V2 (November 2024)
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Science

Core Threads and Topics:

Biology	Chemistry	Physics

Sequencing and progression

The **3** core threads and sub-topics for each section identify learning outcomes for each area in progressive milestone stages, starting with the first stage, 'Foundation' milestone 1, through to the final stage, 'Advanced Expert' milestone 6 (GSCE Higher Tier Specific Content). Each phase uses and builds on the previous stage/milestone, and learning is sequenced throughout, and where appropriate, introduces a new topic within the thread being studied or allows for more consolidation learning through additional practice, before moving on, depending on what best meet the needs of learners. At the Bridge Academy only GCSE Biology (separate science) is offered at Key Stage 4 (although is available for Chemistry, Physics and Trilogy if required). As such milestones 4-6 only cover the Biology thread.

Foundation (Pre-Fundamental) Milestone 1	Fundamental Milestone 2	Intermediate Milestone 3	Expert Milestone 4/5 (GCSE Biology – Separate Science: Foundation Teir)	Advanced Expert Milestone 6 (GCSE Biology – Separate Science: Higher Teir)
Effective engagement in the learning basic scientific skills and general scientific knowledge	*Fundamental learning elements, building the next layer of learning to tackle more challenging investigations and increase the breadth of scientific general knowledge*	*Increasing understanding of learning, starting to develop more independent approaches to scientific investigation using the scientific method and increasing the depth and breadth of scientific knowledge by starting to formalise subject specific learning (Biology, Chemistry and Physics)*	*Deepening and broadening understanding of subject specific content (Biology) and independently investigating a range of scientific hypothesis.*	*Broadening and deepening understanding of subject specific content in Biology and increasing the range of scientific investigation skills used in independent investigation.* *Increasing complexity of question phrasing and application of knowledge.*

Opportunities are presented for pupils (where appropriate/possible) to:

• Experience taking responsibility for their own learning; Feel positive about themselves and their mathematical abilities; Reflect on their perceptions and experiences within the mathematical curriculum; Develop the understanding, language, communication skills and strategies required to be mathematically competent in life and academia; Make real decisions (with support where necessary so that they can act upon them) when dealing with mathematical enquiries; Take part in group activities and make contributions; Develop and maintain positive relationships and interactions with others within the classroom and Recognise and celebrate their achievements, successes whilst developing a passion for mathematical concepts.

<table>
<tr><th>Subject Theme Mapping</th><th>Biology</th><th>Chemistry</th><th>Physics</th></tr>
<tr><td>Theme mapping and topics.</td><td>1. Cell Biology
2. Organisation
3. Infection and response
4. Bioenergetics
5. Homeostasis
6. Inheritance, variation and evolution
7. Ecology</td><td>1. Atoms and the Periodic Table
2. Bonding
3. Chemical Changes and Analysis
4. Energy Changes and Rates of Reaction
5. Chemistry of the Atmosphere
6. Resources
7. Organic Chemistry</td><td>1. Energy
2. Forces
3. Electricity
4. Atoms and Radiation
5. Magnets
6. Waves
7. Space</td></tr>
<tr><td>Links to teaching of National Curriculum</td><td colspan="3">All content in this curriculum links directly to the National Curriculum
• Milestone 1 links to the Primary National Curriculum for Science – Years 3 and 4
• Milestone 2 links to the Primary National Curriculum for Science – Year 5 and 6
• Milestone 3 links to the KS3 National Curriculum for Science
• Milestones 4 and 5 are aimed at allowing pupils to access AQA Entry Level Single Award
• Milestone 6 is aimed at allowing pupils to access AQA Entry Level Double Award
o Entry Level is targeted at pupils working towards GCSE (AQA Entry Level links most closely to the AQA Combined Science: Trilogy and AQA Combined Science: Synergy qualifications.
o Completing Double Award allows pupil to have met the KS4 Programme of Study as outlined by the National Curriculum</td></tr>
<tr><td rowspan="2">Links to teaching of SMSC</td><td colspan="3">Social
• Working as a group to complete scientific investigation
• Communication during group activities e.g. experiments and problem-solving situations
• Consideration of health and safety during experiments
Moral
• Ethical design for scientific investigation
Spiritual
• Sense of enjoyment and fascination in learning about themselves, others and the world around them
• Use of imagination and creativity in their learning – scientific investigations and experiments
• Willingness to reflect on their experiences – evaluation of scientific investigation
Cultural
• Consideration of the work of previous scientist. This can include discussion of how historically most scientific breakthroughs were by white, males from a western society but more recently this scientific community is becoming more culturally diverse.</td></tr>
<tr><td>Social
• How GM and selective breeding can impact their lives e.g. through enhancement of plant growth to meet the needs of a growing population
• Health issues linked to smoking, poor diet and a lack of exercise
• Impact of an increasing population and the demands of this on the NHS
• Regulating bodies and organisation – drug development (detailed content is GCSE, but antibiotics are taught at Entry Level so the development may be discussed here)

Moral
• Ethical use of stem cells and therapeutic clone (although this content is GCSE, the themes may be discussed during teaching of other cell biology)</td><td>Social
• Impacts of increasing population on the use of the Earth’s resources and the impacts this has on the environment e.g. pollution
• Availability of fresh water across the Earth and how variations in this can impact the economics and development of countries.
• Impacts of mining ores for metals
• Use of chromatography in forensic science

Moral
• Continued use of fossil fuels as a resource and the impacts this has – in the full knowledge that their use is having a negative impact on the Earth
o Problems of using plastics
o Problems of burning fossil fuels</td><td>Social
• Continued use of fossil fuels as a resource and the impacts this has – in the full knowledge that their use is having a negative impact on the Earth
o Problems of burning fossil fuels
o Advantages and disadvantages of different renewable energy sources

Moral
• Continued use of fossil fuels as a resource and the impacts this has – in the full knowledge that their use is having a negative impact on the Earth
o Problems of burning fossil fuels
o Advantages and disadvantages of different renewable energy sources</td></tr>
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	• Ethical use of genetic modification • Ethics around selecting breeding • Ethical development of drugs (detailed content is GCSE, but antibiotics are taught at Entry Level so the development may be discussed here) • Ethical development and use of vaccines • Use of animals for testing drugs (and cosmetics) • Dilemmas surrounding increasing population and the need to provide resources for this e.g. food security • Dilemmas surrounding use of resources and the impact this can have on the natural world e.g. destruction of Amazon rainforest causing a loss of habitat vs the economic development of the countries involved (Brazil) • Ethics around the use and legality of recreational drugs • Use of biotechnologies across the world – availability in different countries or to different people, use of different areas for trials. Spiritual • Respectful discussion of religious (and cultural) views around contraception and IVF • Respectful discussion of religious (and cultural) views around the use of medication e.g. vaccination • How all living things in the world are reliant on each other – interdependence in ecosystems Cultural • Appreciation of how different cultural heritages may affect phenotype • Appreciation of how different cultural heritages may affect health and can lead to specific groups of people being more vulnerable to diseases and health conditions. • Darwin's theory of evolution, why is wasn't accepted at the time and what has changes to allow us to accept it now • Use of biotechnologies across the world – availability in different countries or to different people • Use of fossils and other evidence to explain evolution and provide insight into previous life on Earth	○ Impacts of mining ores for metals Spiritual • Consideration of their carbon footprint (although not specific taught in the curriculum it does link to uses of the Earth' resources and the Earth's atmosphere – global warming) Cultural • Consideration of how different countries contribute to fossil fuel usage and the impacts of this, to include discussion on how this has changed over time. • Changing views on the Periodic Table (although not specific taught in this curriculum it could be discussed when atom structure is taught) • Availability of fresh water across the Earth and how variations in this can impact the economics and development of countries. • Impacts of mining ores for metals	Spiritual • Respectful discussion of religious views around how the world/universe was created Cultural • Respectful discussion of religious views around how the world/universe was created • How the views around the solar system have changes – Earth orbiting the Sun vs Sun orbiting the Earth • Different cultures and locations have different views on what a season is – e.g. wet and dry seasons, the indigenous peoples of Australia's (aboriginal) calendar
Links to teaching of Fundamental British Values	Tolerance and mutual respect for different faiths and beliefs and promotion of the Equality duty • Student code of conduct. Good working relationships in the classroom and around the college that promote effective learning. Ensuring that behaviour in the classroom demonstrates respect for those with different faiths and beliefs and those with the protected characteristics set out in the Equality duty. Individual Liberty • The ability to investigate ideas pupils have around a topic, potentially through the use of practical work. Practical work can give pupils the chance to explore their own hypotheses in relation to the topic. • The ability to make personal choices regarding scientific findings, but also to have the ability to evaluate the sources of the information and consider the reliability of these sources		

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- The idea that scientific understanding is ever understanding and changing. This can mean that science cannot answer all questions and can link to ideas of how people's beliefs and morals can influence this – on a personal and national scale.

Rule of law
- Complying with health and safety legislation – especially during practical work and the use of risk assessments
- Correct and responsible use of scientific data

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Tolerance and Respect
- Tolerance and respect of other people's viewpoints in a range of topics to include:
  - Stem cell use and therapeutic cloning
  - Genetic modification
  - Selective breeding
  - Vaccine (and medicine)
  - Life-style choices
  - Evolution
- Use of evolution and variation to discuss how all humans are the same species regardless of their cultural background or race

Individual liberty
- Individual liberty to choice whether to partake in certain situations, e.g.
  - Organ donation and blood transfusion (although not specifically taught can be discussed in cell biology and organisation).
  - Choice to use birth control
  - Choice to use IVF (cost implications and accessibility to all can also be discussed)
  - Choices over personal lifestyle choices

Rule of Law and Democracy
- Laws around the development of drugs and vaccines
- Laws around the advancement and use of stem cells and therapeutic cloning (although not specifically taught in the curriculum the topic may be discussed in other others of cell biology)
- Laws around the development and use of genetically modified organisms – e.g. discuss as to why we cannot create GM humans and the recent developments of GM vaccines
- Promotion of public and civic services to include NHS
- The use of Latin names to allow all scientists to communicate effectively
- Use of evolution and variation to discuss how all humans are the same species regardless of their cultural background or race

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Tolerance and Respect
- Tolerance and respect of other people's viewpoints in a range of topics to include:
  - Use of fossil fuels and other resources

Individual liberty
- Individual liberty to view opinions on topics to include:
  - Use of fossil fuels and other resources

Rule of Law and Democracy
- Laws around the use of fossil fuels and the pledges to reduce greenhouse gas emissions
- Laws around the mining for ores and other resources
- Use of chromatography (and other techniques) in the justice system
- Use of the same element symbols and periodic table to allow all scientists to communicate effectively
- Use of the same standard units to allow all scientists to communicate effectively

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Tolerance and Respect
- Tolerance and respect of other people's viewpoints in a range of topics to include:
  - The Big Bang
  - Use of different energy resources

Individual liberty
- Individual liberty to view opinions on topics to include:
  - Use of fossil fuels and other resources esp. nuclear reactors
  - Big Bang Theory

Rule of Law and Democracy
- Laws around the use of nuclear reactors
- Use of the same standard units to allow all scientists to communicate effectively

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- Use of the same standard units to allow all scientists to communicate effectively

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<tr><td>Links to teaching of RAISE Values</td><td colspan="3">

Respect
During class discussions about possible methods and answers students have to listen to others, demonstrate actively listening within the learning environment and communicate with another person and/or a peer.
During practical work pupils are required to show respect to the equipment they are using and the manner in which they are using them
Aspiration
When working through any problem it is important to identify and evaluate key strengths and weaknesses in relation to a key topic, so strengths, weaknesses and improvements needed in a particular area can be identification and help asked for.
Independence
Science naturally allows students to have the opportunity to make choices around investigation methods for themselves. Students also get the opportunity to independently evaluate the success of practical work and suggest improvements to it.
Independently working through problems posed in Science e.g. what would happen if all the fossil fuels ran out
Success
The independent work allows the students to see and strive for their own success.
Completing of experimental and investigation work to get reliable, reproducible and valid results. The greater the accuracy and precision of these results the greater the success (of that experiment)
Engagement
During lessons students are encouraged to choose to engage in the theoretical work or take the time out to self-regulate before returning to the work.
Practical investigation can help engage pupils in scientific theory by allowing them to ‘put it into practice’ and apply the concepts to relatable, every day situations.

