take a range of Sciences at A level and beyond.

We are fully inclusive and will adapt our teaching and delivery to all learners, especially students identified as SEN, EAL or disadvantaged.

The main aims of the science department are:

1. To ensure that all pupils are engaged and enjoy being in science. Promote curiosity of science.
2. To promote the real-life applications of science in everyday life by a clear focus on cultural capital.
3. To allow students to work as scientists, by using practical skills to enhance the learning of content.



The vision of the department consists of the 4Cs, these are consistency, curriculum, challenge and collaboration.

- **Consistency** in our teaching and our approach to the success of all pupils.
- Having a broad, engaging and ambitious **curriculum** to ensure that we allow pupils to solve problems and apply knowledge to a range of different contexts. Allowing students to ask questions and to promote curiosity in KS3.
- To **challenge** the thinking of students and promote independence in and out of the classroom.
- To **collaborate** and share good practice and to celebrate the strengths of the department and also give support and develop our weaknesses when necessary.

Science Curriculum

Intent

In science, we deliver an ambitious and broad curriculum that caters for all learners. During Key Stage 3 in science, we want our students to be curious about the world around them and be confident to ask questions and investigate a range of possibilities.

Our curriculum is designed to be sequential, building upon the learning in Key Stage 2 and enabling students to develop the necessary skills when working as a scientist. Vocabulary is very important in science, and we develop the number of science-specific words learnt by students and ensure these are practised both orally and in written work.

Once at Key Stage 4, we build upon the key skills and knowledge learnt in Key Stage 3 and continue to master these and apply them to a range of ideas and contexts.

Implementation

We have a centralised spiral curriculum in Key Stage 3, designed to ensure the National Curriculum is covered with appropriate levels of challenge for all students.

We provide opportunities for students to prepare, practise and perform, enabling them to become great learners.

For Key Stage 4, we have a centralised scheme of work designed to ensure the AQA specification is covered from grades 1–9. All pupils are entered for combined science, unless they opt for triple science.

We improve and master the working scientifically skills built upon in Key Stage 3, while covering the required practical elements of the course.

Common formative assessment tasks are used to inform both teachers and students of level of understanding and next steps.

Clear focus on expanding scientific vocabulary to ensure fluency in both written and verbal answers.

Impact

During Key Stage 3, we want students who are ready for Key Stage 4 with necessary skills and knowledge to build upon and are 'GCSE ready'.

Students have high aspirations and enjoyment of science when leaving Key Stage 3 and we have seen increasing percentages of 5+ and 7+ grades over the past three years.

Once in Key Stage 4, our aim is to increase the number of students going on to study a science subject at higher education and to ensure students leave with the ability to question the changing world around them.

Department Expectations

Day to day

During non-contact time, it is the expectation that you work in the STEM office or in your classroom. This is to support other members of the department and to ensure that the area is kept calm and classes are taken in promptly.

All members of staff need to be a corridor presence at lesson changeovers.

All windows need to be closed at the end of the day, sinks checked, the desk kept clear, computer logged off and the screen turned off before leaving.

Meetings

Meetings start promptly at 2pm on a Tuesday in G01. Meetings last for 2hours. Part of this meeting could be a year group or staff meeting. Time during this meeting will be used for the development of the department.

It is expected that **all** members of the team attend and are willing to complete appropriate minutes when requested.

Planners and other note taking equipment (diary, pen and paper etc) should be brought to the meeting to ensure that key dates and actions are noted by all.

If a task needs to be completed between meetings, it is expected that this is done to the deadline. If there is an issue, this must be addressed prior to the meeting.

If you know you are unable to attend the meeting, apologies must be sent to MTU prior to the meeting with reasons.

Sickness and Cover

If you are ill and are unable to come into work, you need to text MTU (07882 681535) as early as possible. You are also required to ring into the school (**023 92 489808**) and leave a message with *your full name, the day and date, a brief reason for the absence*. This is to ensure that cover teachers are notified to cover your lessons.

If you are able to set cover work then this should be emailed in by 8am so any photocopying can be done in the morning prior to any lessons starting. The correct cover sheet should be completed with a suitable amount of activities that can be completed. **No ipads can be used for cover.**

If you are unable to set cover, MTU must be informed as soon as possible in order for cover to be sorted on your behalf.

If you are absent due to a course, trip or other personal reason, cover should be left in school ready to be used. A copy should be left with MTU in case any issues arise.

Technicians

Guide for ordering equipment.

There are two technicians in the department, they are:

Claire Tomlinson (Senior Technician) - Monday, Tuesday, Wednesday.

- 750am until 410pm.

Nicky Marsh (Senior Technician) – Wednesday - 9am until 2pm.

Thursday, Friday – 9am-3pm

Key things to remember when ordering equipment:

- Orders should be in by lunch time on Thursday, especially if shopping is required.
- Please be aware that if more than one person orders the same equipment it will be given on a first come basis.
- If you are hoping to do a practical that is not on a SOW please discuss with us first to check we have what is required.
- Please use CLEAPPS before a practical. **Ensure you have your own personal login account. Liaise with CTO/NMA.**
- If it is practical you have not carried out with a class before, please ask and you will be able to practice first to ensure it is safe for use with a class.
- If you do not use your equipment in the lesson it was prepared for, please be aware that in busy times it may be taken for another class.
- Late requests are usually possible, but please check with us first.
- Please ensure that you count equipment in and out.
- There is a dust pan and brush in each lab, which should be used if there are any breakages. Glass bins are in each prep room.

The perfect request sheet

Name	1	2	3	4	5
Mon	Year Grp, Room, No. in class. Demo or class set. List of equipment & ref to SOW.				
Tues					
Weds					
Thurs					
Fri					

LAB SAFETY



It's not rocket science!

NO
eating or
drinking



WEAR GOGGLES
during practicals



NO
CHEWING
GUM!

No!
Running
In the Lab

Tie Back
Loose Hair

STAND UP
during practicals



Bags
Under
desks or
on hooks



Follow
All
Instructions!

ALWAYS Help clean up

Always listen to your teacher!

Ensure practical safety is clearly seen in every practical.

Student safety sheets should be in each classroom and referred too.

Risk assessments should be developed over time.

Red lines – what this looks like in science

Strand	Expectation	How this can be seen in science.
Reading	Students are expected to read aloud	Including; exam questions, text on screen, textbooks, methods for practical's
	Teacher actively models reading	During I do activities or during the modelling of exam questions
	Reading materials are of a high quality	
	Summarise/ synthesise- reading model added	Key methods from required practicals
First 5	Teacher Greets at the door monitoring entry to lesson – narrates positive	G01 – Outside door, G02 – Technology side, G03 – Lined up at wall, G04 – lined up towards stairs, G05 – Lined up between doors, G06 – lined up outside door, G07 – lined up down stairs
	Do it Now task	Written/on slide prior to LOs – expected to complete in silence – teacher is 'seen' watching and monitoring class
	Objectives, Map & Keywords shared	LO's not written, title and keywords written. Keywords written in margin.
Classroom	Classroom tidy	Check equipment, sinks and floor
	Smart displays support learning	
	Seating plan in place	Boy/girl. Can change during investigations.
Teaching	Teaching is based on clear objectives	KS3 – National curriculum KS4 – Specification
	Questioning is used regularly to check to understanding and assess: ✓ Cold call with wait time ✓ No opt out ✓ Right is right ✓ White boards used to check for understanding	Most students per lesson, targeted students and not always hands up unless suitable. Wait time given and name asked at the end of the question to ensure all students are thinking High ratio of participation
	Modelling is used to promote progress i.e.: metacognitive and/ or WAGOLL	During question modelling activities OR exam questions fortnightly
	Students orally rehearse responses to questions	Kagen strategies (Round Robin, Think pair share, Rally robin)
	Students are expected to 'get stuck'/ think hard	4B's, assessments – applications to think hard Comfort, stretch, panic
	Take 5	Interleaving activities – will cover previous learning
Feedback	Frequent assessment of learning impacts progress	Assessments – Yr 7-9 as per scheme of work. Deep marking and feedback with allocated review time and completion of whole class feedback sticker.
	Regular written feedback given as per dept policy	In-flight marking per fortnight – each student book to be marked fortnightly during lesson time.
	Feedback is effective i.e.: impacts on progress	
	Review of assessments - class based and individual	Review time allocated in lessons – includes green penning for improvements and extension questions, exam questions. Inside cover of exercise books shows summary of all assessments completed
Final 5	Learning is reviewed/ summarised/ questioned	As plenary
	Students behind chairs in silence	
	Teacher dismisses at door	
Making positive choices	System used as necessary	Merits awarded
	Low level disruption is addressed swiftly	Using school behaviour policy
	Calm and consistent manner every lesson	

Schemes of Work - Overview

All schemes of work include:

1. Scheme of Work (produced in a PowerPoint format)
2. Front sheet for all schemes which contain National curriculum/specification content and all practical equipment required for the lesson.
3. At the beginning of each topic, a precise learning checklist is shared.
4. Big Picture of scheme for students (in exercise books)
5. Assessments as prescribed per topic – KS3.
6. Guided reading tasks for KS3 – at least one per topic
7. Three Key Assessment tests linked to STEPS.
8. Homework
 - a. KS3 – Week A – MCQs on google classroom
 - b. KS3 – Week B – Homework book
 - c. KS4 – Year 10 – Green sheet / extended questions set weekly
 - d. KS4 – Year 11 – Past Papers Questions (3 approx) (Paper 1s) set weekly.

Rosenshine's Principles *(taken from Rosenshine's principles in action; Tom Sherrington 2019)*

The following is a list of instructional procedures that underpin our teaching and fundamentally link into our schemes of work;

- Begin a lesson with a short review of previous learning (Do now/starters/Take 5)
- Present new material in small chunks with student practice after each step
- Limit the amount of material students receive at one time
- Give clear and detailed instructions and explanations
- Ask a large number of questions and check for understanding (whole class involvement)
- Provide high level of active practice for all students
- Guide students as they begin to practice
- Think aloud and model steps (metacognition and oral rehearsal is promoted)
- Provide models of worked-out problems
- Ask students to explain what they had learned
- Check the response of all students
- Provide systematic feedback and corrections
- Use more time to provide explanations
- Re-teach material when necessary
- Prepare students for independent practice
- Monitor students when they begin independent practice

All teachers to have a model exercise book – use with visualiser or ipad on good notes, for WAGOLLS etc. Teachers to utilise technology to promote pupils work within lessons. Utilise blank canvas bringing in real life contexts into each explanation.

- The title and key words should be displayed throughout the lesson

Schemes of work

All schemes of work are written and are fully linked to National curriculum and exam specification.

They include any keywords that should be covered in the scheme, the working scientifically skills that are covered and the assessments that would be completed.

