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Y5 and 6 children extracting DNA.

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Science – Intent

At Beckstone Primary School, we believe that a high-quality science education provides the foundations for understanding the world through the specific disciplines of Biology, Chemistry and Physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge, vocabulary and concepts, pupils are encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They are encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes. We use **Unity CUSP planning** and resources to build on prior learning and draw upon substantive and disciplinary knowledge to reason and practice applying knowledge.

Aims of the Science Curriculum

The national curriculum for science aims to ensure that all pupils:

- develop scientific knowledge and conceptual through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- Are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Our Science curriculum is knowledge and vocabulary rich, ensuring children gain a deep understanding of fundamental scientific knowledge and concepts as well as embedding key science specific vocabulary and terminology (Tier 3 vocabulary). In addition, children are encouraged to develop their scientific curiosity and understanding by working scientifically.

Working Scientifically Key Stage 1:

- Ask simple questions and recognise that they can be answered in different ways.
- Use simple equipment to observe closely.
- Perform simple tests.
- Identify and classify.
- Use his/her observations and ideas to suggest answers to questions
- Gather and record data to help in answering questions.

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Lower Key Stage 2:

• 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.

Upper Key Stage 2:

• 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

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WHAT PUPILS WILL KNOW

Substantive knowledge - this is the subject knowledge and explicit vocabulary used to learn about the content. Common misconceptions are taught as non-examples and compared with known and accurate content. The children's science knowledge base is constructed so that they can use these foundations and integrate it with what they already know. Misconceptions are challenged carefully and in the context of the substantive and disciplinary knowledge. In CUSP Science, it is recommended that misconceptions are not introduced too early, as pupils need to construct a mental model in which to position that new knowledge.

WHAT PUPILS WILL DO

Disciplinary knowledge – this is knowing how to collect, use, interpret, understand and evaluate the evidence from scientific processes. This is taught. It is not assumed that pupils will acquire these skills by chance. Pupils construct understanding by applying hwta they know (substantive knowledge) to questioning and planning, observing, performing a range of tests, accurately measuring, comparing through identifying and classifying, using observations and gathering data to help answer questions, explaining and reporting, predicting, concluding, improving, and seeking patterns. We call it 'Working Scientifically.' CUSP Science provides Working Scientifically coverage maps to check the balance of provision in KS1, Lower and Upper KS2.

Scientific analysis is developed through 'Thinking Scientifically.'

- identifying and classifying
- pattern seeking
- research
- observing over time
- fair and comparative testing

These will be mapped throughout CUSP Science against each knowledge note.

Substantive concepts include concrete examples, such as 'plant' or more abstract ideas, such as 'biodiversity'. Concepts are taught through explicit vocabulary instruction as well as through the direct content and context of the study.

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Early Years

In Early Years, children are encouraged and guided to use investigation and exploration to develop their understanding of the world. Our curriculum is designed to enable children to make sense of their physical world and their community. Children are encouraged to be scientists, to:

- Show curiosity and interest in the features of objects and living things
- Describe and talk about what they see
- Show curiosity about why things happen and how things work
- Show understanding of cause-effect relations
- Notice and comment on patterns
- Show an awareness of change
- Explain own knowledge and understanding, and ask appropriate questions of others
- Investigate objects and materials by using all of their senses as appropriate
- Find out about, and identify, some features of living things, objects and events they observe
- Look closely at similarities, differences, patterns and change
- Ask questions about why things happen and how things work

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EYFS to Key Stage 1

Specific Area of Learning **Understanding the World**	ELG's	How this is achieved in EYFS	Key Vocabulary to be developed in EYFS		Science KS1	
					Year 1	**Year 2**
	Managing Self • Manage their own basic hygiene and personal needs, including dressing, going to the toilet, and understanding the importance of healthy food choices. ELG 14 The Natural World • Explore the natural world around them, making observations and drawing pictures of animals and plants.	• Discussions at snack time of the importance of healthy food choices. • During lunch time discussions. • Through stories and circle time discussions, e.g. the story – Now wash your hands and Funny bones. • P.E lessons that encourage getting dressed and undressed independently. • Naming body parts through songs – Heads, shoulders, knees, and toes. • RSE link – Correct naming of body parts. • Talking about pets at home. • Exploring minibeasts and recording our observations.	• Exercise • Healthy • Wash • Toothbrush • Tooth / Teeth • Body • Head • Bones • Skeleton • Family	• Animal • Human • Mammal • Bird • Fish • Amphibian • Insect • Lifecycle • Nocturnal	Animals, including humans.	
	ELG 14 The Natural World • Explore the natural world around them, making observations and drawing pictures of animals and plants.	• Going on walks to observe the local environment and to compare and learn about the seasons. • Taking photos to compare seasons and discuss. • Planting seeds and plants. • Looking after the EYFS garden. • Creating bug hotels.	• Lifecycle • Plant • seed • grow • roots • Flower	• Seasons • Autumn • Winter • Spring • Summer • Change • Weather	Plants Seasonal changes	 Living things and their habitats.
	ELG 14 The Natural World • Understanding some important processes and changes in the natural world around them, including seasons and changing states of matter.	• Growing plants from bulbs and seeds. • Making boats to explore best materials. • Water tray activities to explore water, ice, and materials that float and sink. • Testing the best material for a raincoat for Paddington bear.	• Material • Wood • Plastic • Glass • Float	• Sink • Liquid • Solid	Everyday materials	Uses of everyday materials.
Scientific Vocabulary – scientist, sort, observation, identify, compare, group, investigate, test, evaluate						