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Respect
- Tolerance and respect of other people’s viewpoints in a range of topics to include:
  - Stem cell use and therapeutic cloning
  - Genetic modification
  - Selective breeding
  - Vaccine (and medicine)
  - Life-style choices
  - Evolution
- Use of evolution and variation to discuss how all humans are the same species regardless of their cultural background or race

Aspiration
- Careers linked to topics e.g. health care through vaccination and drug development/antibiotics

Independence and success
- Possible practical activities could include:
  - Use of microscopes
  - Reaction times
  - Classification of organisms
  - Transpiration

Engagement
- Completion of practical work (see above)
- Discuss of topical themes (see above)

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Respect
- Tolerance and respect of other people’s viewpoints in a range of topics to include:
  - Use of fossil fuels and other resources

Aspiration
- Careers linked to topics e.g. construction and engineering

Independence and success
- Possible practical activities could include:
  - Rates of reaction e.g. temperature on dissolving sugar
  - Acids and alkalis (variety of experiments)
  - Classification of materials

Engagement
- Completion of practical work (see above)
- Discuss of topical themes (see above)

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Respect
- Tolerance and respect of other people’s viewpoints in a range of topics to include:
  - The Big Bang
  - Use of different energy resources

Aspiration
- Careers linked to topics e.g. mechanic

Independence and success
- Possible practical activities could include:
  - Electromagnets
  - Circuits
  - Ray boxes (reflection and refraction)
  - Factors affecting friction

Engagement
- Completion of practical work (see above)
- Discuss of topical themes (see above)

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Long Term Planning

Milestone 1			
Theme mapping	Biology	Chemistry	Physics
Learning Outcomes *Sound understanding of powerful knowledge to be reviewed and retained for future learning.* *becomes…* *Successful application of transferable skills*	Cell Biology 1. N/A Organisation 1. identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat 2. identify that humans and some other animals have skeletons and muscles for support, protection and movement 3. investigate the way in which water is transported within plants 4. describe the simple functions of the basic parts of the digestive system in humans 5. identify the different types of teeth in humans and their simple functions 6. identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers Infection and response • N/A Bioenergetics 1. explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant Homeostasis • N/A Genetics and evolution 1. describe in simple terms how fossils are formed when things that have lived are trapped within rock 2. recognise that living things can be grouped in a variety of ways 3. explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment 4. recognise that environments can change and that this can sometimes pose dangers to living things Ecology 1. construct and interpret a variety of food chains, identifying producers, predators and prey 2. explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal	Atoms and the Periodic Table 1. compare and group materials together, according to whether they are solids, liquids or gases 2. observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) 3. identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature Bonding • N/A Chemical Changes and Analysis • N/A Energy Changes and Rates of Reaction • N/A Chemistry of the Atmosphere • N/A Resources 1. compare and group together different kinds of rocks on the basis of their appearance and simple physical properties 2. recognise that soils are made from rocks and organic matter Organic Chemistry • N/A	Energy • N/A Forces 1. compare how things move on different surfaces 2. notice that some forces need contact between 2 objects, but magnetic forces can act at a distance Electricity 1. identify common appliances that run on electricity 2. construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers 3. identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery 4. recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit 5. recognise some common conductors and insulators, and associate metals with being good conductors Atoms and Radiation • N/A Magnets 1. observe how magnets attract or repel each other and attract some materials and not others 2. compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials 3. describe magnets as having 2 poles 4. predict whether 2 magnets will attract or repel each other, depending on which poles are facing Waves 1. recognise that they need light in order to see things and that dark is the absence of light 2. notice that light is reflected from surfaces 3. recognise that light from the sun can be dangerous and that there are ways to protect their eyes 4. recognise that shadows are formed when the light from a light source is blocked by an opaque object 5. find patterns in the way that the size of shadows change 6. identify how sounds are made, associating some of them with something vibrating 7. recognise that vibrations from sounds travel through a medium to the ear

<table>
<tr><td></td><td></td><td></td><td>8. find patterns between the pitch of a sound and features of the object that produced it
9. find patterns between the volume of a sound and the strength of the vibrations that produced it
10. recognise that sounds get fainter as the distance from the sound source increases

Space
1. N/A</td></tr>
<tr><td></td><td colspan="3">Scientific Skills
• asking relevant questions and using different types of scientific enquiries to answer them
• setting up simple practical enquiries, comparative and fair tests
• making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
• gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
• recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
• reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
• using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
• identifying differences, similarities or changes related to simple scientific ideas and processes
• using straightforward scientific evidence to answer questions or to support their findings.</td></tr>
<tr><td>Vocabulary for literacy, reading & oracy</td><td>Cell Biology
• N/A

Organisation
• root
• stem
• flower
• leaves
• nutrient
• skeleton
• muscle
• digestion
• stomach
• liver
• small and large intestine
• oesphagus
• canine
• molar
• incisor

Infection and response
• N/A

Bioenergetics
• N/A

Homeostasis
• N/A

Genetics and Evolution
• classification</td><td>Atoms and the Periodic Table
• solid
• liquid
• gas
• state (of matter)
• change of state
• evaporation
• condensation
• temperature
• reactant
• product

Bonding
• N/A

Chemical changes and analysis
• N/A

Energy changes and rates of reaction
• N/A

Chemistry of the Atmosphere
• N/A

Resources
• igneous
• metamorphic
• sedimentary

Organic Chemistry
• N/A</td><td>Energy
Forces
• force
• contact
• non-contact
• friction

Electricity
• cell
• battery
• switch
• conductor
• insulator

Atoms and Radiation
• N/A

Magnets
• magnetic
• attract
• repel
• pole

Waves
• reflect
• ultraviolet (UV)
• transparent
• translucent
• opaque
• vibration
• medium</td></tr>
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- dichotomous key
- fossil

Ecology
- environment
- pollination
- seed formation
- germination
- seed dispersal
- producer
- consumer
- herbivore
- carnivore
- omnivore

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- pitch
- volume

Space
- N/A

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Scientific Skills
- equipment
- apparatus
- method
- accurate
- measurement
- results
- thermometer
- conclusion
- prediction
- evidence

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<tr><td>Sequenced FROM and TO</td><td>

Cell Biology
- N/A

Organisation
1. From: NA, To: M3 Organisation
2. From N/A, To: M3 Organisation
3. From: N/A, To: M2 Organisation
4. From: N/A, To: M3 Organisation
5. From: N/A, To: N/A
6. From: N/A, To: M2 Organisation

Infection and Response
- N/A

Bioenergetics
1. From: N/A, To: M3 Ecology

Homeostasis
- N/A

Genetics and Evolution
1. From: N/A, To: M5 Genetics and Evolution
2. From: N/A, To: M2 Genetics and Evolution
3. From: N/A, to: M2 Genetics and Evolution

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Atoms and the Periodic Table
1. From: N/A, To: M3 Atoms and the Periodic Table
2. From: N/A, To: M3 Atoms and the Periodic Table
3. From N/A, To: M3 Atoms and the Periodic Table

Bonding
- N/A

Chemical Changes and Analysis
- N/A

Energy Changes and Rates of Reaction
- N/A

Chemistry of the Atmosphere
- N/A

Resources
1. From: N/A, To: N/A
2. From: N/A, To: N/A

Organic Chemistry
- N/A

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Energy
- N/A

Forces
1. From: N/A, To: M2 Forces
2. From: N/A, To: M2 Forces

Electricity
1. From: N/A, To: M2 Forces
2. From: N/A, To: M2 Forces
3. From: N/A, To: M2 Forces
4. From: N/A, To: M2 Forces
5. From: N/A, To: M2 Forces

Atoms and Radiation
- N/A

Magnets
1. From: N/A, To: M3 Magnets
2. From: N/A, To: M3 Magnets
3. From: N/A, To: M3 Magnets
4. From: N/A, To: M3 Magnets

Waves

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	Ecology 1. From: N/A, To: M3 Ecology 2. From: N/A, To: M3 Ecology		1. From: N/A, To: M2 Waves 2. From: N/A, To: M2 Waves 3. From: N/A, To: N/A 4. From: N/A, To: M2 Waves 5. From: N/A, To: M2 Waves 6. From: N/A, To: M3 Waves 7. From: N/A, To: M3 Waves 8. From: N/A, To: M3 Waves 9. From: N/A, To: M3 Waves 10. From: N/A, To: M3 Waves Space • N/A
	Scientific Skills: These progress lineally through the milestones and naturally build on each other in complexity and demand.		