The front sheet for each topic also shows any previous knowledge from KS2/KS3 and where this topic fits in to KS4.

See example below:

Topic 1: Body systems

<p>Precise knowledge: Explain the role of each nutrient in the body. Describe how to test food for starch, lipids, sugar, and protein. Describe some health issues cause by an unhealthy diet. Calculate the energy requirements of different people. Describe the process of digestion. Describe the structure and function of the main parts of the digestive system. Describe the role of enzymes in digestion. Describe how the parts of the gas exchange system are adapted to their function Describe the process of inhaling and exhaling Describe how a bell jar can be used to model what happens during breathing Explain how to measure lung volumes</p>	
<p>Vocabulary Focus: Nutrition, Soluble, Digestion, Exchange, Adaptation</p>	
<p>Previous knowledge:</p> <ul style="list-style-type: none"> recognise the impact of diet, exercise, drugs and lifestyle on the way their <u>bodies</u> function describe the ways in which nutrients and water are transported within animals, including humans. describe the simple functions of the basic parts of the digestive system in humans describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene. 	<p>Next steps...</p> <p>KS4 links: Biology Paper 1—Organisation</p> <div style="text-align: right;">  </div>

For each lesson, there are objectives;

KS3 – These correspond to our new assessment steps.

KS4 – They are aimed at grade 4, grade 6 and grade 8.

They also cover practical or demonstration that could be covered. Equipment is clearly listed for ordering with the technicians.

KS3 – Year 7

Lesson No. and Title	Learning objectives	National Curriculum	Working scientifically skills	Practical equipment
1. Observing cells <i>Possible exit ticket - microscopes</i>	ARE – To explain how to use a microscope and state the magnification. AGD – To calculate a range of magnifications.	<ul style="list-style-type: none"> cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope 		PRAC —Observe prepared slides under microscope Microscopes and prepared slides WS8 – Reading and using a given method WS10 – Selecting the correct equipment
2. Cells	ARE – To correctly draw and label a plant and animal cell. AGD – To explain the functions of the components of animal and plant cells.	<ul style="list-style-type: none"> the functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts 		

KS3 and KS4 – Precise learning checklist

At the beginning of each topic, a precise learning checklist is given to students and stuck into exercise books. This lists all the key information that will be covered during that topic. This is to ensure students have the big picture of the topic and are able to use this for revision prior to assessments/tests.

Students should tick off each time knowledge has been taught/revised/assessed, this should mean the checklist has multiple ticks.

Below are examples for both KS3 and KS4:

KS3:

Identity

Powerful knowledge statements:

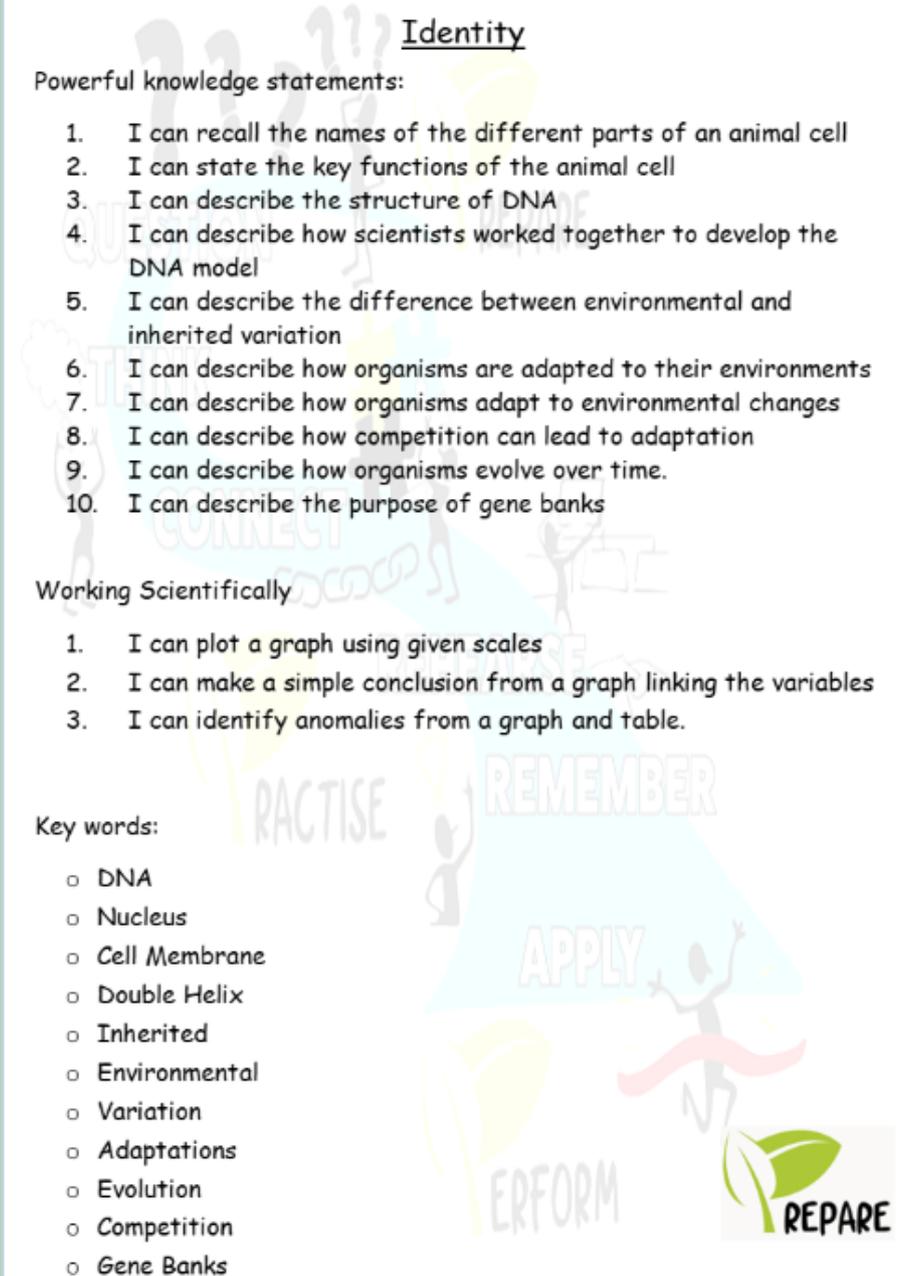
1. I can recall the names of the different parts of an animal cell
2. I can state the key functions of the animal cell
3. I can describe the structure of DNA
4. I can describe how scientists worked together to develop the DNA model
5. I can describe the difference between environmental and inherited variation
6. I can describe how organisms are adapted to their environments
7. I can describe how organisms adapt to environmental changes
8. I can describe how competition can lead to adaptation
9. I can describe how organisms evolve over time.
10. I can describe the purpose of gene banks

Working Scientifically

1. I can plot a graph using given scales
2. I can make a simple conclusion from a graph linking the variables
3. I can identify anomalies from a graph and table.

Key words:

- DNA
- Nucleus
- Cell Membrane
- Double Helix
- Inherited
- Environmental
- Variation
- Adaptations
- Evolution
- Competition
- Gene Banks



KS4:



B1 – Cell Biology (Combined Higher) AQA

By the end of the topic I will be able to:

- Use the terms 'eukaryotic' and 'prokaryotic' to describe types of cell
- Describe the features of bacterial (prokaryotic) cell
- Demonstrate an understanding of the scale and size of cells and be able to make order of magnitude calculations, inc standard form
- Recall the structures found in animal and plant (eukaryotic) cells inc algal cells sub-cellular structures
- Required practical 1: use a light microscope to observe, draw and label a selection of plant and animal cells**
- Describe what a specialised cell is, including examples for plants and animals
- Describe what differentiation is, including differences between animals and plants
- Define the terms magnification and resolution
- Compare electron and light microscopes in terms of their magnification and resolution
- Carry out calculations involving magnification
- Describe the processes that happen during the cell cycle, including mitosis (inc recognise and describe where mitosis occurs)
- Describe stem cells, including sources of stem cells in plants and animals and their roles
- Describe the use of stem cells in the production of plant clones and therapeutic cloning
- Discuss the potential risks, benefits and issues with using stem cells in medical research/treatments (inc diabetes and paralysis)
- Describe the process of diffusion, including examples and how it is affected by different factors
- Define and explain "surface area to volume ratio", and how this relates to single-celled and multicellular organisms (inc calculations)
- Explain how the effectiveness of an exchange surface can be increased, inc examples of adaptations for small intestines, lungs, gills roots & leaves
- Describe the process of osmosis (inc calculation of water uptake & percentage gain and loss of mass of plant tissue)
- Required practical 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue**
- Describe the process of active transport, including examples - gut and roots
- Explain the differences between diffusion, osmosis and active transport



B1 – Cell Biology (Triple Higher) AQA

By the end of the topic I will be able to:

- Use the terms 'eukaryotic' and 'prokaryotic' to describe types of cell
- Describe the features of bacterial (prokaryotic) cell
- Demonstrate an understanding of the scale and size of cells and be able to make order of magnitude calculations, inc standard form
- Recall the structures found in animal and plant (eukaryotic) cells inc algal cells sub-cellular structures
- Required practical 1: use a light microscope to observe, draw and label a selection of plant and animal cells**
- Describe what a specialised cell is, including examples for plants and animals
- Describe what differentiation is, including differences between animals and plants
- Define the terms magnification and resolution
- Compare electron and light microscopes in terms of their magnification and resolution
- Carry out calculations involving magnification
- Describe how bacteria reproduce and the conditions required
- Describe how to prepare an uncontaminated culture
- Calculate cross-sectional areas of colonies or clear areas around colonies using πr^2
- Calculate the number of bacteria in a population after a certain time if given the mean division time
- Express answers for last two points in standard form
- Required practical 2: investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition**
- Describe the processes that happen during the cell cycle, including mitosis (inc recognise and describe where mitosis occurs)
- Describe stem cells, including sources of stem cells in plants and animals and their roles
- Describe the use of stem cells in the production of plant clones and therapeutic cloning
- Discuss the potential risks, benefits and issues with using stem cells in medical research/treatments (inc diabetes and paralysis)
- Describe the process of diffusion, including examples and how it is affected by different factors
- Define and explain "surface area to volume ratio", and how this relates to single-celled and multicellular organisms (inc calculations)
- Explain how the effectiveness of an exchange surface can be increased, inc examples of adaptations for small intestines, lungs, gills roots & leaves
- Describe the process of osmosis (inc calculation of water uptake & percentage gain and loss of mass of plant tissue)
- Required practical 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue**
- Describe the process of active transport, including examples - gut and roots
- Explain the differences between diffusion, osmosis and active transport