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Science Provision Y1 - Y6 - Intent

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
KS1 YA	Introduce Everyday Materials	Introduce Uses of everyday Materials	Introduce Animals including humans	Introduce Living things and their habitats	Revisit Living things and their habitats – everyday materials	Revisit Animals including humans
KS1 YB	Introduce Seasonal Changes	Introduce Animals including humans	Introduce Plants including trees	Revisit Plants		Revisit Plants and animals
LKS2 YA	Introduce Forces and Magnets	Introduce Forces and Magnets	Introduce Electricity	Introduce Light	Introduce Animals including humans	Revisit Animals including humans
LKS2 YB	Introduce Sound	Sound	Introduce Rocks	Introduce States of Matter	Introduce Plants	Revisit Rocks
UKS2 YA	Introduce Forces	Introduce Earth and Space	Introduce Changes of materials and their properties	Introduce Electricity	Introduce Light	Introduce Living Things: Classification and Microorganisms
UKS2 YB	Introduce Evolution and Inheritance	Introduce Living Things: Classification and Microorganisms	Introduce Living things and their habitats Development Cycles	Introduce Animals including humans Old Age		Introduce Animals including humans; Diet, drugs and lifestyles. Water Transportation

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Key Stage 1 – Intent

In Key Stage 1 pupils learn about the **Seasons** and develop an early understanding of how **day becomes night**. An understanding of change over time connects to the study of **Plants, including trees**. This focus enables children to associate trees as belonging to the plant kingdom and notice the changes deciduous trees go through connected to the seasons.

Pupils also learn about the animal kingdom, studying **Animals, including humans**. Non-examples of plants are used to contrast the features of an animal.

Pupils are introduced to **identifying and classifying materials**. Scientific terms, such as transparent, translucent and opaque are taught explicitly through vocabulary instruction and pupils make further sense by applying it to what they know and then to working and thinking scientifically tasks.

To deepen their understanding, pupils revisit the study **Animals, including humans** as a retrieval module and deepen their knowledge through revisiting and thinking hard through increasingly challenging tasks.

As pupils progress through KS1, new knowledge is integrated with pre-existing understanding. For example, in Year 2, the study of **Living things and their habitats** and **Uses of everyday materials**, engages pupils to integrate and draw upon their knowledge of **Animals, including humans** as well as **Plants,** and the study of **Materials**.

New substantive knowledge is constructed and made sense of through **Working and Thinking Scientifically** tasks.

Planning is a two year cycle. This means that Y1 and Y2 science objectives are balanced across the two years. Planning and teaching is adapted to support understanding of objectives across Y1 and Y2.

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LOWER KEY STAGE 2 - Intent

The unit on **Rocks** is studied and connected with prior knowledge from 'Everyday materials' in KS1. A study of Animals, including humans is built upon from KS1 and children learn about the skeleton and muscles. Rocks is revisited again to sophisticate and deepen pupils' knowledge, advancing their understanding.

Forces and magnets are introduced and connect with KS1 materials, including twisting, bending and squashing. Contact and non-contact forces are taught and understanding applied through **Working and Thinking Scientifically**. The abstract concept of **Light** is made concrete through knowing about light sources and shadows. **Plants** are studied to develop a more sophisticated understanding of their parts and functions, including pollination.