Milestone 2			
Theme mapping	Biology	Chemistry	Physics
Learning Outcomes *Sound understanding of powerful knowledge to be reviewed and retained for future learning.* *becomes…* *Successful application of transferable skills*	Cell Biology • describe the life process of reproduction in some plants and animals Organisation 1. identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood 2. recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function 3. describe the ways in which nutrients and water are transported within animals, including humans Infection and response • N/A Bioenergetics • N/A Homeostasis 1. describe the changes as humans develop to old age Inheritance, variation and evolution 1. describe how living things are classified into broad groups according to common observable characteristics and based	Atoms and the Periodic Table 1. compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets 2. know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution 3. use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating 4. give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic 5. demonstrate that dissolving, mixing and changes of state are reversible changes Bonding • N/A Chemical Changes and Analysis 1. explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda	Energy • N/A Forces 1. explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object 2. identify the effects of air resistance, water resistance and friction, that act between moving surfaces 3. recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect Electricity 1. associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit 2. compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches 3. use recognised symbols when representing a simple circuit in a diagram Atoms and Radiation

	on similarities and differences, including micro-organisms, plants and animals 2. give reasons for classifying plants and animals based on specific characteristics 3. recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago 4. recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents 5. identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution Ecology 1. describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird	Energy Changes and Rates of Reaction • N/A Chemistry of the Atmosphere • N/A Resources • N/A Organic Chemistry • N/A	• N/A Magnets • N/A Waves 1. recognise that light appears to travel in straight lines 2. use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye 3. explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes 4. use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them Space 1. describe the movement of the Earth and other planets relative to the sun in the solar system 2. describe the movement of the moon relative to the Earth 3. describe the sun, Earth and moon as approximately spherical bodies **4.** use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky
	Scientific Skills • planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary • taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments		
Vocabulary *for literacy, reading & oracy*	Cell Biology • N/A Organisation • reproduction • penis • vagina • sperm • ovum (egg) • menstrual cycle • menstruation • circulatory system • heart	Atoms and the Periodic Table • reactant • product • conductivity • solubility • dissolve • solution • soluble • insoluble • solute • solvent • filtration	Energy • N/A Forces • Gravity • Air resistance • Friction • Levers • Pulley • Gear Electricity

	• artery • vein • capillary • atrium • ventricle • aorta • vena cava • blood Infection and response • N/A Bioenergetics • N/A Homeostasis • puberty • adolescence Genetics and Evolution • Classification • Characteristic • Micro-organism • Fossil • Evolution • Variation • Adaptation Ecology • amphibian • mammal • insect • bird	• sieving • evaporation (crystallisation) • reversible (reaction) Bonding • N/A Chemical changes and analysis • N/A Energy changes and rates of reaction • N/A Chemistry of the Atmosphere • N/A Resources • N/A Organic Chemistry • N/A	• Voltage • Component (electrical) Atoms and Radiation • N/A Magnets • N/A Waves • Reflect Space • Solar system • Planet • Orbit • Moon • Day • Night
	Scientific Skills • plan • variable • measurement • equipment • apparatus • accuracy • precision • repeat • results • scatter graph • fair test • comparative • conclusion • evidence		

Sequenced *FROM and TO*	Cell Biology 1. From: N/A, To: M3 Cell Biology Organisation 1. From: N/A, To: M4 Organisation 2. From: N/A, To: M3 Organisation 3. From: M2 Organisation, To M3 Organisation Infection and Response • N/A Bioenergetics • N/A Homeostasis 1. From: N/A, To: N/A Genetics and Evolution 1. From: M1, To: M4 2. From: M1, To: M4 Genetics and Evolution 3. From: M1, To: M4 Genetics and Evolution 4. From: N/A, To: M3 Genetics and Evolution 5. From: M1, To: M3 Genetics and Evolution Ecology 1. From: N/A, To: N/A	Atoms and the Periodic Table 1. From: N/A, To: M3 Atoms and the Periodic Table 2. From: N/A, To: N/A 3. From: M2 Atoms and the Periodic Table, To: M3 Atoms and the Periodic Table 4. From: N/A, To M3: Atoms and the Periodic Table 5. From N/A, To: M3 Atoms and the Periodic Table Bonding • N/A Chemical Changes and Analysis 1. From: N/A, To: M3 Atoms and the Periodic Table Energy Changes and Rates of Reaction • N/A Chemistry of the Atmosphere • N/A Resources • N/A Organic Chemistry • N/A	Energy • N/A Forces 1. From: N/A, To: M3 Forces 2. From: M1, To: M3 Forces 3. From: N/A, To: N/A Electricity 4. From: M1 Electricity, To: M3 Electricity 5. From: M1 Electricity, To: M3 Electricity 6. From: M1 Electricity, To: M3 Electricity Atoms and Radiation 7. N/A Magnets 8. N/A Waves 1. From: M1, To: N/A 1. From: M1, To: N/A 2. From: M1, To: N/A 3. From: M1, To: N/A Space 1. From: N/A, To: M3 Space 2. From: N/A, To: M3 Space 3. From: N/A, To: M3 Space 4. From: N/A, To: M3 Space

Milestone 3			
Theme mapping	Biology	Chemistry	Physics
Learning Outcomes *Sound understanding of powerful knowledge to be reviewed and retained for future learning.* *becomes…*	Cell Biology 1. cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope 2. the functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts 3. the similarities and differences between plant and animal cells 4. features and adaptations of specialised cells Organisation	Atoms and the Periodic Table 1. the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure 2. changes of state in terms of the particle model 3. differences between atoms, elements and compounds 4. chemical symbols and formulae for elements and compounds 5. diffusion in terms of the particle model 6. simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography	Energy 1. domestic fuel bills, fuel use and costs 2. fuels and energy resources 3. other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels 4. energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change Forces

Successful application of transferable skills	1. the structure and functions of the human skeleton, to include support, protection, movement and making blood cells 2. the content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed 3. the consequences of imbalances in the diet, including obesity, starvation and deficiency diseases 4. the tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food (enzymes simply as biological catalysts) 5. the structure and functions of the gas exchange system in humans, including adaptations to function 6. the impact of exercise, asthma and smoking on the human gas exchange system 7. reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta Infection and response • N/A Bioenergetics 1. aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life 2. a word summary for aerobic respiration 3. the reactants in, and products of, photosynthesis, and a word summary for photosynthesis Homeostasis • N/A Genetics and evolution 1. heredity as the process by which genetic information is transmitted from one generation to the next 2. a simple model of chromosomes, genes and DNA in heredity 3. changes in the environment which may leave individuals within a species, and some entire species,	7. the periodic table: periods and groups; metals and non-metals 8. the properties of metals and non-metals Bonding • N/A Chemical Changes and Analysis 1. chemical reactions as the rearrangement of atoms 2. representing chemical reactions using formulae and using equations 3. combustion, thermal decomposition, oxidation and displacement reactions 4. defining acids and alkalis in terms of neutralisation reactions 5. the pH scale for measuring acidity/alkalinity; and indicators Energy Changes and Rates of Reaction 1. energy changes on changes of state (qualitative) 2. exothermic and endothermic chemical reactions (qualitative) Chemistry of the Atmosphere 1. the composition of the atmosphere 2. the production of carbon dioxide by human activity and the impact on climate Resources • N/A Organic Chemistry • N/A	1. speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time) 2. forces as pushes or pulls, arising from the interaction between 2 objects 3. using force arrows in diagrams, adding forces in 1 dimension, balanced and unbalanced forces 4. non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets, and forces due to static electricity 5. forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only) 6. change depending on direction of force and its size Electricity 1. electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge 2. potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current 3. differences in resistance between conducting and insulating components (quantitative) Atoms and Radiation • N/A Magnets 1. magnetic poles, attraction and repulsion 2. magnetic fields by plotting with compass, representation by field lines 3. the magnetic effect of a current, electromagnets, Waves 1. waves on water as undulations which travel through water with transverse motion; these waves can be reflected, and add or cancel – superposition 2. frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound 3. sound produced by vibrations of objects, in loudspeakers, detected by their effects on microphone diaphragm and the ear drum; sound waves are longitudinal

	less well adapted to compete successfully and reproduce, which in turn may lead to extinction 4. the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material Ecology 1. the interdependence of organisms in an ecosystem, including food webs and insect pollinated crops 2. the importance of plant reproduction through insect pollination in human food security		4. the similarities and differences between light waves and waves in matter 5. colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection Space 1. gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and sun (qualitative only) 2. our sun as a star, other stars in our galaxy, other galaxies 3. the seasons and the Earth's tilt, day length at different times of year, in different hemispheres 4. the light year as a unit of astronomical distance
	Scientific Skills Scientific attitudes • pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility • evaluate risks Experimental skills and investigations • ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience • make predictions using scientific knowledge and understanding • select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables • use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety • make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements • apply sampling techniques Analysis and evaluation • apply mathematical concepts and calculate results • present observations and data using appropriate methods, including tables and graphs • 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 • identify further questions arising from their results Measurement • understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature • use and derive simple equations and carry out appropriate calculations • undertake basic data analysis including simple statistical techniques		

Vocabulary *for literacy, reading & oracy*	Cell Biology
	• cell
	• nucleus
	• cell membrane
	• cytoplasm
	• cell wall
	• vacuole
	• chloroplast
	• mitochondria
	• specialised (cell)
	  ○ sperm
	  ○ nerve
	  ○ root hair
	  ○ ovum
	  ○ palisade
	Organisation
	• carbohydrate
	• lipids
	• protein
	• vitamin
	• mineral
	• fibre
	• obesity
	• malnutrition
	• starvation
	• deficiency
	• digestion
	  ○ stomach
	  ○ oesphagus
	  ○ small and large intestine
	  ○ liver
	  ○ pancreas
	  ○ gall bladder
	  ○ rectum
	  ○ anus
	• enzyme
	• reproduction
	  ○ penis
	  ○ vagina
	  ○ testicle
	  ○ ovary
	  ○ oviduct
	  ○ ovum (egg)
	  ○ sperm
	  ○ sperm duct
	  ○ urethra
	  ○ uterus
	  ○ menstruation
	  ○ menstrual cycle
	  ○ gamete
	  ○ fertilisation
	  ○ gestation
		Atoms and the Periodic Table
		• solid
		• liquid
		• gas
		• particle
		• particle model
		• state (of matter)
		• changes of state
		• atom
		• element
		• compound
		• diffusion
		• filtration
		• evaporation
		• distillation
		• chromatography
		• period
		• groups
		• Reactant
		• Product
		
		Bonding
		• N/A
		
		Chemical changes and analysis
		• Acid
		• Alkali
		• Neutralisation
		• pH
		• indicator
		
		Energy changes and rates of reaction
		• exothermic
		• endothermic
		
		Chemistry of the Atmosphere
		• oxygen
		• nitrogen
		• carbon dioxide
		• photosynthesis
		• respiration
		• combustion
		• global warming
		• climate change
		
		Resources
		• N/A
		
		Organic Chemistry
		• N/A
			Energy
			• Energy
			• Energy store
			• Energy transfer
			• Energy resource/source of energy
			• Renewable
			• Non-renewable
			• Efficiency
			
			Forces
			• Balanced
			• Unbalanced
			• Force
			• Contact
			  ○ Friction
			  ○ Air resistance/drag
			• Non-contact
			  ○ Gravity
			  ○ Weight
			  ○ Magnetic
			  ○ Static electricity
			
			Electricity
			• Current
			• Potential difference (Voltage)
			• Resistance
			• Series
			• Parallel
			• Conductor
			• Insulator
			