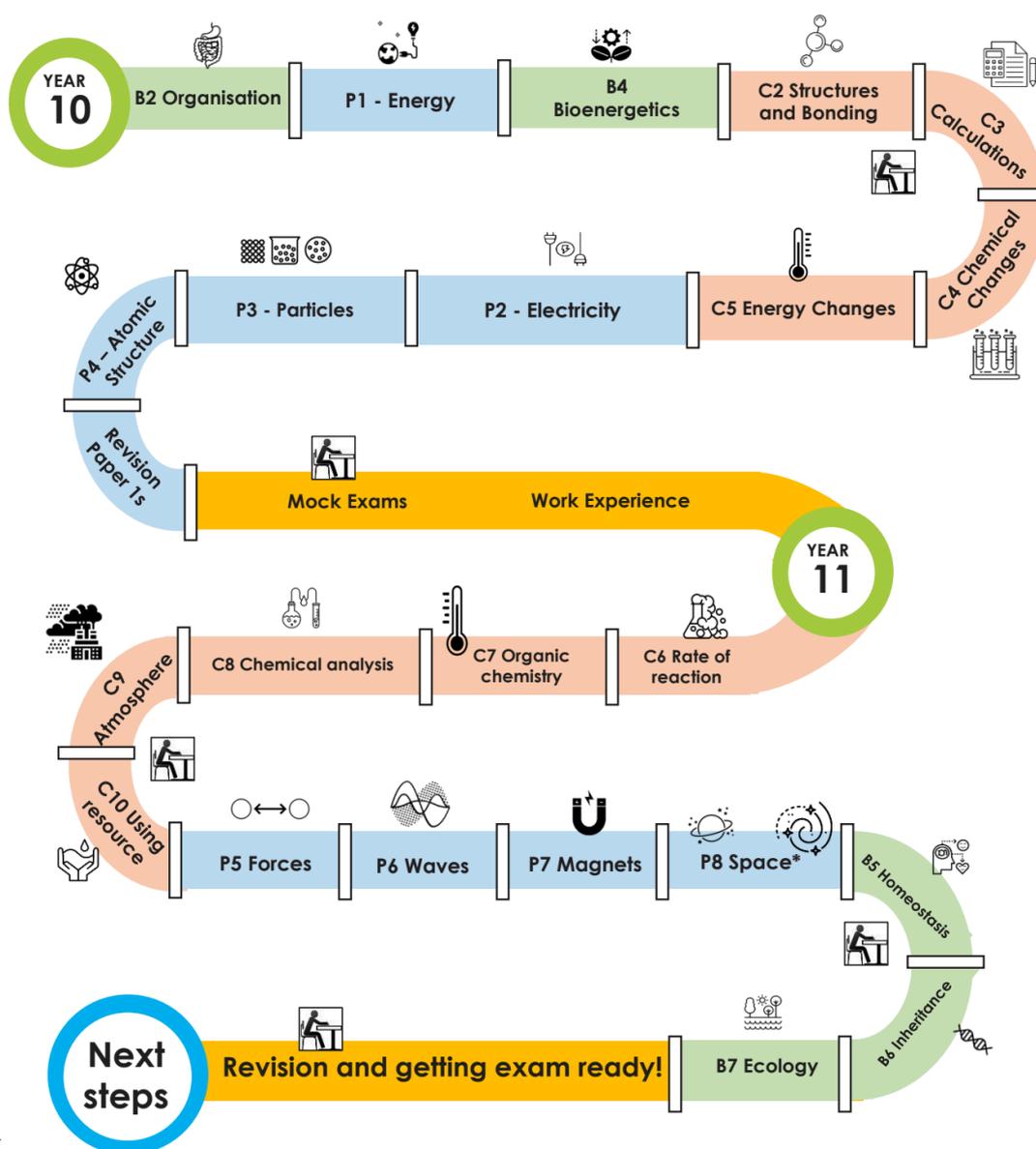


KS4 Learning Journey

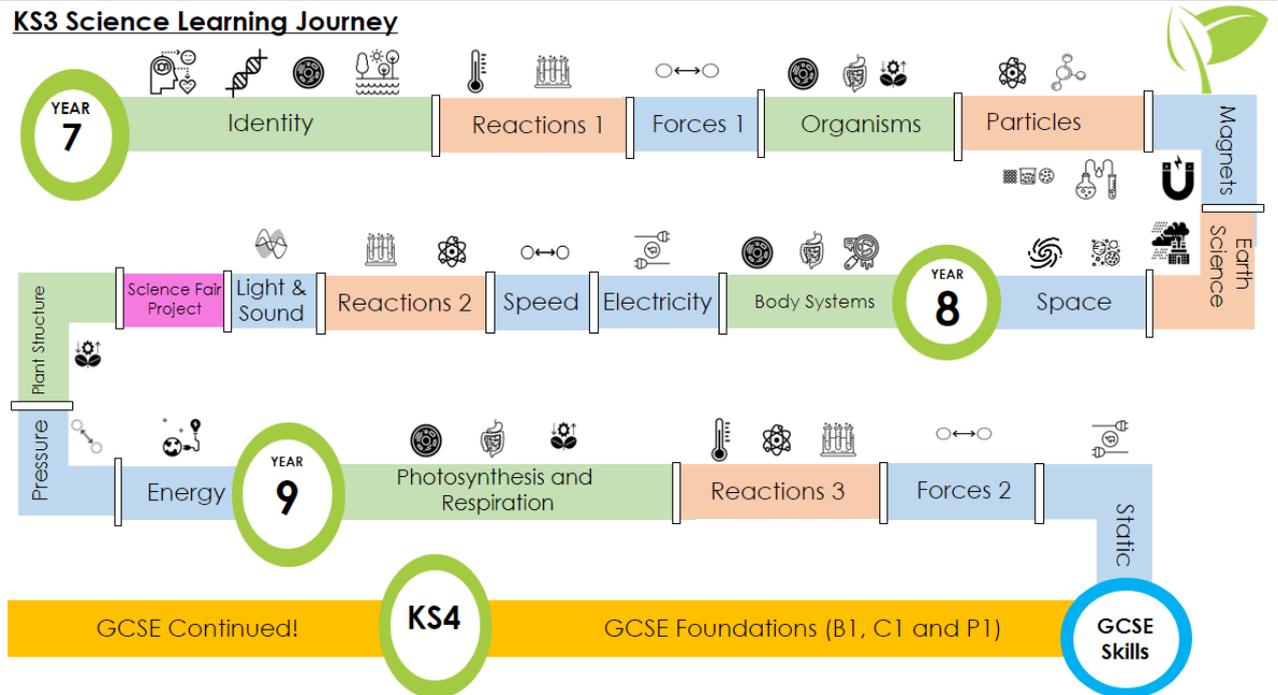


Previously studied in year 9:

- B1 – Cells and Transport
- B3 – Infection and Response
- C1 – Periodic Table and Atoms



KS3 Big picture



These should be discussed with students in the first lesson and referred to as often as possible. For KS4, once topics or required practicals are completed, they should be ticked off.

Exercise book expectations:

1. Exercise books are printed larger than A4 so all worksheets are neatly stuck in.
2. Assessments will be stuck into books (not folded and stuck on one page) with the relevant model answer and feedback. (Assessments are printed on purple paper)
3. Pencil and ruler are used to draw any diagrams and tables.
4. Title and date should be in books but objectives do not need to be written but must be discussed with class at the beginning of the lesson and referred back to at the end of the lesson.
5. Keywords for the lesson should be written in the margin clearly.

See WAGOLL below:

Wednesday 11th
Dec 2019

key words

Epidermis
Phloem
Xylem
Palisade
sponge-Meso
phyl
Stomata
Guard cell

Do now
petals have a large surface area to allow for more uv rays to be absorbed so photosynthesis can take place.

In the stem is the Xylem and the phloem. Xylem transfers water and the phloem transfers nutrients.

Seed allows for new life to grow. ✓

Plant Cell

- barrier.	epidermal	the epidermal surface. its creates a waxy surface. creating a waterproof -
	Palisade Mesophyll	This contains a lot of chloroplast which carries out photosynthesis.
	spongy Mesophyll	this tissue has some chloroplast but has a large air space to make the diffusion easier.
	Xylem	This carries water and dissolves mineral ions.
	Phloem	The phloem carries the Sap.
	Meristem tissue	This grows at the tips this is made up of rapidly dividing cells.

Take 5 ✓

Oxygen + glucose = waste products of carbon and water

$$6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6\text{H}_2\text{O} + 6\text{CO}_2$$

KS3 Assessments

Assessments are used with all classes and should be completed at identified points. They are used to check the progress of the class and ensure that key concepts are fully understood by all.

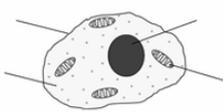
KS3 assessments are written so all students can access the key knowledge that needs to be assessed. They are written into different sections of our steps, knowledge and recall, understanding. Application and analysis; and evaluation.

An example is below:

Key Stage 3 Assessment: Identity 1

Knowledge/Remembering Questions:

Label the animal cell: (4)



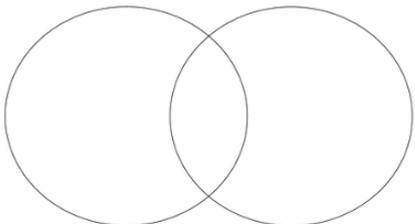
Where is the DNA found in the cell? _____ (1)

What is the shape of DNA called? _____ (1)

Understanding Questions:

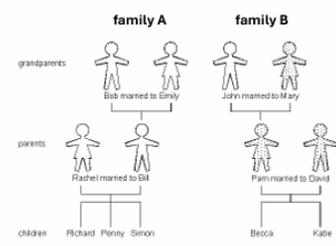
Sort the following into the Venn diagram below: (6)

Weight	Eye Colour	Skin Colour	Scars
Natural hair colour		Hair style	
Inherited		Both	Environmental



Application/Analysis:

The diagram shows two families. Some of the people in the diagram have freckles. People with freckles have dots in the diagram.



(a) Which children are most likely to have freckle? Tick the correct boxes. (1)

Richard	Simon	Katie	Penny	Becca
<input type="checkbox"/>				

(b) Explain your answers: (2)

.....

.....

(c) Suggest why Bill does **not** have freckles. (2)

.....

.....

Evaluation and Synthesis Questions:

A student says there is a relationship between a person's arms span and height. Their results are below:

Pupils	Height	Arm Span
1	130	120
2	140	140
3	150	150
4	120	130
5	125	125
6	135	140
7	145	140
8	155	150
9	160	155
10	110	160

Plot the data on the axis opposite and draw a line of best fit. (3)

1 mark – some points (3-5) plotted accurately.

1 mark – most points (5-9) plotted accurately.