A study of **Living things and their habitats** teaches children how to classify living things and is directly taught using prior knowledge. Explicit vocabulary instruction supports pupils to deconstruct words for their component meaning, for example invertebrate. **Animals, plants and environments** are connected in this study with a summary focusing on changes in the environment

Electricity is introduced. Substantive knowledge is taught so that pupils acquire understanding about electrical sources, safety and components of a single loop circuit. Practical tasks give pupils the opportunity to think using disciplinary knowledge in the context of variables. Pupils make sense of what they know by testing, proving and disproving hypotheses.

Animals, including humans focuses on the sequence of digestion, from the mouth to excretion. Misconceptions, such as digestion begins in the stomach, are pre-empted, limited and represented as non-examples.

States of matter and **Sound** are taught using knowledge of the particle theory. Acquiring substantive knowledge about 'states' of matter supports pupils to understand how solids, liquids and gases behave. This knowledge is connected further to geographical studies of the **Water cycle** and life processes. Practical scientific tasks and tests help pupils build a coherent understanding of the particle theory by applying what they know through practical enquiry. Misconceptions, such as 'liquid particles are slightly more separated than gas and less compacted than solids' are addressed.

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UPPER KEY STAGE 2 - Intent

In the study of **Properties and changes of materials**, pupils reuse and draw upon their understanding of states of matter. This prior content eases the load on the working memory to process and make sense of new knowledge, including solutions, mixtures, reversible and irreversible changes.

Change is also studied within **Animals, including humans**, focusing on growth and development of humans and animals.

Earth in Space develops the conceptual understanding of our place in the universe. This study unwraps misconceptions, including the Moon changing shape, the Sun moving across the sky and how seasons occur.

A study of **Forces** builds on the substantive knowledge acquired in KS1 and LKS2. New content, including air resistance and water resistance is studied. Force multipliers, such as levers are studied to understand how we can be efficient with effort. For example, a spanner with a long handle multiplies the force and makes it easier to turn a bolt than spanner with a shorter handle. Simple machines, such as pulleys are also studied as force multipliers – they move the load through a greater distance with the same energy being used.

Living things and their habitats focuses on differences in life cycles of living things and how they reproduce.

Light is revisited and taught with advanced substantive knowledge. This is physics study with a focus on the properties of light, not the biology of the eye.

The study of **Animals, including humans** enables pupils to add new knowledge to their understanding of biological systems. They learn that circulation, the components of blood and the mechanism of the heart is connected to healthy living through diet and exercise.

Electricity is enhanced with an advanced study of electrical circuits.. Working and Thinking scientifically tasks help to deepen and make sense of new learning, such as the concept of electricity and the way we explain it using terms such as charge, potential difference and flow.

Evolution and inheritance includes adaption and variation which are taught explicitly through vocabulary and clarity is achieved through worked examples. This study draws on how misconceptions may have been arrived at to explain the past and how theories explain significant change, over time.

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Conceptual Models to Support Deeper Understanding in Science - Intent

A 'science model' is an abstract conceptual idea that is taken to its simplest form. These then become the starting point and the basis of pupil understanding and responses as they study a topic. They should be built upon, Key Stage by Key Stage, to provide an appropriate level of depth for the required expectation.

The use of a science model supports:

- A **simple, clear starting point** for pupil descriptions and explanations. The model should be 'boss' throughout the lesson.
- **Scientific language development** as pupils use 'things' to represent the concept and so can show first, then build key language and structure to their responses as they become more proficient. Show then tell. Develops **'hands-on' learning** and **divergent thinking**.
- **Bridging between topics** as models often thread through the curriculum. **Knowledge 'sticks'** to a concept and so becomes both memorable and forms connections (schemata) that support **depth of understanding**. These connections should bridge topics.
- **Concept recognition** as pupils remember the model from previous topics and so gain immediate familiarity in new topics.

There are four key science models in the primary curriculum. Models used in the teaching of science should reflect a 'good enough model' until raised expectations (Key Stage), new information or cognitive development allows for these to be modified into more complex models.