			Atoms and Radiation
			• N/A
			
			Magnets
			• Magnetic
			• Attraction
			• Repulsion
			• Pole
			• Electromagnet
			• Magnetic field
			
			Waves
			• Frequency
			• Transverse
			• Longitudinal
			• Prism
			
			Space
			• Gravity
			• Weight
			• Mass

	○ placenta ○ pollination ○ germination ○ seed formation ○ seed dispersal ○ anther ○ stigma ○ style ○ stamen ○ carpel Infection and response • N/A Bioenergetics • photosynthesis • glucose • carbon dioxide • aerobic • anaerobic • respiration Homeostasis Genetics and Evolution • heredity • inheritance • genetic • chromosome • gene • DNA • Species • Extinction Ecology • interdependence • pollination • producer • consumer (primary, secondary, tertiary etc) • carnivore • herbivore • omnivore • apex predator • predator • prey • food security • accumulation • biodiversity		• Sun/star • Planet • Galaxy • Comet • Asteroid • Satellite • Moon • Nebula • Light-year
	Scientific Skills • Accuracy • Precision • Repeatability		

	• Reproducibility • Validity • Scientific method • Theory • Evidence • Peer review • Prediction • Independent (Variable) • Dependent (variable) • Control (variable) • Apparatus • Equipment • Measurements • Results • Conclusion • Evaluation • Hypothesis		
Sequenced *FROM and TO*	Cell Biology 1. From: N/A, To: M4 Cell Biology 2. From: N/A, To: M4 Cell Biology 3. From: N/A, To: M4 Cell Biology 4. From: N/A, To: M4 Cell Biology Organisation 1. From: M1 Organisation, To: N/A 2. From: M1 Organisation, To: M4 Organisation 3. From: M2 Organisation, To: M4 Organisation 4. From: M1 Organisation, To: M4 Organisation 5. From: N/A, To: M4 6. From: M2 Organisation, To: M4 Organisation 7. From: M2 Organisation, To: M4 Organisation Infection and Response • N/A Bioenergetics 1. From: N/A, To: M4 Bioenergetics 2. From: N/A, To: M4 Bioenergetics 3. From: N/A, To: M4 Bioenergetics Homeostasis • N/A Genetics and Evolution 1. From: M2 Genetics and Evolution, To: M4 Genetics and Evolution 2. From: N/A, To: M4 Genetics and Evolution 3. From: M2 Genetics and Evolution, To: M4 Genetics and Evolution 4. From: N/A, To: M4 Ecology Ecology 1. From: M2 Ecology, To: M4 Ecology	Atoms and the Periodic Table 1. From: M1 Atoms and the Periodic Table, To: Beyond this Curriculum 2. From: M1 Atoms and the Periodic Table, To: M4 Beyond this Curriculum 3. From: N/A, To: Beyond this Curriculum 4. From: N/A, To: Beyond this Curriculum 5. From: N/A, To: Beyond this Curriculum 6. From: M2 Atoms and the Periodic Table, To: Beyond this Curriculum 7. From: N/A, To: Beyond this Curriculum 8. From: M2 Atoms and the Periodic Table, To: Beyond this Curriculum Bonding • N/A Chemical Changes and Analysis 1. From: N/A, To: underpins all chemistry 2. From: N/A, To: Beyond this Curriculum 3. From: N/A, To: Beyond this Curriculum 4. From N/A, To: Beyond this Curriculum 5. From N/A, To: Beyond this Curriculum Energy Changes and Rates of Reaction 1. From: N/A, To Beyond this Curriculum 2. From: N/A, To Beyond this Curriculum Chemistry of the Atmosphere 1. From: N/A, To: Beyond this Curriculum 2. From: N/A, To: Beyond this Curriculum 3. From: N/A, To: Beyond this Curriculum Resources	Energy 1. From: N/A, To: Beyond this Curriculum 2. From N/A, To: Beyond this Curriculum 3. From: N/A, To: Beyond this Curriculum 4. From: N/A, To: Beyond this Curriculum Forces 1. From: N/A, To: Beyond this Curriculum 2. From: M2 Forces, To: Beyond this Curriculum 3. From: N/A, To: Beyond this Curriculum 4. From: M2 Forces, To: Beyond this Curriculum 5. From: N/A, To: Beyond this Curriculum 6. From: N/A, To: Beyond this Curriculum Electricity 1. From: M2 Electricity, To: Beyond this Curriculum 2. From: M2 Electricity, To: Beyond this Curriculum 3. From: M2 Electricity, To: Beyond this Curriculum Atoms and Radiation • N/A Magnets 1. From: M1 Magnets, To: Beyond this Curriculum 2. From: M1 Magnets, To Beyond this Curriculum 3. From: M1 Magnets, To: Beyond this Curriculum Waves 1. From: M2 Waves, To: Beyond this Curriculum 2. From: M2 Waves, To: Beyond this Curriculum 3. From: M2 Waves, To: Beyond this Curriculum 4. From: M2 Waves, To: Beyond this Curriculum 5. From M2 Waves, To: Beyond this Curriculum

	2. From: M1 Ecology, To: M5 Ecology	• N/A Organic Chemistry • N/A	Space 1. From: N/A, To: Beyond the Curriculum 2. From: M2 Space, To: Beyond the Curriculum

Milestone 4			
Theme mapping	Biology	Chemistry	Physics
Learning Outcomes *Sound understanding of powerful <u>knowledge</u> to be reviewed and retained for future learning.* *becomes…* *Successful application of transferable <u>skills</u>*	Cell Biology 1. Students should be able to explain how the main sub-cellular structures in a plant and animal cell, including: nucleus, cell membranes, cytoplasm, mitochondria, chloroplasts, vacuole, cell wall and ribosome are related to their functions. 2. Students should explain how the structure of different types of cell relate to their function to include: sperm cells, nerve cells and muscle cells in animals and root hair cells, xylem and phloem cells in plants. 3. Microscopy techniques have developed over time and now use electron microscopes. An electron microscope has much higher magnification and resolving power than a light microscope. This means that it can be used to study cells in much finer detail. 4. Bacteria multiply by simple cell division (binary fission) as often as once every 20 minutes Use to investigated the action of disinfectants and antibiotics. 5. The nucleus of a cell contains chromosomes made of DNA molecules. Each chromosome carries a large number of genes. In body cells the chromosomes are normally found in pairs. 6. A stem cell is an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation. Stem cells from human embryos can be cloned and made to differentiate into most different types of human cells. Stem cells from adult bone marrow can form many types of cells including blood cells. 7. Treatment with stem cells may be able to help conditions such as diabetes and paralysis. 8. Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas, resulting in a net movement from an area of higher concentration to an area of lower concentration. 9. Some of the substances transported in and out of cells by diffusion are oxygen and carbon dioxide in gas exchange, and of the waste product urea from cells into the blood plasma for excretion in the kidney. 10. Students should be able to explain how different factors affect the rate of diffusion. Factors which affect the rate of diffusion are the difference in concentrations (concentration gradient), the temperature and the surface area of the membrane. 11. Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated	• Not specifically taught at the Bridge Academy but support is available if required	○ Not specifically taught at the Bridge Academy, but support is available if required

	solution through a partially permeable membrane. Osmosis affects plants and animal cells in a variety of ways Required Practical • Microscopy • Osmosis Organisation 1. Cells are the basic building blocks of all living organisms. A tissue is a group of cells with a similar structure and function. Organs are aggregations of tissues performing specific functions. Organs are organised into organ systems, which work together to form organisms. 2. This section assumes knowledge of the digestive system studied in Key Stage 3 science (refer back to milestone ___) 3. Enzymes catalyse specific reactions in living organisms due to the shape of their active site 4. Students should be able to use the 'lock and key theory' as a simplified model to explain enzyme action. 5. Digestive enzymes convert food into small soluble molecules that can be absorbed into the bloodstream Students should be able to recall the sites of production and the action of amylase, proteases and lipases. 6. The heart is an organ that pumps blood around the body in a double circulatory system. The right ventricle pumps blood to the lungs where gas exchange takes place. The left ventricle pumps blood around the rest of the body. 7. The respiratory system comprises the trachea, bronchi, alveoli and the capillary network surrounding the alveoli. 8. The body contains three different types of blood vessel: • arteries • veins • capillaries. Students should be able to explain how the structure of these vessels relates to their functions 9. Blood is a tissue consisting of plasma, in which the red blood cells, white blood cells and platelets are suspended. Students should know the functions of each of these blood components. 10. Students should be able to recognise different types of blood cells in a photograph or diagram, and explain how they are adapted to their functions. 11. In coronary heart disease layers of fatty material build up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle. Stents are used to keep the coronary arteries open. Statins are widely used to reduce blood cholesterol levels which slows down the rate of fatty material deposit. 12. In the case of heart failure a donor heart, or heart and lungs can be transplanted. 13. Health is the state of physical and mental well-being. Diseases, both communicable and non-communicable, are major causes of ill health.		

	14. Other factors including diet, stress and life situations may have a profound effect on both physical and mental health. Different types of disease may interact. 15. Risk factors are linked to an increased rate of a disease (see specification for stated examples) and many diseases are caused by the interaction of a number of factors 16. Students should be able to describe cancer as the result of changes in cells that lead to uncontrolled growth and division, describe the difference between benign and malignant tumours. 17. Students should be able to explain how the structures of plant tissues are related to their functions. 18. The leaf is a plant organ. Knowledge limited to epidermis, palisade and spongy mesophyll, xylem and phloem, and guard cells surrounding stomata 19. The roots, stem and leaves form a plant organ system for transport of substances around the plant. Students should be able to explain the effect of changing temperature, humidity, air movement and light intensity on the rate of transpiration. 20. Xylem tissue transports water and mineral ions from the roots to the stems and leaves. 21. The role of stomata and guard cells are to control gas exchange and water loss. 22. Phloem tissue transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage. 23. The movement of food molecules through phloem tissue is called translocation Required Practical • Food Tests Infection and Response 1. Pathogens are microorganisms that cause infectious disease. Pathogens may be viruses, bacteria, protists or fungi. 2. They may infect plants or animals and can be spread by direct contact, by water or by air. 3. The spread of diseases can be reduced or prevented. 4. Bacteria and viruses may reproduce rapidly inside the body. Bacteria may produce poisons (toxins) that damage tissues and make us feel ill. Viruses live and reproduce inside cells, causing cell damage. 5. Measles is a viral disease showing symptoms of fever and a red skin rash. The measles virus is spread by inhalation of droplets from sneezes and coughs. Vaccination, isolation and masks can be used to reduce the spread. 6. HIV initially causes a flu-like illness. Unless successfully controlled with antiretroviral drugs the virus attacks the body's immune cells and can develop into AIDs. HIV is spread by sexual contact or exchange of body fluids. Spread can be reduced by using condoms or treatment with antiretrovirals. 7. Tobacco mosaic virus (TMV) is a widespread plant pathogen. Symptoms include 'mosaic' pattern of discolouration on the leaves which affects the growth of the plant due to lack of photosynthesis.		