1 mark – all points plotted accurately.

1 mark – clear line of best fit produced.

What can you conclude from the graph? Support your answer with data. (2)

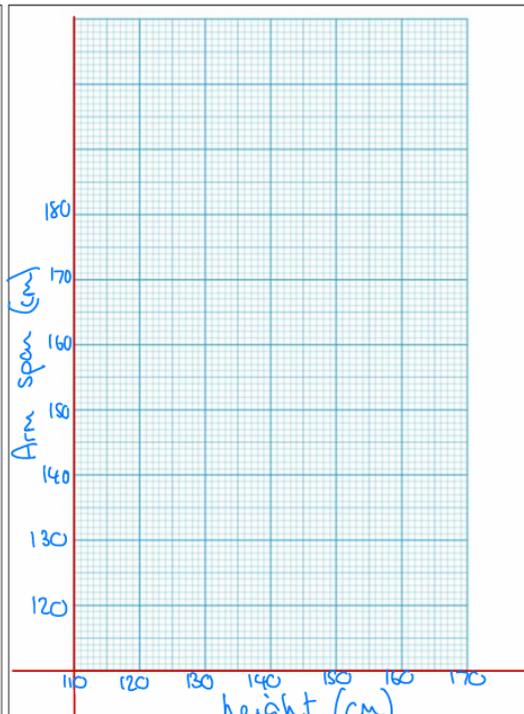
.....

.....

Is there an anomaly, if so, which pupil? How can you tell? (2)

.....

.....



Feedback sheet –

After each assessments pupils complete a blue sheet for feedback in green pen. This is then stuck in and students complete an extension activity for this.



Identity Assessment Feedback – Green Pen

Skill	Score	Out of?
Step 1 - Knowledge / Remembering		6
Step 2 - Understanding		6
Steps 3 and 4 - Application and Analysis		5
Steps 5 and 6 - Evaluation and Synthesis		8
Total		25

Read the powerful knowledge statements. Did you demonstrate this in your assessment?

Question Number	Assessed Content	Number of Marks
1	I can label the key organelles of an animal cell.	6 5 4 3 2 1 0
2	I can categories features into inherited and environmental features.	6 5 4 3 2 1 0
3	I can interpret a diagram to make predictions and justify them	5 4 3 2 1 0
4	I can plot data onto a graph accurately.	4 3 2 1 0
5	I can draw conclusions from a set of data.	2 1 0
6	I can spot anomalies and explain what they are.	2 1 0

My strengths	My areas for improvement:

Now complete the follow up activity.

KS4 Assessments

Alongside exam questions for GCSE classes, a range of exit tickets may be completed throughout each topic. These exit tickets are designed to focus on precise knowledge identified as a department that are key to exam success. These are not exam questions but bespoke questions created by the department. They should be quick to mark as the expectation is to mark them ready for the following lesson.

There is at least one exit ticket per topic but teachers are able to create more for their group if required.

Example of exit ticket below

Exit Ticket 1 - Chemistry 1

- All substances are made up of
- Select which is an example of an element and a compound, and justify why?
 H_2O O_2

Element:

.....

Compound:

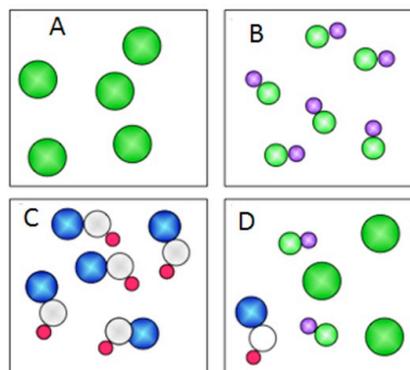
.....

- Identify the element, compounds and mixture in the diagrams below.

Element =

Compound =

Mixture =



- Complete the word equation:

Magnesium + Fluorine \longrightarrow

- Calcium sulfate, $CaSO_4$.

Number of elements =

Number of atoms =

Teachers may swap out exit tickets for specific past paper questions if they deem it better suited.

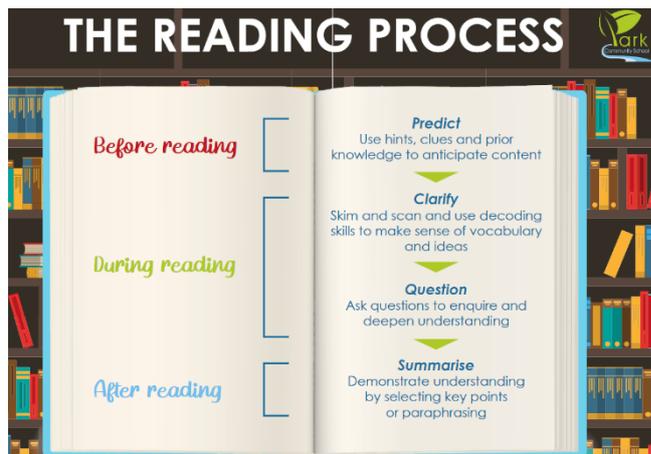
We aim for fortnightly marking to provide regular feedback (exit tickets or past paper question) in addition to weekly homework, which may be peer, self or teacher marked.

Pupils will also have exam papers marked during the middle and end of exam papers. Question level analysis will be provided and homework will be set to ensure the gaps in knowledge are acted on.

KS3 – Guided Reading

Each KS3 topic will have a specific guided reading task to complete. These will be printed on A3 buff paper and will be glued neatly into books on a double page.

These guided reading tasks follow the schools own reading process. Students are expected to predict what the article is about – this is the BEFORE question at the topic of the article. There are then a range of questions that are answered during the reading (the reading could be done as a whole class read or teacher read depending on the class). Once the article has been read and the DURING questions have been answered, students then complete the AFTER activities.



These will be either a summary of the article or demonstration of knowledge gained from the text.



READING

BEFORE: Predict what the article will say about how the structure of DNA was discovered.

Discovering the Structure of DNA

At midday on 28 February 1953, Francis Crick and James Watson walked into The Eagle pub in Cambridge and announced, "We have discovered the secret of life."

Earlier that morning, in the nearby Cavendish laboratory, the two scientists had discovered the structure of deoxyribonucleic acid, or DNA.

This discovery changed the world of science and medicine forever. Crick, Watson, and Maurice Wilkins shared the Nobel Prize for their work in 1962.

DNA was discovered in 1869, but it took until 1943 before scientists realised that DNA was the genetic material in cells, and that it contained a code for life. The next step was to find out its structure, in order to understand how the gene, the basic unit of heredity, works and how it is passed from one generation to the next.

Crick and Watson were trying to build a 3D model of the DNA molecule. But they were not the only ones working on finding its structure. They were competing with a team at King's College London, who were using a new

technique called crystallography to study DNA.

Rosalind Franklin, from the King's College team, made an X-ray diffraction image of DNA, which is known as Photograph 51. This showed that DNA had a helix shape. Without her knowledge, one of her colleagues showed the picture to James Watson. When he saw it, he knew that his and Francis Crick's theory about the structure of DNA was correct.

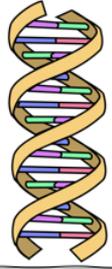
Crick and Watson's feat was to realise that there are two strands that coil around each other to form a double helix. The two threads are held together by bonds between base pairs. There are four types of base - adenine, thymine, cytosine and guanine.

All human cells contain DNA. The 3 billion pairs of bases in each cell fit into a space that is six microns across. If the DNA in one cell was extended it would be two metres long. All the DNA in a human body

would extend to Pluto and back.

The human genome - all the genetic material in our DNA - is like the recipe to make a human being. One copy would fill more than a hundred books. It contains 700MB of data (the Encyclopedia Britannica only contains about 130MB).

Incredibly, the four base strands in DNA are responsible for the whole variety of life on Earth. Humans, bacteria and mammoths have the same DNA system. We share 99% of our DNA with chimpanzees and about 50% of our DNA with bananas.



1 DURING: State who won the Nobel Prize for this discovery.

2 DURING: Describe the work that Rosalind Franklin did.

3 DURING: Describe how Watson and Crick got Franklin's work.

4 DURING: Describe what Watson and Crick discovered about DNA structure.

5 DURING: Describe what is meant by the human genome.

6 AFTER: Summarise the article in two sentences.

7 AFTER: Write a question that you have based on this article.



KS3 – Vocabulary

Along side the reading tasks for KS3, increasing the vocabulary of our students is a clear focus.

Tier 1 Vocabulary	High frequency words in casual conversation.
Tier 2 Vocabulary	Words found more frequently in written forms of communication or in conversation between those more academic.
Tier 3 Vocabulary	Words that appear in specialist domains or fields of study.

Each KS3 scheme will have 3-5 words (predominantly tier 2) that will be the vocabulary focus for the topic. These words have been identified as key terms that are important for students to fully understand and use in both written and verbal answers.

Tier 2-3 vocabulary for KS3 listed below:

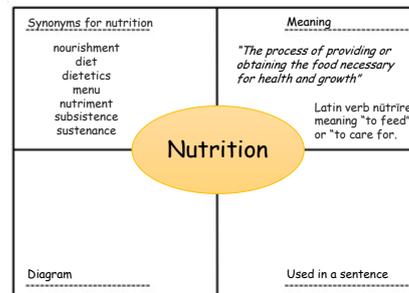
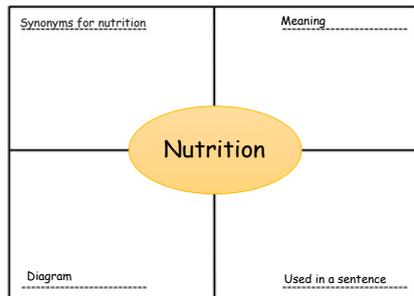
Adaptation	Efficiency	Particles
Adaptations	Electromagnet	Permanent
Arrangement	Electron	Porous
Atmosphere	Emitter	Potential Difference
Atom	Equilibrium	Pressure
Attract	Ethanol	Product
Attraction	Evaporation	Properties
Biodiversity	Evolution	Property
Charge	Exchange	Proton
Collapse	Exert	Radiation
Collide	Exploration	Reactant
Combustion	Extension	Reaction
Compaction	Fermentation	Reactivity
Component	Force	Reduction
Composites	Gas	Repel
Compound	Glucose	Repulsion
Compression	Induced	Resistance
Condensation	Inheritance	Resources
Conduction	Interaction	Resultant
Convection	Iodine	Series
Current	Limit	Soluble
Decomposition	Lunar	Specialised
Deficit	Magnification	Speed
Density	Multicellular	Starch
Deposit	Neutralisation	Static
Depth	Neutron	System
Digestion	Non-contact	Variation
Discharge	Nutrition	Vector
Displacement	Ohms	Voltage
Dissolving	Orbit Solar	Weight
Ecosystem	Parallel	Weightless

Frayer Model

The Frayer model will be used to facilitate some of this vocabulary. Below is an example of what this will look like.