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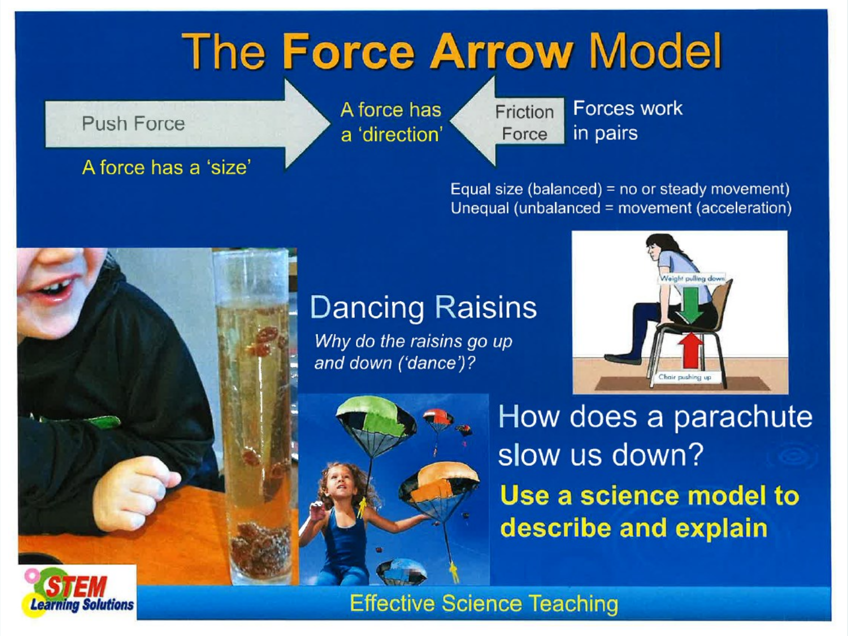
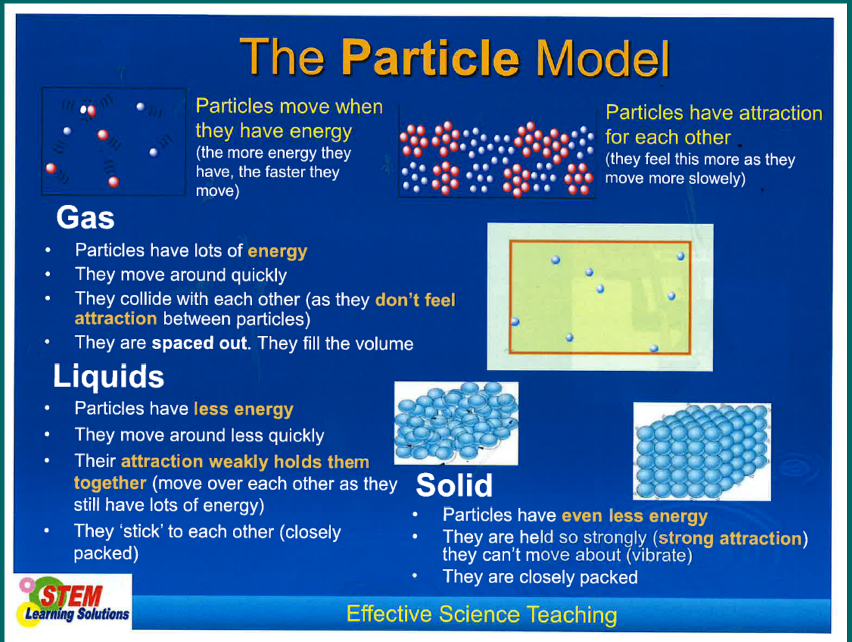
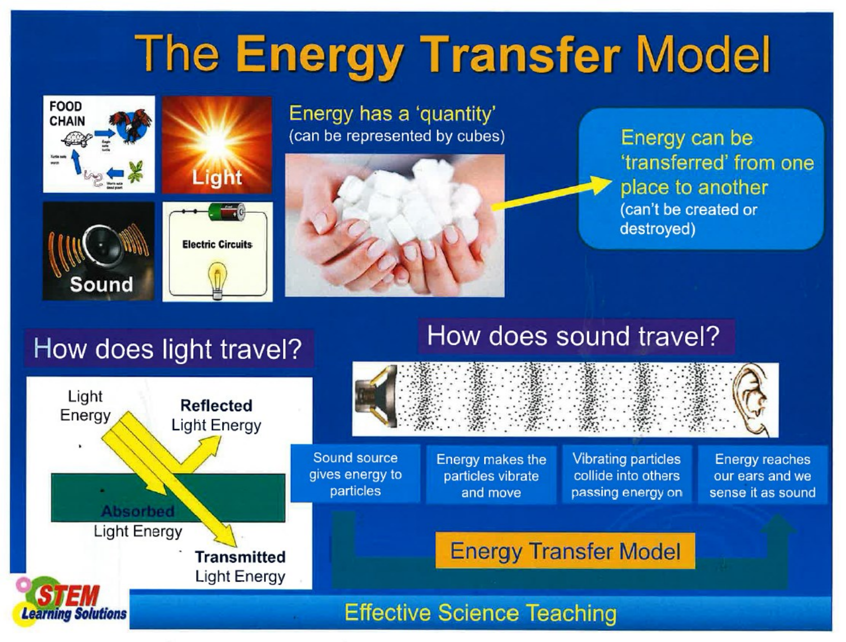
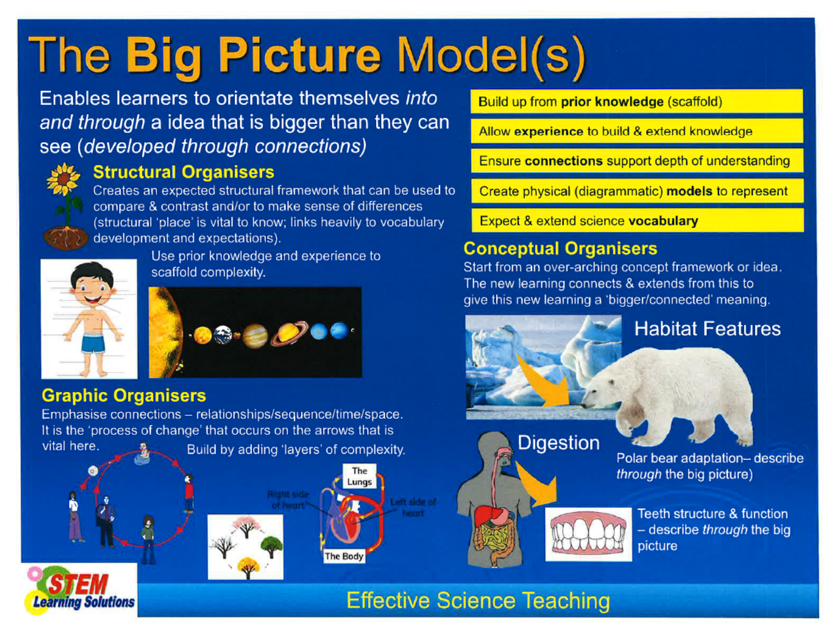