	8. Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. Fever, abdominal cramps, vomiting and diarrhoea are symptoms. 9. Gonorrhoea is a sexually transmitted bacterial disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. The spread can be controlled by treatment with antibiotics or the use of condoms. 10. Rose black spot is a fungal disease where purple or black spots develop on leaves. It is spread in the environment by water or wind. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves. 11. The pathogens that cause malaria are protists. The malarial protist has a life cycle that includes the mosquito. Malaria causes recurrent episodes of fever and can be fatal. The spread of malaria is controlled by controlling the mosquitos, e.g. by using mosquito nets, repellent and insecticide. 12. The body have a variety of non-specific defence systems against pathogens e.g. mucus, ear and nose hair etc 13. The immune system also defends against disease by destroying pathogens that get into the body. White blood cells help to defend against pathogens by phagocytosis, antibody production and antitoxin production. 14. Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body 15. Antibiotics, such as penicillin, cure bacterial disease by killing infective bacteria inside the body. 16. Antibiotics cannot kill viral pathogens. 17. Painkillers and other medicines are used to treat the symptoms of disease but do not kill pathogens. 18. Traditionally drugs were extracted from plants and microorganisms and many new drugs still originate from natural sources. The heart drug digitalis originates from foxgloves. The painkiller aspirin originates from willow. Penicillin was from the Penicillium mould. 19. New drugs are extensively tested for toxicity, efficacy and dose. 20. Preclinical testing is done in a laboratory using cells, tissues and live animals. 21. Clinical trials use healthy volunteers and patients There are three phases to clinical trials, details are required. Bioenergetics 1. Photosynthesis is a process used by plants that absorbs light and produces glucose. Knowledge of both word and symbol equations is required 2. The uses of glucose by plants (see specification for details) 3. Organisms need energy for chemical reactions to build larger molecules, movement and keeping warm. 4. Respiration in cells can take place aerobically (using oxygen) or anaerobically (without oxygen), to transfer energy. 5. Word equations for both aerobic and anaerobic respiration required 6. Symbol equation for aerobic respiration is required		

	7. Compare the processes of aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred. **8.** During exercise the human body reacts to the increased demand for energy. The heart rate, breathing rate and breath volume increase during exercise to supply the muscles with more oxygenated blood. Required Practical • Photosynthesis Homeostasis 1. Homeostasis is the regulation of the internal conditions of a cell or organism to maintain optimum conditions for function in response to internal and external changes. In the human body, these include control of blood glucose concentration, body temperature and water levels. 2. All control systems (nervous and chemical) include: cells called receptors, which detect stimuli (changes in the environment), coordination centres (such as the brain, spinal cord and pancreas) that receive and process information from receptors and effectors, muscles or glands, which bring about responses which restore optimum levels. 3. The nervous system enables humans to react to their surroundings and to coordinate their behaviour. 4. Students should be able to explain how the various structures in a reflex arc – including the sensory neurone, synapse, relay neurone and motor neurone – relate to their function. 5. Reflex actions are automatic and rapid; they do not involve the conscious part of the brain. 6. The endocrine system is composed of glands which secrete chemicals called hormones directly into the bloodstream. The blood carries the hormone to a target organ where it produces an effect. 7. Compared to the nervous system the effects are slower but act for longer. 8. The pituitary gland in the brain is a 'master gland' which secretes several hormones into the blood in response to body conditions. These hormones in turn act on other glands to stimulate other hormones to be released to bring about effects. 9. Students should be able to identify the position of the following on a diagram of the human body: pituitary gland, pancreas, thyroid, adrenal gland, ovary and testes. 10. Blood glucose concentration is monitored and controlled by the pancreas. 11. Students should be able to explain how insulin controls blood glucose (sugar) levels in the body. 12. Students should be able to compare Type 1 and Type 2 diabetes and explain how they can be treated. 13. During puberty reproductive hormones cause secondary sex characteristics to develop.		

	14. Oestrogen is the main female reproductive hormone produced in the ovary. At puberty eggs begin to mature and one is released approximately every 28 days. This is called ovulation. 15. Testosterone is the main male reproductive hormone produced by the testes and it stimulates sperm production. 16. Students should be able to evaluate the different hormonal and nonhormonal methods of contraception. Fertility can be controlled by a variety of hormonal and non-hormonal methods of contraception (see specification for details). Required Practical • Reaction time Inheritance, variation and evolution 1. Sexual reproduction involves the joining (fusion) of male and female gametes. In sexual reproduction there is mixing of genetic information which leads to variety in the offspring. The formation of gametes involves meiosis. 2. Asexual reproduction involves only one parent and no fusion of gametes. There is no mixing of genetic information. This leads to genetically identical offspring (clones). Only mitosis is involved 3. Meiosis leads to non-identical cells being formed while mitosis leads to identical cells being formed. 4. Students should be able to describe the structure of DNA and define genome. 5. The whole human genome has now been studied and this will have great importance for medicine in the future and tracing human migration patterns. 6. Students should be able to explain the terms: gamete, chromosome, gene, allele, dominant, recessive, homozygous, heterozygous, genotype, phenotype. 7. Some characteristics are controlled by a single gene, such as: fur colour in mice; and red-green colour blindness in humans. But most phenotype features are the result of multiple genes rather than single gene inheritance. 8. Each gene may have different forms called alleles. 9. The alleles present, or genotype, operate at a molecular level to develop characteristics that can be expressed as a phenotype. 10. A dominant allele is always expressed, even if only one copy is present. 11. A recessive allele is only expressed if two copies are present (therefore no dominant allele present). 12. If the two alleles present are the same the organism is homozygous for that trait, but if the alleles are different they are heterozygous. 13. Most characteristics are a result of multiple genes interacting, rather than a single gene. 14. Students should be able to use direct proportion and simple ratios to express the outcome of a genetic cross – for a single gene characteristic 15. Students should be able to complete a Punnett square diagram		

	16. Some disorders are caused by the inheritance of certain alleles including Polydactyly which is caused by a dominant allele and Cystic fibrosis which is caused by a recessive allele. 17. Ordinary human body cells contain 23 pairs of chromosomes. 22 pairs control characteristics only, but one of the pairs carries the genes that determine sex. a. In females the sex chromosomes are the same (XX). b. In males the chromosomes are different (XY). 18. Students should be able to carry out a genetic cross to show sex inheritance. 19. Differences in the characteristics of individuals in a population is called variation and may be genetic, environmental or a combination of the two 20. Students should be able to describe evolution as a change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of a new species. 21. The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago. 22. Students should be able to explain how evolution occurs through natural selection of variants that give rise to phenotypes best suited to their environment. 23. If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species. 24. Students should be able to explain the impact of selective breeding of food plants and domesticated animals. 25. Selective breeding (artificial selection) is the process by which humans breed plants and animals for particular genetic characteristics. Details of the process are required. 26. The characteristic can be chosen for usefulness or appearance (see specification for examples) 27. Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects. 28. The evidence for evolution includes fossils and antibiotic resistance in bacteria. 29. Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks. The processes of fossil formation 30. Scientists cannot be certain about how life began on Earth and the reasons for this. 31. We can learn from fossils how much or how little different organisms have changed as life developed on Earth. 32. Extinctions occur when there are no remaining individuals of a species still alive. 33. Lots of factors contribute to the extinction of a species. 34. Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus. 35. Linnaeus classified living things into kingdom, phylum, class, order, family, genus and species. 36. Organisms are named by the binomial system of genus and species.		

	37. As evidence of internal structures became more developed due to improvements in microscopes, and the understanding of biochemical processes progressed, new models of classification were proposed. 38. A 'three domain system' developed by Carl Woese Ecology 1. An ecosystem is the interaction of a community of living organisms (biotic) with the non-living (abiotic) parts of their environment. 2. To survive and reproduce, organisms require a supply of materials from their surroundings and from the other living organisms there. 3. Plants in a community or habitat often compete with each other for light and space, and for water and mineral ions from the soil. 4. Animals often compete with each other for food, mates and territory. Within a community each species depends on other species for food, shelter, pollination, seed dispersal etc. 5. If one species is removed it can affect the whole community. This is called interdependence. A stable community is one where all the species and environmental factors are in balance so that population sizes remain fairly constant. 6. Abiotic (non-living) factors which can affect a community are light intensity, temperature, moisture levels, soil pH and mineral content, wind intensity and direction, carbon dioxide levels for plants and oxygen levels for aquatic animals. 7. Biotic (living) factors which can affect a community are availability of food, new predators arriving, new pathogens, one species outcompeting another. 8. Organisms have features (adaptations) that enable them to survive in the conditions in which they normally live. These adaptations may be structural, behavioural or functional. 9. Some organisms live in environments that are very extreme, such as at high temperature, pressure, or salt concentration. These organisms are called extremophiles. Bacteria living in deep sea vents are extremophiles. 10. Students should understand that photosynthetic organisms are the producers of biomass for life on Earth. 11. Feeding relationships within a community can be represented by food chains. 12. All food chains begin with a producer which synthesises molecules. This is usually a green plant or alga which makes glucose by photosynthesis. 13. Producers are eaten by primary consumers, which in turn may be eaten by secondary consumers and then tertiary consumers. 14. Consumers that kill and eat other animals are predators, and those eaten are prey. In a stable community the numbers of predators and prey rise and fall in cycles 15. All materials in the living world are recycled to provide the building blocks for future organisms. The carbon cycle returns carbon from organisms to the atmosphere as carbon dioxide to be used by plants in photosynthesis.		

	16. The water cycle provides fresh water for plants and animals on land before draining into the seas. Water is continuously evaporated and precipitated. 17. Students should be able to explain the role of microorganisms in cycling materials through an ecosystem by returning carbon to the atmosphere as carbon dioxide and mineral ions to the soil. 18. Biodiversity is the variety of all the different species of organisms on earth, or within an ecosystem. 19. A great biodiversity ensures the stability of ecosystems by reducing the dependence of one species on another for food, shelter and the maintenance of the physical environment. 20. The future of the human species on Earth relies on us maintaining a good level of biodiversity. 21. Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. Pollution kills plants and animals which can reduce biodiversity. 22. Pollution can occur: a. in water, from sewage, fertiliser or toxic chemicals b. in air, from smoke and acidic gases c. on land, from landfill and from toxic chemicals. 23. Humans reduce the amount of land available for other animals and plants by building, quarrying, farming and dumping waste. 24. Large-scale deforestation in tropical areas has occurred to provide land for cattle and rice fields and grow crops for biofuels. 25. Students should be able to describe some of the biological consequences of global warming. 26. Levels of carbon dioxide and methane in the atmosphere are increasing, and contribute to 'global warming'. 27. Students should be able to describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity. Required Practical • Sampling		
	Scientific Skills Experimental design • Indicates how a problem can be investigated and identifies techniques or equipment that can be used to investigate the problem • describes the way in which techniques or equipment can be used to produce results. Working safety and making measurements or observation • Handles equipment and materials safely • uses equipment to make simple measurements or observations. Recording Data • Records the results of an experiment • uses a table or framework that has been provided. Presenting Data • Selects an appropriate method of displaying the data • displays the results using a framework that has been provided.		