Frayer model stickers will be used (same ones used in English). The PowerPoint will have the template and an example that can be used as a model for teachers and students.

Meaning of the word must be include and linked to the root of the word (as per the root word display in each science lab)



Student Talk

- **Say it** ... *put your insecurities aside and say it aloud to the group.*

How – You say the word clearly and request the students to repeat it as a class. Individuals to repeat it. Encourage them to be loud and confident with the word. *“RESPECT”*.

Why - Feeling how the word feels to say and how it sounds will improve memory and allow for quick teacher assessment.

- **Write it** ... *compose the word.*

How – Write the word on the board, modelling the forming of the letters. Request the students write the word in their book. *Respect*

Why – Writing forces your brain to process information in a more detailed sensory way, which helps you successfully load that information into your memory.

- **Define it** ... *apply a statement about the word.*

How – Show and read a student friendly definition of the word. Request students independently (in silence) record their own. Students to turn to face a partner and Time Pair Share their definition. Select a couple to share ideas. *“Respect to means to me ...”*

Why – Words can mean different things at different times. Knowing a words root will help you to understand the meaning of other words with similar roots. The students forming their own definition will be an assessment of that understanding.

- **Use it in a full sentence with accuracy** ... *develop the word in a context.*

How – Show students a model of the word in a sentence. Request students independently (in silence) record their own. Students to turn to face a partner and Time Pair Share their definition. Select a couple to share ideas. *“I show respect by listening to others’ ideas”*

Why – Students words in context measures their understanding of the meaning and use of the word. This will allow the teacher to assess and revisit stages if required.

Assessments – Testing

KS3

Year 7, 8 and 9 are tested three times per year linked to the six steps. They each focus on two topics from the curriculum studied so far.

KS4 – Year 10

Year 10 will complete past exam papers twice throughout the year. They will test knowledge from the current year and previous years learning. There may be additional testing throughout the year if required.

KS4 – Year 11

Year 11 have two mock fortnights scheduled over each half term.

Threshold testing on graphing skills, data analysis and method planning can occur when necessary.

Assessments – Judging progress

KS3

To ensure consistency across the department this will be judged using the assessment tracker and further checked through moderation of books and assessments in department meetings.

The tracker will show overall grades for each assessment, allowing an average to be calculated at each key assessment point.

The tracker would be used to give clear areas for development when at parents evening and feeding back to the individual. It will allow teachers to identify underachievers and those that need extra support. It will be reviewed regularly and discussed at department meetings.

Included in these trackers, homework and any other tests scores are recorded and a holistic approach is used when entering any Key Assessment data.

KS3/KS4 Grades

Science KS3 Assessment Competencies

	Step 1 Know and Remember	Step 2 Comprehend and Understand	Step 3 Apply	Step 4 Analysis	Step 5 Evaluation	Step 6 Synthesis and Creating
Substantive Knowledge	To recall key facts from the walls of knowledge in science. To list examples To state definitions To label basic diagrams with given keywords To match keywords to their definitions	To describe a keyword or process To explain a diagram or process To give clear examples to support scientific concepts.	To apply scientific terminology / concepts to new scenarios. To apply keywords correctly	To analyse data and link to a scientific concept To compare different processes and concepts	To evaluate the use of models. To evaluate given concepts within science (Cloning, Stem Cells, Atomic Models)	To create models to explain scientific processes.
Disciplinary Knowledge	To recall the names of equipment. To read and follow a given method. To produce basic predictions. To record data in each table To plot points on a graph with a given scale and given axes	To identify the variables in an investigation To describe the purpose of chosen equipment To identify hazards, risks, and precautions in each practical To state a basic conclusion To recognise limitations in each investigation To draw an accurate graph (own scales and axes) To describe the basic trend on a graph To calculate results using a given equation To write a basic method from given equipment To calculate the mean from a given set of data. To convert basic units	To link the variables in an investigation to a conclusion To suggest improvements and the limitations of practical investigations To apply the terms reproducibility and repeatability to investigations. To construct a table for an investigation independently To draw more complex graphs with appropriate scales labels and plots. To identify the type of graph required from the set of data provided/collected. To write a method with appropriate equipment independently. To convert units independently and apply equations in different contexts. To rearrange equations using the FIFA model.	To draw detailed conclusions and trends from complex graphical data (multiple axes and complex trends) To calculate the mean and range from a set of data. To use line of best fits on a graph to make predictions and extrapolate data. To calculate the gradient of a line To recognise the sources of error in an investigation as random, systematic or zero error To include the use of a control group when planning an investigation. To solve calculations involving equations and unit conversions.	To justify the use of equipment with appropriate resolution and accuracy. To evaluate the impact of sources of error in an investigation on the data obtained. To evaluate the accuracy and validity of primary and secondary data.	To formulate a hypothesis independently based on previous scientific concepts. To design an investigation independently, removing sources of error and including the use of a control group To create a scientific graph that is of the correct type, accurately plotted with correct scales. Graphs may include multiple axes to represent data.

KS4

To assess and judge progress in GCSE, students will complete a number of exam questions to practise exam skills and knowledge. These exam questions are chosen by the class teacher and should be included/planned into lessons at least three times per week.

Alongside this, KS4 have a series of mock weeks to allow students to perform their knowledge and skills and to allow teachers to judge progress.

Threshold testing

Year 11 will complete a range of threshold tests – these tests are primarily focused on key scientific skills. Students will complete three sets of threshold papers:

1. Graphs
2. Methods / Planning
3. Data Interpretation

These papers require very little scientific knowledge but focus on skills. Two threshold tests are completed per topic above. This is so impact and improvement can be evidenced. IT also allows for targeted intervention to occur with students if needed.

After the completion of these test, time should be taken to go over these specific questions in detail during lessons.

Walking Talking Mocks – WTM

A walking talking mock (WTM) is used to reinforce key knowledge/skills in an exam setting. This allows the teacher to clearly show the thinking process needed when approaching and tackling an exam question.

Teacher uses the visualiser to model this process. They read the question clearly and then will:

- Underline keywords in the question – define these words using questioning.
- Box the command word in the question and glance at the marks for the question.
- Answer the question using bullet points

During the WTM, teachers will use the mark scheme to ensure that the answers are precise and would achieve maximum marks.

Exam feedback/Review

After a series of mock exams, students will receive feedback on areas of strength and weakness. See example below.

Combined Science Mock Review Higher – February 2023

Name: Wright, Jorja

Class: 11S1/Sc1 [LCO]

Target: 7-7

Biology Paper 1	
Q1. Bacteria and disease	9/9
Q2. Cell division	11/14
Q3. Enzymes and digestion	11/15
Q4. Photosynthesis	1/9
Q5. Tumors	7/14
Q6. The heart	6/9

Biology Paper 2	
Q1. Water and carbon cycle	10/16
Q2. Water pollution	3/6
Q3. Quadrats	5/9
Q4. Fertilisers (graph)	9/12
Q5. Blood glucose	7/18
Q6. Classification and populations	7/11

Students will use this very specific feedback to create an 'areas of focus' list. This will allow students to be precise on the areas they need to revise and focus on during independent study.

Chemistry Paper 1	
Q1. Salts	7/9
Q2. Electrolysis	4/8
Q3. Reactivity – Plan	4/6
Q4. Group 7 elements	7/10
Q5. Structure and bonding	2/9
Q6. Acids and bond energies	7/11
Q7. Metals and conduction	3/17

Chemistry Paper 2	
Q1. Chromatography	9/10
Q2. Potable water	3/10
Q3. Rate of reaction – sodium thio	9/12
Q4. Hydrocarbons	4/12
Q5. Earth's atmosphere and resources	3/16
Q6. Catalysts and equilibrium	2/10

Students also receive an overview of the exams completed. This contains number of marks per paper and then the overall grade. This is linked to the number of marks needed for their target grade or the next grade.

Physics Paper 1	
Q1. Power and national grid	6/8
Q2. Specific heat capacity	13/15
Q3. Energy stores and springs	1/10
Q4. Pressure	4/12
Q5. Circuits - current	12/14
Q6. Radiation	6/11

Physics Paper 2	
Q1. Waves	9/11
Q2. Speed and acceleration	8/12
Q3. Velocity and momentum	5/8
Q4. Motor effect – Fleming's Left hand rule	2/7
Q5. Infrared	6/11
Q6. Thinking distance	4/9
Q7. Acceleration	9/12

Mock 2 - Combined Science Mock Review January 2023

Wright, Jorja	Target: 7-7	Marks needed to achieve target grade: Mock 1: 201 Mock 2: 202
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Biology	Chemistry	Physics
Paper 1: 45/70	Paper 1: 34/70	Paper 1: 42/70
Paper 2: 41/70	Paper 2: 30/70	Paper 2: 43/70
Grade: 87		Total: 235/420

Once exams have been completed, during the review and feedback process students will 'green pen' specifically chosen questions. Using the results from the whole class, the weakest questions should be reviewed. This process should NOT be for the whole paper.

During 'green penning' students should correct those questions incorrectly answered or not attempted. This process should be modelling under the visualiser by the teacher using the mark scheme.

Homework

KS3

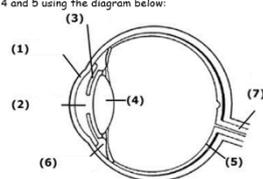
Homework for Year 7,8 and 9 is given on a fortnightly basis on a Week A on a Monday morning.

It will consist of a 10 mark Google forms quiz set on Google Classroom. These questions focus on steps 1-3.

Reminders sent to parents/students to promote completion.

During Week B, teachers must go over any misconceptions from that week's homework. The questions which have not been answered correctly should be chosen and given again to the class to complete as a do now activity. Example shown:

Students who completed homework regularly should be sent reward postcards and rewarded at the end of each term.

Homework MCQ - Light 2	Score ____/10
1. Name parts 1, 2, 4 and 5 using the diagram below:	
	
2. What is the function of the optic nerve?	
3. Why do red apples appear red?	

During Week B students will complete work focussed on steps 4-6 inside their written homework booklet.

KS4

Homework for Year 10 and 11 will be set weekly.

Year 10 – Weekly green sheet questions (ordered centrally but teachers can replace with their own questions if needed).