The Force Arrow Model
Push Force
A force has a 'size'
A force has a 'direction'
Friction Force
Forces work in pairs
Equal size (balanced) = no or steady movement)
Unequal (unbalanced = movement (acceleration)
Dancing Raisins
Why do the raisins go up and down ('dance')?
How does a parachute slow us down?
Use a science model to describe and explain
STEM Learning Solutions
Effective Science Teaching


The Particle Model
Particles move when they have energy
(the more energy they have, the faster they move)
Particles have attraction for each other
(they feel this more as they move more slowly)
Gas
Particles have lots of energy
They move around quickly
They collide with each other (as they don't feel attraction between particles)
They are spaced out. They fill the volume
Liquids
Particles have less energy
They move around less quickly
Their attraction weakly holds them together (move over each other as they still have lots of energy)
They 'stick' to each other (closely packed)
Solid
Particles have even less energy
They are held so strongly (strong attraction) they can't move about (vibrate)
They are closely packed
STEM Learning Solutions
Effective Science Teaching


The Energy Transfer Model
FOOD CHAIN
Light
Sound
Electric Circuits
Energy has a 'quantity'
(can be represented by cubes)
Energy can be 'transferred' from one place to another
(can't be created or destroyed)
How does light travel?
Light Energy
Reflected Light Energy
Absorbed Light Energy
Transmitted Light Energy
How does sound travel?
Sound source gives energy to particles
Energy makes the particles vibrate and move
Vibrating particles collide into others passing energy on
Energy reaches our ears and we sense it as sound
Energy Transfer Model
STEM Learning Solutions
Effective Science Teaching


The Big Picture Model(s)
Enables learners to orientate themselves into and through a idea that is bigger than they can see (developed through connections)
Build up from prior knowledge (scaffold)
Allow experience to build & extend knowledge
Ensure connections support depth of understanding
Create physical (diagrammatic) models to represent
Expect & extend science vocabulary
Structural Organisers
Creates an expected structural framework that can be used to compare & contrast and/or to make sense of differences (structural 'place' is vital to know; links heavily to vocabulary development and expectations).
Use prior knowledge and experience to scaffold complexity.
Conceptual Organisers
Start from an over-arching concept framework or idea. The new learning connects & extends from this to give this new learning a 'bigger/connected' meaning.
Habitat Features
Polar bear adaptation– describe through the big picture)
Graphic Organisers
Emphasise connections – relationships/sequence/time/space. It is the 'process of change' that occurs on the arrows that is vital here.
Build by adding 'layers' of complexity.
The Lungs
The Body
Digestion
Teeth structure & function – describe through the big picture
STEM Learning Solutions
Effective Science Teaching