<table>
<tr><td></td><td colspan="3">Identifying patterns and relationships
States what has been found out in the experiment
describes a simple relationship in the results or draws a simple conclusion.</td></tr>
<tr><td>Vocabulary for literacy, reading & oracy</td><td>Cell Biology
cell
nucleus
cytoplasm
cell membrane
cell wall
chloroplast
vacuole
mitochondria
ribosome
microscopy
iodine solution
tissue
organ
organ system
organism
Specialised (cell)
Sperm
acrosome
Ovum
Nerve
Dendrites
Axon
Mylin sheath
Ciliate epithelial
Cilia
mitochondria
Root hair
Protrusion
Palisade
chloroplast
Muscle
Red Blood Cell
Haemoglobin
stem cell
diffusion
osmosis
Organisation
Organ
brain
heart
lungs
stomach
small and large intestine
liver
gall bladder
pancreas</td><td>N/A</td><td>N/A</td></tr>
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	• kidneys
	• testes
	• ovaries
	• vagina
	• uterus
	• Organ system
	• Digestive
	• Circulatory system
	  ○ Heart
	  ○ Atrium
	  ○ Ventricle
	  ○ Vena cava
	  ○ Aorta
	  ○ Artery
	  ○ vein
	  ○ Capillary
	  ○ Platelets
	  ○ Plasma
	  ○ Blood
	  ○ Coronary heart disease (CHD)
	• Reproductive
	• Respiratory
	• Endocrine
	• Excretory
	• Nervous
	• Benedict's solution
	• Biuret's solution
	• Iodine
	• Sudan III
	• gas exchange
	• obesity
	• transpiration
	• translocation
	
	Infection and response
	• Infectious
	• Contagious
	• Non-contagious
	• Micro-organism
	• Pathogen
	• Vector
	• White blood cell
	• Engulf
	• Antibody
	• Antitoxin
	• Antigen
	• Antibiotic
	• Vaccine
	• Clinical
	• Preclinical
	
	Bioenergetics		

	• photosynthesis • epidermis • spongy mesophyll • palisade mesophyll • xylem • phloem • respiration • glucose Homeostasis • automatic • hormones • stimulus • receptor • neurone (sensory, relay, motor) • effector • synapse • endocrine • oestrogen • progesterone • insulin • glycogen • diabetes Genetics and Evolution • sexual reproduction • asexual reproduction • gamete • DNA • Base (nitrogenous) • Gene • Chromosome • Genome • Allele • Recessive • Dominant • Homozygous • Heterozygous • Phenotype • Genotype • Classification • Species • Selective breeding • Evolution • Extinction Ecology • Ecosystem • Population • Species • Community		

	• Biotic • Abiotic • Producer • Autotroph • Consumer • Herbivore • Carnivore • Omnivore • Predator • Prey • Adaptation • Extremophiles • Biodiversity • Sampling • Quadrat • Transect		
	Scientific Skills • Accuracy • Precision • Repeatability • Reproducibility • Validity • Scientific method • Theory • Evidence • Peer review • Prediction • Independent (Variable) • Dependent (variable) • Control (variable) • Apparatus • Equipment • Measurements • Results • Conclusion • Evaluation • Hypothesis		
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	Organisation 1. From: M3 Cell Biology, to: N/A **2.** From: M3 Organisation, to: M5 Organisation **3.** From: M3 Organisation, to: N/A **4.** From: M3 Organisation, to: N/A **5.** From: M3 Organisation, to: N/A **6.** From: M2 Organisation, to: M5 Organisation **7.** From: M3 Organisation, to: N/A **8.** From: M2 Organisation, to: N/A **9.** From: M2 Organisation, to: N/A **10.** From: M2 Organisation, to: N/A **11.** From: N/A, to: M5 Organisation **12.** From: N/A, to: M5 Organisation **13.** From: N/A, to: M5 Organisation **14.** From: M3 Organisation, to: M5 Organisation **15.** From: N/A, to: M5 Organisation **16.** From: N/A, to: M5 Organisation **17.** From: N/A, to: M5 Organisation **18.** From: N/A, to: M5 Organisation **19.** From: N/A, to: M5 Organisation **20.** From: N/A, to: M5 Organisation **21.** From: N/A, to: M5 Organisation **22.** From: N/A, to: M5 Organisation **23.** From: N/A, to: M5 Organisation Infection and Response **1.** From: N/A, to: M5 Infection and Response **2.** From: N/A, to: N/A **3.** From: N/A, to: N/A **4.** From: N/A, to: N/A **5.** From: N/A, to: N/A **6.** From: N/A, to: N/A **7.** From: N/A, to: M6 Infection and Response **8.** From: N/A, to: N/A **9.** From: N/A, to: N/A **10.** From: N/A, to: M6 Infection and Response **11.** From: N/A, to: N/A **12.** From: N/A, to: N/A **13.** From: N/A, to: M5 Infection and Response **14.** From: N/A, to: M5 Infection and Response **15.** From: N/A, to: M5 Infection and Response **16.** From: N/A, to: M5 Infection and Response **17.** From: N/A, to: N/A **18.** From: N/A, to: N/A **19.** From: N/A, to: M5 Infection and Response **20.** From: N/A, to: M5 Infection and Response **21.** From: N/A, to: M5 Infection and Response Bioenergetics **1.** From: M3 Bioenergetics, to: M5 Bioenergetics **2.** From: N/A, to: N/A **3.** From: N/A, to: M5 Bioenergetics **4.** From: M3 Bioenergetics, to: M5 Bioenergetics		

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Milestone 5						
Theme mapping	Biology		Chemistry		Physics	
Learning Outcomes *Sound understanding of powerful knowledge to be reviewed and*	Cell Biology 1. Bacterial cells (prokaryotic cells) are much smaller in comparison. They have cytoplasm and a cell membrane surrounded by a cell wall. The genetic material is not enclosed in a nucleus. It is a single DNA loop and there may be one or more small rings of DNA called plasmids. 2. Students should be able to explain the importance of cell differentiation and that as a cell differentiates it acquires		• Not specifically taught at the Bridge Academy, but support can be provided if required		• Not specifically taught at the Bridge Academy, but support can be provided if required	

retained for future learning. *becomes…* *Successful application of transferable <u>skills</u>*	different sub-cellular structures to enable it to carry out a certain function. It has become a specialised cell 3. Most types of animal cell differentiate at an early stage whereas many types of plant cells retain the ability to differentiate throughout life. 4. In mature animals, cell division is mainly restricted to repair and replacement 5. Students should be able to carry out calculations involving magnification, real size and image size using the formula: magnification = size of image size of real object 6. Students should be able to describe how to prepare an uncontaminated culture using aseptic technique. They should be able to explain why: • Petri dishes and culture media must be sterilised before use • inoculating loops used to transfer microorganisms to the media must be sterilised by passing them through a flame • the lid of the Petri dish should be secured with adhesive tape and stored upside down • in school laboratories, cultures should generally be incubated at 25°C. 7. Cells divide in a series of stages called the cell cycle. Students should be able to describe the stages of the cell cycle including mitosis 8. Meristem tissue in plants can differentiate into any type of plant cell, throughout the life of the plant. 9. Describe the process of therapeutic cloning 10. Stem cells from meristems in plants can be used to produce clones of plants quickly and economically using tissue cultures 11. Students should be able to calculate and compare surface area to volume ratios. 12. Students should be able to explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials. 13. Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). This requires energy from respiration. Required Practical • Culturing Micro-organisms Organisation 1. Bile is made in the liver and stored in the gall bladder. It is alkaline to neutralise hydrochloric acid from the stomach. It also emulsifies fat to form small droplets which increases the surface area. The alkaline conditions and large surface area increase the rate of fat breakdown by lipase. 2. The natural resting heart rate is controlled by a group of cells located in the right atrium that act as a pacemaker. Artificial pacemakers are electrical devices used to correct irregularities in the heart rate. 3. In some people heart valves may become faulty, preventing the valve from opening fully, or the heart valve might develop a leak. Faulty heart valves can be replaced using biological or mechanical valves.		

	4. non-communicable diseases have a financial and human impact on an individual, a local community, a nation or globally 5. lifestyle factors including diet, alcohol and smoking affect the incidence of non-communicable diseases at local, national and global levels. 6. Scientists have identified lifestyle risk factors for various types of cancer. There are also genetic risk factors for some cancers. 7. Students should be able to describe the process of transpiration and translocation, including the structure and function of the stomata. 8. Root hair cells are adapted for the efficient uptake of water by osmosis, and mineral ions by active transport. 9. The xylem is composed of hollow tubes strengthened by lignin adapted for the transport of water in the transpiration stream. 10. Phloem is composed of tubes of elongated cells. Cell sap can move from one phloem cell to the next through pores in the end walls. Require Pracitcal • Enzymes Infection and Response 1. Vaccination will prevent illness in an individual and the spread of pathogens. 2. Vaccines stimulate the white blood cells to produce antibodies. If the same pathogen re-enters the body the (memory) white blood cells respond quickly to produce the correct antibodies, preventing infection. 3. The use of antibiotics has greatly reduced deaths from infectious bacterial diseases. However, the emergence of strains resistant to antibiotics is of great concern. 4. It is difficult to develop drugs that kill viruses without also damaging the body's tissues. 5. In double blind trials, some patients are given a placebo. 6. Peer review is used to check findings for bias etc 7. Plants can be infected by a range of viral, bacterial and fungal pathogens as well as by insects. 8. Knowledge of plant diseases is restricted to tobacco mosaic virus as a viral disease, black spot as a fungal disease and aphids as insects. 9. Plants can be damaged by a range of ion deficiency conditions including stunted growth caused by nitrate deficiency and chlorosis caused by magnesium deficiency. 10. Knowledge of ions is limited to nitrate ions needed for protein synthesis and therefore growth, and magnesium ions needed to make chlorophyll. 11. Students should be able to describe physical and chemical plant defence responses. 12. Physical defence responses to resist invasion of microorganisms and include cellulose cell walls, tough waxy cuticle on leaves, layers of dead cells around stems (bark on trees) which fall off. 13. Chemical plant defence responses including antibacterial chemicals, poisons to deter herbivores.		