Year 11 – Weekly past papers (approx 3 questions per week to be attempted)

Curriculum Route – KS3

Week Commencing	Year 7	Year 8	Year 9
2 nd Sept	Introduction to Science	Body Systems	Respiration and Photosynthesis
9 th Sept	Identity		
16 th Sept			
23 rd Sept			
7 th Oct			
14 th Oct			
21 st Oct			Reactions 3
Half Term			
4 th Nov	Reactions 1	Electricity	Forces 2
11 th Nov			
18 th Nov		Speed	Static
25 th Nov			
2 nd Dec			
9 th Dec			
16 th Dec	Xmas Activities - Overspill	Xmas Activities - Overspill	Xmas Activities - Overspill
Xmas Holiday			
6 th Jan	Forces 1	Reactions 2	B1 – Cells and Transport
13 th Jan			
20 th Jan			
27 th Jan			
3 rd Feb			
10 th Feb			
Half Term			
24 th Feb	Organisms	Light and Sound	C1 – Atoms and Periodic Table
3 rd March			
10 th March		Science Fair	
17 th March			
24 th March			
31 st March			
Easter Holiday			
21 st April	Particles	Pressure	B3 – Infection and Response
28 th April			
5 th May		Magnets	
12 th May			
19 th May			
Half Term			
2 nd June	Earth	Energy	Air Brick / Required Practical Revision
9 th June			
16 th June			
23 rd June	Revision and End of Year Tests	Revision and End of Topic Tests	
30 th June			
7 th July	Space	Energy	
14 th July			



Assessment Schedule and Guided reading– KS3

<u>Year 7</u>	<u>Year 8</u>	<u>Year 9</u>
Identity 1. DNA Discovery 2. Variation in a family 3. Adaptations of a bear 4. Evolution and extinction	Body Systems 1. Digestive system 2. Breathing and gas exchange	Photosynthesis and Respiration 1. Photosynthesis vs Respiration
Guided Reading Discovering of DNA First Galapagos Tortoise	Guided Reading	Guided Reading
Space -Guided Reading Moon Landing		
Reactions 1 1. Neutralisation 2. Separating mixtures	Reactions 2 1. Chemical compounds 2. Group 1 metals	Earth 1. Recycling materials
Guided Reading	Guided Reading	Guided Reading
Organisms 1. Animal and plant cells 2. Fertilisation 3. Feeding relationships	Electricity 1. Series and Parallel	Reactions 3 1. Metals and acids 2. Displacement reactions
Guided Reading Zacharias Janssen	Guided Reading	Guided Reading
Forces 1. Forces 2. Floating	Light & Sound 1. Reflection 2. Refraction	Energy 1. Generating electricity
Guided Reading Shape shifting cuts	Guided Reading	Guided Reading
Particles 1. States of matter 2. Diffusion	Magnets 1. Electromagnets	Forces 2 1. Hooke's Law
Guided Reading The future of smart clothing	Guided Reading	Guided Reading
	Speed 1. Distance-time graphs and speed	
	Guided Reading	
	Pressure 1. Gas pressure	
	Guided Reading	

- Guided reading tasks to be confirmed (page to be updated)

Curriculum Route – KS4 Year 10

Date	Triple LCO	Set 2 Higher Combined PBA	Combined Foundation
03-Sep	B2	B2	B2
08-Sep	B2	B2	B2
15-Sep	B2	B2	B2
22-Sep	B2	B2	B2
29-Sep	B4	B4	B4
06-Oct	B4	B4	B4
13-Oct	C2	C2	C2
20-Oct	C2	C2	C2
Half Term			
03-Nov	C2	C2	C2
10-Nov	C3	C3	C3
17-Nov	C3	C3	C4
24-Nov	C3	C3	C4
01-Dec	C3	C4	C4
08-Dec	C4	C4	C5
15-Dec	C4	C5	C5
Xmas			
05-Jan	C4	C5	P2
12-Jan	C5	P2	P2
19-Jan	C5	P2	P2
26-Jan	P2	P2	Recap P1
02-Feb	P2	Recap P1	Recap P1
09-Feb	P2	Recap P1	Recap P1
Half Term			
23-Feb	P2	P3	P3
02-Mar	P3	P3	P3
09-Mar	P3	P3	P3
16-Mar	P3	P4	P4
23-Mar	P4	P4	P4
Easter			
13-Apr	P4	Recap B1	Recap B1
20-Apr	P4	Recap B1	Recap B1
27-Apr	P4	Recap B3	Recap B3
04-May	Airbrick	Recap B3	Recap B3
11-May	Airbrick	Recap C1	Recap C1
18-May	Airbrick	Recap C1	Recap C1
Half Term			
01-Jun	Revision	Revision	Revision
08-Jun	Testing Fortnight	Testing Fortnight	Testing Fortnight
15-Jun	Testing Fortnight	Testing Fortnight	Testing Fortnight
22-Jun	WEX	WEX	WEX
29-Jun	WEX	WEX	WEX
06-Jul	C8	Required Practical Revision	Required Practical Revision
13-Jul	C8	Required Practical Revision	Required Practical Revision
20-Jul	C8	Required Practical Revision	Required Practical Revision
Summer			

Curriculum Route – KS4 Year 11

Date	Triple	Set 2	Combined Foundation
03-Sep	B5	B5	B5
08-Sep	B5	B5	B5
15-Sep	B5	B5	B5
22-Sep	B5	B6	B6
29-Sep	B6	B6	B6
06-Oct	B6	B6	B6
13-Oct	B6	B7	B7
20-Oct	Mocks	Mocks	Mocks
Half Term			
03-Nov	Mocks	Mocks	Mocks
10-Nov	B6	B7	B7
17-Nov	B7	C6	C6
24-Nov	B7	C6	C6
01-Dec	C6	C7	C7
08-Dec	C6	C8	C8
15-Dec	C7	C9	C9
Xmas			
05-Jan	C7	C9	C9
12-Jan	C7	C10	C10
19-Jan	C8	C10	C10
26-Jan	C9	P5	P5
02-Feb	C9	P5	P5
09-Feb	Mocks	Mocks	Mocks
Half Term			
23-Feb	Mocks	Mocks	Mocks
02-Mar	C10	P6	P6
09-Mar	C10	P6	P6
16-Mar	P5	P7	P7
23-Mar	P5	P7	P7
Easter			
13-Apr	P5	Revision B1	Revision B1
20-Apr	P6	Revision C1	Revision C1
27-Apr	P6	Revision P1	Revision P1
04-May	P7	Revision	Revision
11-May	P7	Revision	Revision
18-May	Exams	Exams	Exams
Half Term			
01-Jun	Exams	Exams	Exams
08-Jun	Exams	Exams	Exams
15-Jun	Exams	Exams	Exams
22-Jun	Exams	Exams	Exams
29-Jun	Exams	Exams	Exams
06-Jul	Exams	Exams	Exams
13-Jul	Exams	Exams	Exams
20-Jul	Exams	Exams	Exams
Summer			

Week A Dept Timetable

Week B Dept Timetable

Appendix A – KS3 Science competencies

Science KS3 Assessment Competencies

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
	Know and Remember	Comprehend and Understand	Apply	Analysis	Evaluation	Synthesis and Creating
Substantive Knowledge	<ul style="list-style-type: none"> To recall key facts from the walls of knowledge in science. To list examples To state definitions To label basic diagrams with given keywords To match keywords to their definitions 	<ul style="list-style-type: none"> To describe a keyword or process To explain a diagram or process To give clear examples to support scientific concepts. 	<ul style="list-style-type: none"> To apply scientific terminology / concepts to new scenarios. To apply keywords correctly 	<ul style="list-style-type: none"> To analyse data and link to a scientific concept To compare different processes and concepts 	<ul style="list-style-type: none"> To evaluate the use of models. To evaluate given concepts within science (Cloning, Stem Cells, Atomic Models) 	<ul style="list-style-type: none"> To create models to explain scientific processes.
Disciplinary Knowledge	<ul style="list-style-type: none"> To recall the names of equipment. To read and follow a given method. To produce basic predictions. To record data in each table To plot points on a graph with a given scale and given axes 	<ul style="list-style-type: none"> To identify the variables in an investigation To describe the purpose of chosen equipment To identify hazards, risks, and precautions in each practical To state a basic conclusion To recognise limitations in each investigation To draw an accurate graph (own scales and axes) To describe the basic trend on a graph To calculate results using a given equation To write a basic method from given equipment To calculate the mean from a given set of data. To convert basic units 	<ul style="list-style-type: none"> To link the variables in an investigation to a conclusion To suggest improvements and the limitations of practical investigations To apply the terms reproducibility and repeatability to investigations. To construct a table for an investigation independently To draw more complex graphs with appropriate scales labels and plots. To identify the type of graph required from the set of data provided/collected. To write a method with appropriate equipment independently. To convert units independently and apply equations in different contexts. To rearrange equations using the FIFA model. 	<ul style="list-style-type: none"> To draw detailed conclusions and trends from complex graphical data (multiple axes and complex trends) To calculate the mean and range from a set of data. To use line of best fits on a graph to make predictions and extrapolate data. To calculate the gradient of a line To recognise the sources of error in an investigation as random, systematic or zero error To include the use of a control group when planning an investigation. To solve calculations involving equations and unit conversions. 	<ul style="list-style-type: none"> To justify the use of equipment with appropriate resolution and accuracy. To evaluate the impact of sources of error in an investigation on the data obtained. To evaluate the accuracy and validity of primary and secondary data. 	<ul style="list-style-type: none"> To formulate a hypothesis independently based on previous scientific concepts. To design an investigation independently, removing sources of error and including the use of a control group To create a scientific graph that is of the correct type, accurately plotted with correct scales. Graphs may include multiple axes to represent data.

Stuck Resources

Graphs

A meaningful title

You might want to start your title 'A graph to show...'

On the vertical line (y axis) put the dependent variable.
This is what you measured to find out the effect.

Tip tip! Make sure you have a consistent scale along each axis. For example, the same gap between each value along the axis.

Another variable (its units)

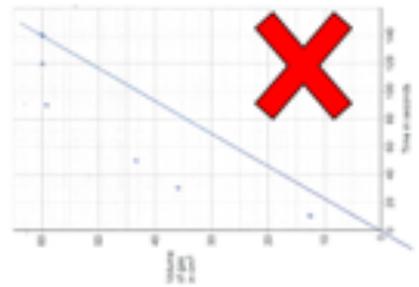
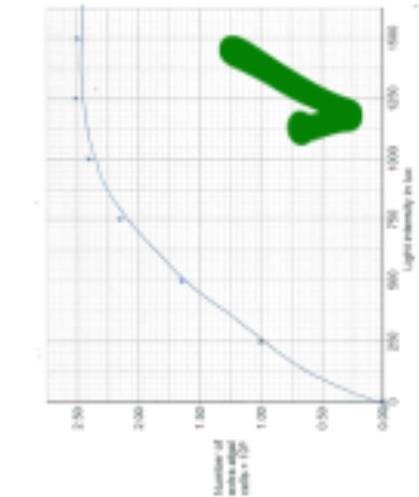
Tip tip! A line of best fit does not mean joining the dots. Draw a straight or curved line that 'best fits' the data.