	14. Mechanical adaptations including thorns and hairs deter animals, leaves which droop or curl when touched and mimicry to trick animals. Bioenergetics 1. Students should be able to describe photosynthesis as an endothermic reaction as light energy is taken into the plant 2. Students should be able to explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll on the rate of photosynthesis. 3. Students should be able to describe cellular respiration as an exothermic reaction which is continuously occurring in living cells. 4. Anaerobic respiration in yeast cells is called fermentation and has economic importance in the manufacture of bread and alcoholic drinks 5. The word equation for fermentation is required 6. If there is a lack of oxygen anaerobic respiration occurs. This causes a build-up of lactic acid and creates an oxygen debt. 7. During long periods of vigorous activity muscles become fatigued and stop contracting efficiently. 8. Metabolism is the sum of all the reactions in a cell or the body. 9. Metabolism includes: a. conversion of glucose to starch, glycogen and cellulose b. the formation of lipid molecules from a molecule of glycerol and three molecules of fatty acids c. the use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins d. respiration **e.** breakdown of excess proteins to form urea for excretion**.** Homeostasis 1. The brain controls complex behaviour. It is made of billions of interconnected neurones and has different regions that carry out different functions. 2. Students should be able to identify the cerebral cortex, cerebellum and medulla on a diagram of the brain, and describe their functions. 3. The eye is a sense organ containing receptors sensitive to light intensity and colour. 4. Students should be able to identify the following structures on a diagram of the eye and explain how their structure is related to their function. 5. Accommodation is the process of changing the shape of the lens to focus on near or distant objects. Details of how this is done are required. 6. Two common defects of the eyes are myopia (short sightedness) and hyperopia (long sightedness) in which rays of light do not focus on the retina. Details of treatments of these conditions is required. 7. Students should be able to interpret ray diagrams, showing these two common defects of the eye and demonstrate how spectacle lenses correct them.		

	8. The thermoregulatory centre in the brain contains receptors sensitive to the temperature of the blood. 9. The skin contains temperature receptors and sends nervous impulses to the thermoregulatory centre. 10. A variety of methods are used to maintain body temperature (see specification for details) 11. Water leaves the body via the lungs during exhalation. 12. Water, ions and urea are lost from the skin in sweat. There is no control over water, ion or urea loss by the lungs or skin. 13. Excess water, ions and urea are removed via the kidneys in the urine. 14. Students should be able to describe the function of kidneys in maintaining the water balance of the body. 15. People who suffer from kidney failure may be treated by organ transplant or by using kidney dialysis. Students should know the basic principles of dialysis. 16. Several hormones are involved in the menstrual cycle of a woman including: a. Follicle stimulating hormone (FSH) causes maturation of an egg in the ovary. b. Luteinising hormone (LH) stimulates the release of the egg. c. Oestrogen and progesterone are involved in maintaining the uterus lining 17. Students should be able to explain the use of hormones in modern reproductive technologies to treat infertility. This includes giving FSH and LH in a 'fertility drug' to a woman. She may then become pregnant in the normal way. 18. Details of In Vitro Fertilisation (IVF) treatment are required. 19. Students should be able to evaluation the pros and cons of fertility treatments. 20. Plants produce hormones to coordinate and control growth and responses to light (phototropism) and gravity (gravitropism or geotropism). **21.** Unequal distributions of auxin cause unequal growth rates in plant roots and shoots. Required Practical • Auxins Inheritance, variation and evolution 1. Meiosis halves the number of chromosomes in gametes and fertilisation restores the full number of chromosomes. 2. The process of meiosis to form gametes 3. Gametes join at fertilisation to restore the normal number of chromosomes. The new cell divides by mitosis. The number of cells increases. As the embryo develops cells differentiate. 4. Advantages of sexual reproduction and disadvantages of sexual and asexual reproduction. 5. Some organisms reproduce by both methods depending on the circumstances to include malaria, plants and fungi		

	6. Each gene codes for a particular sequence of amino acids. A sequence of three bases is the code for a particular amino acid. The order of bases controls the order in which amino acids are assembled to produce a particular protein. 7. extract and interpret information from genetic crosses and family trees. 8. Students should make informed judgements about the economic, social and ethical issues concerning embryo screening, given appropriate information. 9. Population of an organism have lots of variation caused by mutations and that: most have no effect on the phenotype; some influence phenotype; very few determine phenotype. 10. Mutations occur continuously. 11. Very rarely a mutation will lead to a new phenotype. 12. If the new phenotype is suited to an environmental change it can lead to a relatively rapid change in the species. 13. Students should be able to describe genetic engineering as a process which involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic. 14. In genetic engineering, genes from the chromosomes of humans and other organisms can be 'cut out' and transferred to cells of other organisms. 15. Students should be able to explain the potential benefits and risks of genetic engineering in agriculture and in medicine and that some people have objections. 16. The process of cloning plants using tissue culture and cuttings 17. The process of cloning in animals using embryo transplants: and adult cell cloning. Details are required. 18. Charles Darwin, as a result of observations on a round the world expedition, backed by years of experimentation and discussion and linked to developing knowledge of geology and fossils, proposed the theory of evolution by natural selection. 19. Details of evolution by natural selection are required. 20. Darwin published his ideas in On the Origin of Species (1859). The theory of evolution by natural selection was only gradually 21. Jean-Baptiste Lamarck based his theory on the idea that changes that occur in an organism during its lifetime can be inherited. 22. Alfred Russel Wallace independently proposed the theory of evolution by natural selection. He published joint writings with Darwin in 1858 which prompted Darwin to publish On the Origin of Species (1859) the following year. 23. Wallace worked worldwide gathering evidence for evolutionary theory. 24. He is best known for his work on warning colouration in animals and his theory of speciation. Students should be able to describe the steps which give rise to new species. 25. Our understanding of genetics was increased by the work of Mendel – details of his work are required. 26. Mendel's discovery was not recognised until after his death. 27. In the late 19th century behaviour of chromosomes during cell division was observed.		

	28. In the early 20th century it was observed that chromosomes and Mendel's 'units' behaved in similar ways. 29. This led to the idea that the 'units', now called genes, were located on chromosomes. 30. In the mid-20th century the structure of DNA was determined and the mechanism of gene function worked out. 31. Bacteria can evolve rapidly because they reproduce at a fast rate. Mutations of bacterial pathogens produce new strains and how this can lead to antibiotic resistance e.g. MRSA. 32. The actions that can be done to reduce the rate of development of antibiotic resistant strains. 33. The development of new antibiotics is costly and slow. It is unlikely to keep up with the emergence of new resistant strains. 34. Evolutionary trees are a method used by scientists to show how they believe organisms are related. 35. They use current classification data for living organisms and fossil data for extinct organisms. Ecology 1. Students should be able to explain how temperature, water and availability of oxygen affect the rate of decay of biological material. 2. Gardeners and farmers try to provide optimum conditions for rapid decay of waste biological material. 3. The compost produced is used as a natural fertiliser for growing garden plants or crops. 4. Anaerobic decay produces methane gas. Biogas generators can be used to produce methane gas as a fuel. 5. The destruction of peat bogs, and other areas of peat to produce garden compost, reduces the area of this habitat and thus the variety of different plant, animal and microorganism species that live there (biodiversity). 6. The decay or burning of the peat releases carbon dioxide into the atmosphere. 7. Students should be able to describe the differences between the trophic levels of organisms within an ecosystem. 8. Trophic levels can be represented by numbers, starting at level 1 with plants and algae. Further trophic levels are numbered subsequently according to how far the organism is along the food chain. 9. Apex predators are carnivores with no predators. 10. Decomposers break down dead plant and animal matter by secreting enzymes into the environment. Small soluble food molecules then diffuse into the microorganism. 11. Pyramids of biomass can be constructed to represent the relative amount of biomass in each level of a food chain. Trophic level 1 is at the bottom of the pyramid. 12. Producers are mostly plants and algae which transfer about 1% of the incident energy from light for photosynthesis. 13. Only approximately 10% of the biomass from each trophic level is transferred to the level above it and the reasons for losses of biomass		

	14. Students should be able to calculate the efficiency of biomass transfers between trophic levels by percentages or fractions of mass. 15. The amount of biomass transferred between trophic levels affects the number of organisms at each trophic level. 16. Food security is having enough food to feed a population. 17. Many biological factors which are threatening food security (see specification for details) and sustainable methods must be found to feed all people on Earth. 18. The efficiency of food production can be improved by using intensive farming and the way this works. 19. Fish stocks in the oceans are declining. 20. Control of net size and the introduction of fishing quotas play important roles in conservation of fish stocks at a sustainable level. 21. The fungus Fusarium is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The process of producing Fusarium is required. 22. A genetically modified bacterium produces human insulin. 23. GM crops could provide more food or food with an improved nutritional value such as golden rice. Required Practical • Decay		
	Scientific Skills Experimental design • Indicates how a problem can be investigated and identifies techniques or equipment that can be used to investigate the problem • describes the way in which techniques or equipment can be used to produce results, eg by completing a flow chart for the method • makes a prediction about the outcome. Working safety and making measurements or observations • Handles equipment and materials safely • uses equipment to make simple measurements or observations • shows recognition of the need for results to be meaningful. Recording Data • Records the results of an experiment • uses a table or framework that has been produced by the student. Presenting data • Selects an appropriate method of displaying the data • displays the results using a framework that has been produced by the student. Identifying patterns and relationships • States what has been found out in the experiment • describes a simple relationship in the results or draws a simple conclusion • makes a relevant comment about the success or otherwise of the experiment.		

Vocabulary *for literacy, reading & oracy*	Cell Biology
	• Eukaryotic
	• Prokaryotic
	• Plasmid
	• Meristem
	• Inoculation
	• Contamination
	• Aseptic
	• Mitosis
	• Embryonic
	• Therapeutic cloning
	• Active transport
	Organisation
	• Enzyme
	  ○ Lipase
	  ○ Carbohydrase
	  ○ Amylase
	  ○ Protease
	• Optimal
	• Active site
	• Denature
	• Specific
	• Absorbed
	• Bile
	• Emulsify
	• Cancer
	• Pacemaker
	• Lignin
	
	Infection and response
	• Bacteria
	• Virus
	• Vaccine
	• Vaccination
	• Antibodies
	• Antibiotics
	• Antibiotic resistance
	• Double blind trial
	• Peer review
	• Placebo
	
	Bioenergetics
	• Endothermic
	• Exothermic
	• Chlorophyll
	• Aerobic
	• Anaerobic
	• Fermentation
	• Oxygen debt
	• Muscle fatigue
	• Metabolism
		• N/A	• N/A

	Homeostasis • Hormone • Menstrual cycle • Fertility • Contraception • IVF • Luteinising hormone (LH) • Follicle stimulating hormone (FSH) • Cerebral cortex • Cerebellum • Medulla • Pitutitary • Accommodation (in relation to the eye and focusing) • Myopia • Hyperopia • Vasoconstriction • Vasodilation • Dialysis • Infertility • In vitro fertilisation (IVF) • Phototropism • Geotropism • Auxin Genetics and Evolution • Meiosis • Gamete • Amino acid • Mutation • Natural selection • Genetic modification • Clone • Speciation • Evolutionary tree Ecology • Compost • Biogas • Peat bog • Trophic level • Apex predator • Biomass • Food security		
	Scientific Skills • Accuracy • Precision • Repeatability • Reproducibility • Validity		