On the horizontal line (x axis) put the independent variable.
This is the thing you changed to find out its effect.

A variable (its units)

Tip tip! Look at your results to determine an appropriate scale. Don't go up to 100 if your highest result is 12!

Lines of best fit ...

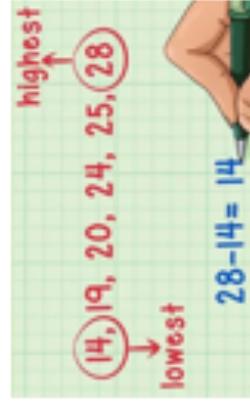


Calculation questions...

- F Formula** → Write the equation
- I Insert values** → Underline numbers in question & put into equation
- F Fine tune** → Rearrange the equation if needed
- A Answer** → Calculate the answer – UNITS!

$$\text{Mean} = \frac{\text{sum of all values}}{\text{total number of values}}$$

$$\text{Range} =$$



Independent Variable – The one you change & are investigating

Dependent Variable – What you measure (written in results table)

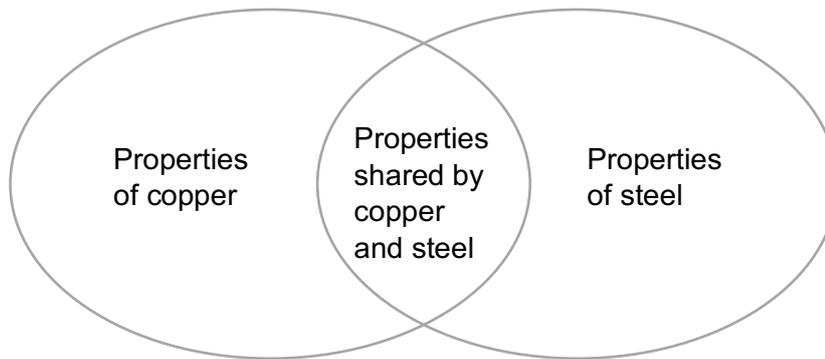
Controlled Variables – Kept the same to ensure test is fair & valid

Appendix C– How we at Park teach Science

Exam command words

Compare

Set out a sheet with a Venn diagram of two overlapping ovals. For example, if the task was to compare copper and steel, the diagram might look like this:



Then give students some sentence templates, for example:

- Copper and steel are different because copper is _____ and steel is _____.
- Copper and steel are both _____.
- When comparing copper and steel it is important to think about: _____.
- When comparing copper and steel it might be useful to measure: _____.

Structures like these will help students focus not only on similarities and differences, but also on key characteristics and features that could be quantified.

This approach can be applied to a variety of contexts – for example, comparing mammals and birds, or ammeters and voltmeters.

Useful vocabulary:

- same, similar, similarity, both have, both are, both appear to ..., etc.
- differ, different to, different from, difference between, this one ... on the other hand ..., however.

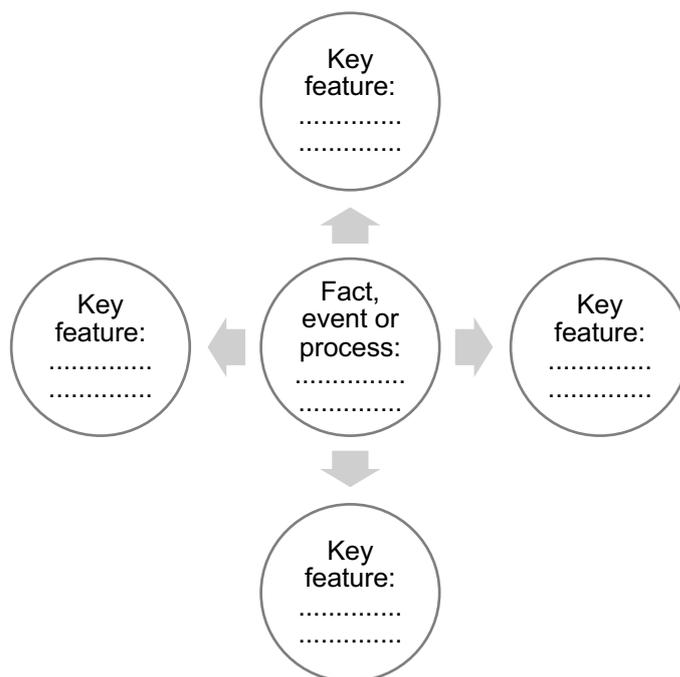
Useful structures:

When comparing two things and producing a written account:

- use the first paragraph to describe similarities and the second to describe differences
OR
- use the first paragraph to describe the significant features of one, the second paragraph to identify how the second thing is similar to the first, and the third paragraph to suggest how it is different OR
- devote a paragraph to each feature, then explore whether this is something that is a similarity or a difference.

Describe

Create a kind of spider diagram on a sheet of paper similar to the one below. In the middle there should be space for what is being described – for example, a palisade cell in a leaf, the water cycle or an object undergoing constant acceleration.



Ask students to identify and add important features around it. Finally, ask them to check each one and ask:

- Is what we have written accurate?
- Is it significant?
- Is there any more detail we can usefully add?

Design/plan/describe a method

This is a good way of getting students, especially reluctant writers, to engage with recording their experiences. Give them table templates to complete to help them structure their response. For example, they may record the purification of rock salt in the following way:

What I did	What I did it to	How I did it
<i>I crushed</i>	<i>the lumps of rock</i>	<i>using a mortar and pestle.</i>
<i>I added</i>	<i>water to the crushed rock</i>	<i>stirring it in to dissolve the salt.</i>
<i>I filtered</i>	<i>the mixture</i>	<i>using a filter paper and funnel.</i>
<i>I evaporated</i>	<i>the water</i>	<i>using a Bunsen burner.</i>

The important things for students to consider are:

- whether they have included all the necessary steps
- whether they have put them in the right order.
- whether someone following that sequence would get a valid outcome.

Useful vocabulary:

- first, next, then, finally, ...
- relevant verbs (see first column above)
- relevant nouns (see second and third columns above).

Useful structures:-

- Template above
- First, ...
- Next, ...
- Then, ...
- Finally, ...

Evaluate

There are three key features here. Students need to make a judgement, support it with evidence and make sure the evidence is well linked.

Useful vocabulary:

- therefore, because, as a result, ...
- the evidence is, the data show, for example, this is because, ...
- also, in addition, furthermore, ...
- however, on the other hand, ...

Useful structures:

The acronym PEE stands for Point, Evidence, Explain and is a useful structure for *evaluate* questions. For example, using ideas about atmospheric pollution, a PEE response might be structured as follows:

Point	Evidence	Explain
I think that it is better to use electric buses in towns than ones with diesel engines.	Diesel engines release poisonous gases such as nitrogen oxides. Nitrogen oxides can cause respiratory diseases such as asthma.	Switching from diesel buses to electric ones would reduce the emission of dangerous gases and therefore reduce health issues.

Explain

The important aspects here are to be clear about causal links and to provide an appropriate amount of detail. Causal links are a cornerstone of science, so it is crucial that students understand them and explain them clearly in their writing. This can be the basis for some useful discussion and questioning. For example, in the table below all the phrases on the right are true, but only one of them explains why more sugar dissolves.

If a beaker of water is heated it will dissolve more sugar ...	because ...	heating the water also makes the beaker hotter. heating the water increases evaporation if the water is hotter the molecules are moving around with more energy. the sugar also gets hotter.
--	-------------	--

Activities such as this encourage students to think through causal links and become used to this kind of reasoning.

Useful vocabulary:

- because, due to, so, since, as, ...
- therefore, as a result, thus, ...
- makes, produces, causes, ...

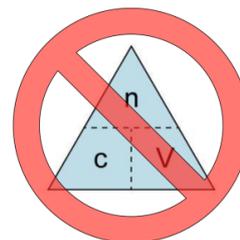
(All taken from AQA GCSE Science 9-1 Extended Response Questions Teacher Resource Pack)

FIFA for the GCSE Physics calculation

The FIFA method is an AQA mark scheme-friendly* way of approaching GCSE Physics calculation questions.

The FIFA method:

1. Avoids the use of formula triangles
2. Minimises the cognitive load on students when approaching calculations.



Why we shouldn't use formula triangles

Formula triangles are bad news. They are a cognitive dead end.

The use of formula triangle also increases (rather than decreases) the cognitive load on students when carrying out calculations. For example, if the concentration c is 0.5 mol dm^{-3} and the number of moles n required is 0.01 mol , then in order to calculate the volume V they need to:

- recall the relevant equation and what each symbol means and hold it in working memory
- recall the layout of symbols within the formula triangle and either (a) write it down or (b) hold it in working memory
- recall that n and c are known values and that V is the unknown value and hold this information in working memory when applying the formula triangle to the problem

The FIFA acronym stands for:

- **FORMULA** – Recall the equation or look it up on the equation sheet
- **INSERT VALUES** – Highlight the numbers in the question and put them into the equation
- **FINE TUNE** - this often, but not always, equates to rearranging the formula or check units
- **ANSWER** - Calculate

See below for a range of worked examples.

HIGHER EXAMPLE:

1. Add the rubric at the side of the question
2. Recall the relevant equation as it is not given on the Data and Formula Sheet. Write it down. *This is an important step as once it is written down they no longer have to hold it in their working memory.*
3. Insert the values.
4. Fine tune what we have written down in order to calculate the final answer. In this instance, the “fine tuning” process equates to a simple algebraic rearrangement. However, it is useful to leave room for some “creative ambiguity” here as we can also use the “fine tuning” process to resolve difficulties with units.
5. Input the values on a calculator to give a final answer.

A car which is moving has kinetic energy.



The faster a car goes, the more kinetic energy it has. The kinetic energy of this car was 472 500 J when travelling at 30 m/s. Calculate the total mass of the car. Show clearly how you work out your answer and give the unit.

Formula

$$E_k = 0.5 \times m \times v^2$$

Insert values

$$472\,500 = 0.5 \times m \times 30^2$$

Fine Tune

$$\frac{472\,500}{0.5} = m \times 30^2$$

$$\frac{472\,500}{0.5 \times 30^2} = m$$

Answer

Mass of the car = 1050 kg

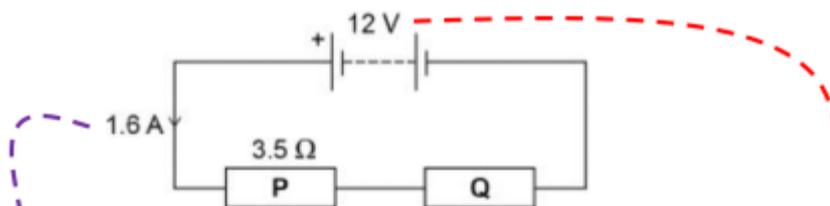
(Total 5 marks)

The key idea here is to be as positive and encouraging as possible. Even if all they can do is recall the formula and remember that mass is measured in kg, there is an incremental gain. A mark or two here is always better than zero marks.

FOUNDATION EXAMPLE 1:

1. Clearly indicate where the data came
2. The fine tune stage is not needed, so we can move straight to the answer.

A student built the circuit shown in the diagram below.



- (b) Calculate the total resistance of the circuit in the diagram above.

Use the equation:

Formula

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

Insert values

$$R = \frac{12}{1.6}$$

~~**Fine Tune**~~

Answer

Total resistance = 7.5 Ω

(2)

FOUNDATION EXAMPLE 2:

- (c) The resistance of P is 3.5 Ω.

Calculate the resistance of Q.

Formula

$$R_{total} = R_1 + R_2$$

Insert values

$$7.5 = 3.5 + R_2$$

Fine Tune

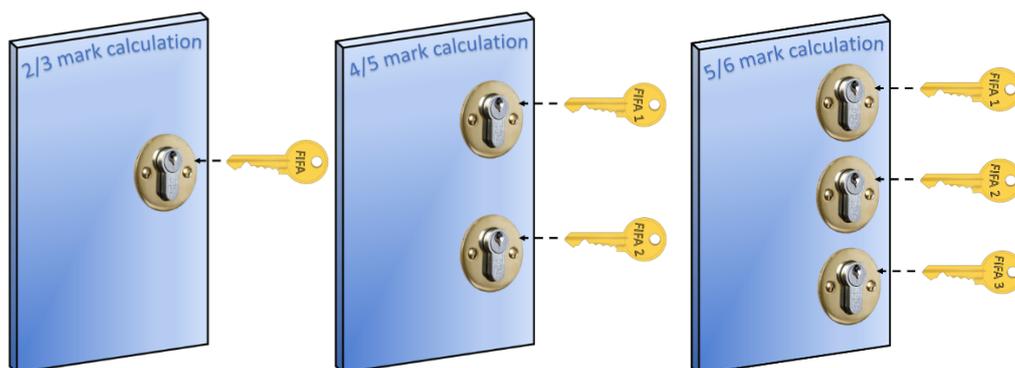
$$7.5 - 3.5 = R_2$$

Answer

Resistance of Q = 4.0 Ω

(1)

Using FIFA method for Higher grade questions:



Some lolly pop moulds are filled with cola and placed in a freezer.



The cola is initially at a temperature of 8 °C and freezes at 0 °C.

The specific heat capacity of the cola is 4190 J / kg °C and its latent heat of fusion is 337 kJ / kg.

A total of 111 kJ of internal energy is transferred from the cola in order to cool it and freeze it.

Find the mass of the cola. Give your answer to 2 significant figures

[6 marks]

FIFA 1	FIFA 2
F Formula $\Delta E = mc\Delta\theta$	F Formula $E = mL$
I Insert values $\Delta E = m \times 4190 \times (8 - 0)$	I Insert values $E = m \times 337 \text{ kJ}$
F Fine-tune $\Delta E = m \times 4190 \times 8$	F Fine-tune $E = m \times 337 \times 1000$
$\Delta E = m \times 32520$	$E = m \times 337000$
A Answer $\Delta E = 33520m$	A Answer $E = 337000m$
FIFA 3	F Formula $\Delta E + E = \text{Total energy transferred}$
	I Insert values $33520m + 337000m = 111 \text{ kJ}$
	F Fine-tune $370520m = 111 \text{ kJ}$
	$370520m = 111 \text{ 000}$
	$m = \frac{111000}{370520}$
A	A Answer $m = 0.30 \text{ kg (2 s.f.)}$

Graphs

KS4 – Steps for graph drawing and interpretation

Drawing a Graph

1. Type of data - continuous or discontinuous - what type of graph needs to be drawn?
2. Variables - independent (x axis) and dependent (y axis)
3. Scales - what is each square worth? What is the maximum value for each axis?
4. Labelling axis - what does each axis represent and UNITS
5. Plot with small crosses - line of best fit (straight or curved) if appropriate

Interpreting a Graph

1. Type of data - continuous or discontinuous
2. Variables - independent (x axis) and dependent (y axis)
3. Scales (each box in each direction is worth....)
4. Annotate - increase, decrease, or plateau; rate of change (gradient) Relationship - proportional, linear, inversely proportional
5. Interpreting - use 'data' points and chunk patterns to explain general trend



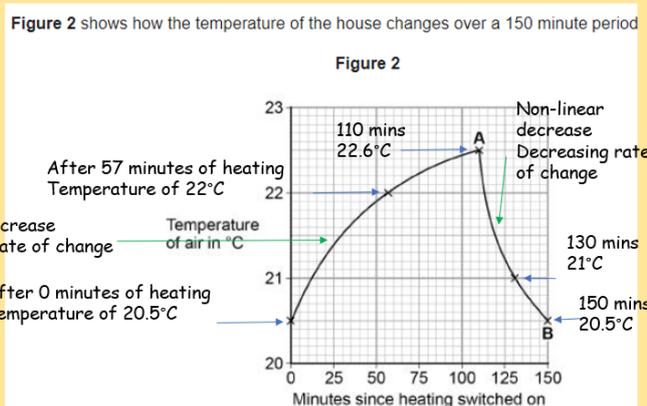
'I do' introduced – Teacher models how to use the steps

Animation builds up on PowerPoint or alternatively use visualiser

'I do' to success!

5. Interpreting - use the important changes and data points to explain what the graph shows.

When the heating is initially turned on the temperature is 20.5°C. The temperature then increases fast initially and then slows down over the course of 110 minutes until it reaches a maximum of 22.6°C. For the next 40 minutes (110 minutes until 150 minutes) the temperature decreases at a much faster rate than it increased and does so in a non-linear manner until it reduces back to the original temperature of 20.5°C. Overall the temperature increased to a maximum but then decreased at a much faster rate to the same temperature it started at.



'You do' practise opportunities given

Slightly simplified version of KS4.

Drawing a Graph	Interpreting a Graph
<ol style="list-style-type: none"> 1. Type of data - continuous or discontinuous - what type of graph needs to be drawn? 2. Variables - independent (x axis) and dependent (y axis) 3. Scales - what is each square worth? What is the maximum value for each axis? 4. Labelling axis - what does each axis represent and UNITS 5. Plot with small crosses and join 	<ol style="list-style-type: none"> 1. Type of data - continuous or discontinuous (categorical) 2. Variables - what is being changed and what is being measured? 3. Scale - how much is each box worth in each direction? 4. Labelling - label important changes and data points (numbers) 5. Interpreting - use the important changes and data points to explain what the graph shows

'I do' introduced – Teacher models how to use the steps

Animation builds up on PowerPoint or alternatively use visualiser

'I do' to success!

4. Labelling - important changes and data points (numbers).

(b) A woman cycled along a straight flat road.

The graph below shows how the woman's velocity changed with time.

'You do' practise opportunities given

Tables

KS3 and KS4 – Steps for interpreting data from a table.

Skill builds from KS3 to KS4 depending on data and number of variables being compared.

How to interpret a TABLE

1. Identify variables
2. Units
3. Patterns and trends
 - Identify the highest and lowest values (Positive and negative)
 - Is there a pattern?
 - Anomalous results (unusual results that do not fit the pattern)
 - Differences between values
4. Relationship between variables (what it shows)



'I do' introduced – Teacher models how to use the steps

Animation builds up on PowerPoint or alternatively use visualiser

IV - Height the ball is dropped

DV - Depth of crater

height the ball was dropped from (cm)	depth of crater (cm)		
	Jack's results		Aneesa's results
10	1.1	1.2	0.8
20	1.4	1.5	1.4
30	1.6	1.6	1.5
40	1.8	1.7	1.8
50	2.0	2.1	2.1

Height increases

Depth of crater increases

As the height of the ball increases, the depth of crater created increases.

'You do' practise opportunities given

Planning/Writing a Method

KS3 and KS4 – Steps for planning a method, including variables and equipment used.

Planning/Writing a Method

Step 1) Plan your method!!

1. **Identify** what you are **changing (independent variable)** and what you are **recording (dependent variable)**
2. **Equipment** - Brainstorm what equipment you might need and **HOW you will use it.**
3. **Control Variables** - What do you need to keep the **same?**
4. What specific **measurements** are you going to make (what is the **range** of the IV)
5. If stated, consider your **risk assessment** (what are the **hazards**, what are the **minimising actions?**)

'I do' introduced – Teacher models how to use/apply the steps

Animation builds up on PowerPoint or alternatively use visualiser

Modelled Example (I do): A question you might recognise.... Show your planning, do not cross it out!

0 2 . 6 Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

You do **not** need to write about safety precautions.

[6 marks]

1. IV and DV

IV - **Changing** the masses of ammonium nitrate

DV - Temperature **CHANGE**

2. Equipment:

Temperature - **Thermometer**

Solutions - Beaker (or better - a **polystyrene cup** with lid) inside a beaker

Mass of ammonium nitrate - **measuring scales/balance**

4. Specific Measurements

This is your plan, so make up the measurements you will test.

Keep it simple. **E.g. 1g, then 2g, 3g, 4g and 5g.** To see a clear pattern, you need at least 5 changes to the IV.

Remember you always do X3 repeats and calculate an average.

3. Control Variables:

1. Same volume of water
2. Same type of water (spring, tap, fizzing)
3. Same cup / beaker
4. Same starting temperature of solution

5. Risk Assessment - It has told you **NOT** to write about it. But what could you say?

Let's put all that together into a written method.

1. Get 5 beakers with **polystyrene cups** inside and add **100cm³ of still tap** water to each using a **measuring cylinder**.
2. Add a lid to the cup and record the starting temperature of each with a **thermometer**.
3. Using a **balance** measure out **1g, 2g, 3g, 4g and 5g of ammonium nitrate, one mass for each beaker**.
4. Add them to each cup and record the final temperature
5. **Calculate the temperature change** by doing final temp - starting temperature.
6. **Repeat this X3** for each mass
7. Calculate an average temperature change for each mass.

Then mentally highlight you have included everything:

IV
DV
Equipment
Control Variables
Specific
Measurements

Risk Assessment - If needed

'You do' practise opportunities given

The below can be used to scaffold, self/peer assess or reflect.

Step	Complete Y/N	What must I include?
1. IV DV		
2. Equipment		
3. Control Variables		
4. Specific Measurements		
5. Risk Assessment - If needed		

Notes

Notes