	• Scientific method • Theory • Evidence • Peer review • Prediction • Independent (Variable) • Dependent (variable) • Control (variable) • Apparatus • Equipment • Measurements • Results • Conclusion • Evaluation • hypothesis		
Sequenced *FROM and TO*	Cell Biology 1. From: M4 Cell Biology, to: N/A 2. From: M4 Cell Biology, to: N/A 3. From: M4 Cell Biology, to: N/A 4. From: M4 Cell Biology, to: N/A 5. From: M4 Cell Biology, to: N/A 6. From: M4 Cell Biology, to: N/A 7. From: M4 Cell Biology, to: N/A 8. From: M4 Cell Biology, to: N/A 9. From: M4 Cell Biology, to: N/A 10. From: M4 Cell Biology, to: N/A 11. From: M4 Cell Biology, to: N/A 12. From: M4 Cell Biology, to: N/A 13. From: M4 Cell Biology, to: N/A Organisation 1. From: M4 Organisation, to: N/A 2. From: M4 Organisation, to: N/A 3. From: M4 Organisation, to: N/A 4. From: M4 Organisation, to: N/A 5. From: M4 Organisation, to: N/A 6. From: M4 Organisation, to: N/A 7. From: M4 Organisation, to: N/A 8. From: M4 Organisation, to: N/A 9. From: M4 Organisation, to: N/A 10. From: M4 Organisation, to: N/A Infection and Response 1. From: M4 Infection and Response, to: N/A 2. From: M4 Infection and Response, to: M6 Infection and response 3. From: M4 Infection and Response, to: N/A 4. From: M4 Infection and Response, to: N/A 5. From: M4 Infection and Response, to: N/A 6. From: M4 Infection and Response, to: N/A 7. From: M4 Infection and Response, to: M6 Infection and response 8. From: M4 Infection and Response, to: M6 Infection and response 9. From: M4 Infection and Response, to: N/A	•	•

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Milestone 6			

Theme mapping	Biology (Higher Teir Only Content)	Chemistry	Physics
Learning Outcomes *Sound understanding of powerful knowledge to be reviewed and retained for future learning.* *becomes…* *Successful application of transferable skills*	Cell Biology 1. Students should be able to express the answer in standard form when doing microscopy calculations. Organisation • N/A Infection and Response 1. Students should be able to describe how monoclonal antibodies are produced. 2. Students should be able to describe some of the ways in which monoclonal antibodies can be used. Some examples include: pregnancy tests, to measure the levels of hormones and other chemicals in blood, or to detect pathogens, to treat some diseases e.g. cancer. 3. Monoclonal antibodies create more side effects than expected. They are not yet as widely used as everyone hoped when they were first developed. 4. Plant diseases can be detected by: stunted growth, spots on leaves, areas of decay (rot), growths, malformed stems or leaves, discolouration and the presence of pests. 5. Identification can be made by: reference to a gardening manual or website, taking infected plants to a laboratory to identify the pathogen and using testing kits that contain monoclonal antibodies. Bioenergetics 1. These factors interact and any one of them may be the factor that limits photosynthesis. 2. Students should be able to explain graphs of photosynthesis rate involving two or three factors and decide which is the limiting factor. 3. Students should understand and use inverse proportion – the inverse square law and light intensity in the context of photosynthesis. 4. Limiting factors are important in the economics of enhancing the conditions in greenhouses to gain the maximum rate of photosynthesis while still maintaining profit. 5. Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose. Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from the cells. Homeostasis 1. Students should be able to explain some of the difficulties of investigating brain function and treating brain damage and disease. 2. Neuroscientists have been able to map the regions of the brain to particular functions by studying patients with brain damage,	• Not specifically taught at the Bridge Academy, but support can be provided if required	• Not specifically taught at the Bridge Academy, but support can be provided if required

	electrically stimulating different parts of the brain and using MRI scanning techniques. 3. The complexity and delicacy of the brain makes investigating and treating brain disorders very difficult. 4. Students should be able to explain how these mechanisms lower or raise body temperature in a given context. 5. If the blood glucose concentration is too low, the pancreas produces the hormone glucagon that causes glycogen to be converted into glucose and released into the blood. 6. Students should be able to explain how glucagon interacts with insulin in a negative feedback cycle to control blood glucose (sugar) levels in the body. 7. The digestion of proteins from the diet results in excess amino acids which need to be excreted safely. In the liver these amino acids are deaminated to form ammonia. Ammonia is toxic and so it is immediately converted to urea for safe excretion. 8. Students should be able to describe the effect of ADH on the permeability of the kidney tubules. 9. The water level in the body is controlled by the hormone ADH which acts on the kidney tubules. ADH is released by the pituitary gland when the blood is too concentrated and it causes more water to be reabsorbed back into the blood from the kidney tubules. This is controlled by negative feedback. 10. Students should be able to explain the interactions of FSH, oestrogen, LH and progesterone, in the control of the menstrual cycle. 11. Students should be able to extract and interpret data from graphs showing hormone levels during the menstrual cycle. 12. Adrenaline is produced by the adrenal glands in times of fear or stress. It increases the heart rate and boosts the delivery of oxygen and glucose to the brain and muscles, preparing the body for 'flight or fight'. 13. Thyroxine from the thyroid gland stimulates the basal metabolic rate. It plays an important role in growth and development. 14. Thyroxine levels are controlled by negative feedback. 15. Gibberellins are important in initiating seed germination. 16. Ethene controls cell division and ripening of fruits. 17. Plant growth hormones are used in agriculture and horticulture. 18. Auxins are used as weed killers, as rooting powders and for promoting growth in tissue culture. Ethene is used in the food industry to control ripening of fruit during storage and transport. Gibberellins can be used to end seed dormancy, promote flowering and increase fruit size. Inheritance, variation and evolution 1. Students should be able to: a. recall a simple description of protein synthesis b. explain simply how the structure of DNA affects the protein made c. describe how genetic variants may influence phenotype: a) in coding DNA by altering the activity of a protein: and		

	b) in non-coding DNA by altering how genes are expressed. 2. In the complementary strands a C is always linked to a G on the opposite strand and a T to an A. 3. Students should be able to explain how a change in DNA structure may result in a change in the protein synthesised by a gene. 4. Proteins are synthesised on ribosomes, according to a template. Carrier molecules bring specific amino acids to add to the growing protein chain in the correct order. 5. When the protein chain is complete it folds up to form a unique shape. This unique shape enables the proteins to do their job as enzymes, hormones or forming structures in the body such as collagen. 6. Mutations occur continuously. Most do not alter the protein, or only alter it slightly so that its appearance or function is not changed. A few mutations code for an altered protein with a different shape. An enzyme may no longer fit the substrate binding site or a structural protein may lose its strength. 7. Not all parts of DNA code for proteins. Non-coding parts of DNA can switch genes on and off, so variations in these areas of DNA may affect how genes are expressed. 8. Students should be able to construct a genetic cross by Punnett square diagram and use it to make predictions using the theory of probability. 9. Students should be able to describe the main steps in the process of genetic engineering. 10. In genetic engineering: a. enzymes are used to isolate the required gene; this gene is inserted into a vector, usually a bacterial plasmid or a virus b. the vector is used to insert the gene into the required cells c. genes are transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with desired characteristics. Ecology 1. Students should be able to evaluate the impact of environmental changes on the distribution of species in an ecosystem given appropriate information. 2. Environmental changes affect the distribution of species in an ecosystem. 3. These changes include: temperature, availability of water and composition of atmospheric gases. 4. The changes may be seasonal, geographic or caused by human interaction.		

Vocabulary *for literacy, reading & oracy*	Cell Biology
	• Standard form
	
	Organisation
	• N/A
	
	Infection and Response
	• Monoclonal antibody
	• Hybridoma
	• Lymphocyte
	• Tumour cell
	
	Bioenergetics
	• Inverse square law
	• Glucagon
	• Negative feedback loop
	• Thyroxine
	• ADH
	• Reabsorbed
	• Kidney tubules
	• Permeability
	• Adrenaline
	• Gibberellins
	• Ethene
	
	Inheritance, variation and evolution
	• Protein synthesis
	• Codon
	• Complimentary
	• Genetic engineering
	  ○ Isolation
	  ○ Insertion
	Ecology
	• Seasonal
	• geographical
		• N/A	1. N/A

Sequenced *FROM and TO*	Cell Biology **1.** From: N/A (cross-curricular: Maths), to: N/A Organisation N/A Infection and Response **1.** From: M4 Infection and Response, to: N/A **2.** From: M4 Infection and Response, to: N/A **3.** From: M4 Infection and Response, to: N/A **4.** From: M4 Infection and Response, to: N/A **5.** From: N/A, to: N/A Bioenergetics **1.** From: M4 Bioenergetics, to: N/A **2.** From: M4 Bioenergetics, to: N/A	1.	•

	3. From: N/A (cross-curricular: Maths), to: N/A 4. From: M4 Bioenergetics, to: N/A 5. From: M4 Bioenergetics, to: N/A Homeostasis 1. From: M5 Homeostasis, to: N/A 2. From: M5 Homeostasis, to: N/A 3. From: M5 Homeostasis, to: N/A 4. From: M5 Homeostasis, to: N/A 5. From: M4 Homeostasis, to: N/A 6. From: M4 Homeostasis, to: N/A 7. From: M5 Homeostasis, to: N/A 8. From: M5 Homeostasis, to: N/A 9. From: M5 Homeostasis, to: N/A 10. From: M5 Homeostasis, to: N/A 11. From: M5 and M6 Homeostasis, to: N/A 12. From: M4 Homeostasis, to: N/A 13. From: M4 Homeostasis, to: N/A 14. From: M4 Homeostasis, to: N/A 15. From: M5 Homeostasis, to: N/A 16. From: M5 Homeostasis, to: N/A 17. From: M5 Homeostasis, to: N/A 18. From: M5 Homeostasis, to: N/A Genetics and Evolution (AQA: Inheritance, variation and evolution) 1. From: M4 Genetics and Evolution, to: N/A 2. From: M4 Genetics and Evolution, to: N/A 3. From: M4 Genetics and Evolution, to: N/A 4. From: M4 Genetics and Evolution, to: N/A 5. From: M4 Genetics and Evolution, to: N/A 6. From: M4 Genetics and Evolution, to: N/A 7. From: M4 Genetics and Evolution, to: N/A 8. From: M4 Genetics and Evolution, to: N/A 9. From: M5 Genetics and Evolution, to: N/A 10. From: M5 Genetics and Evolution, to: N/A Ecology 1. From M4: Ecology, to: N/A 2. From M4: Ecology, to: N/A 3. From M4: Ecology, to: N/A 4. From M2: Ecology, to N/A		