Science

A conversation with Bryony Turford

Bryony Turford has taught primary science for over 20 years, across the entire primary age range, and has led the primary science curriculum in schools. She now works with primary schools supporting their development of the science curriculum in many roles across Yorkshire and the Humber region including: Chartered Science Teacher (CSciTeach); STEM CPD Mark – lead facilitator; PSQM senior regional hub leader in Yorkshire and the Humber; associate consultant for Leeds LA; Red Kite improvement partner; co-author of the *Snap Science* series and co-author of *100 ideas for Primary Teachers: Science*.

If you've taught a rich, challenging, ambitious science curriculum since Early Years, what will your Year 6s know, understand, and be able to do in science before they move on to Year 7?

I hope science is something they enjoy doing, but I think what I want more than anything is for them to be able to work in a scientific manner; that they have a genuine curiosity and interest in the world around them, and have developed skills to explore those things. I want them to have developed skills around observation and measurements, recording data and presenting findings. I want them to be able to decide whether their findings support predictions or ideas before they've carried out those practical investigations. I think that sits alongside a rich body of knowledge about the world around them. They will have explored things around plants and habitats, and humans in the biology curriculum. They'll have explored sound and electricity and forces in the physics curriculum. They'll have a good understanding of states of matter and how they change within the chemistry curriculum. That will have been stitched together cohesively over the time they've been in primary school; they will have been constantly challenged to develop those skills, alongside a rich body of knowledge about the world.

In the national curriculum at primary there's no expectation on the pupils to write up full scientific methods with a prediction, hypothesis, etc., but what is an expectation is they've got the skills to do that, so when that's instigated in secondary that's not an unfamiliar skill set. They might not know how to write it in that order, but that should be a natural jump. Children leaving primary can already write, they can already read, so actually putting it into that context shouldn't be a massive jump.

Over the course of a year in Year 6, we would look at writing questions and considering, 'What's a scientific question?' We'd look at making predictions. We'd look at considering what equipment we might require. We'd look at controlling variables depending on what type of scientific inquiry we're carrying out. We'd look at equipment. We'd look at what type of recording was required. We'd look at interpreting graphs and tables and charts that we've created, or that someone else has created for us. We'd look at evaluating the outcomes of what we'd done compared to what we thought might happen. We would rarely do all of those in a lesson. We would do all of those over time, so the children had experienced all of those, but this current curriculum has taken away that demand to write up an experiment.

What we tend to do at primary is have two objectives in a lesson. You'd have one that's about working scientifically, which might be around observing, and then you would have one around your knowledge and content. Here's an example from forces and magnets in Year 3. The children are learning about everyday materials and how they are attracted to a magnet, and the properties of materials that might be attracted to a magnet. That will be the knowledge they're learning, but I want them to do work on comparing and grouping; so, the recording would focus on their comparisons in grouping in a two-column table that they've constructed. That's the 'working scientifically' aspect that would go alongside the knowledge that I'm teaching them about magnetic materials. The children are constantly doing science while learning science.

How do you build up the science curriculum from EYFS all the way through to Year 6?

Any good Early Years science teaching always begins with the child and what they know, what they want to do, what they're interested in, what's around them, what they find, and any good Early Years practitioner will tell you how long they can spend talking about a ladybird, and how long they can spend exploring the chopped-in-half worm the child has found at lunchtime. It's such a rich place to be because science is everywhere, all the time, because it's about materials, because it's about living things, because it's about physical processes. In the current English science curriculum there isn't any physics in the primary curriculum until Year 3, so there are no forces or electricity formally until lower KS2. It doesn't mean you can't do stuff earlier, however; try stopping a four-year-old rolling cars down a ramp, or opening and shutting a door repeatedly! They are constantly exploring the world around them, and what a good Early Years practitioner would do is enrich that environment, and be capturing those things. We'd talk about those things with the children, perhaps a magnet discovery area where there are opportunities to try different magnets and do different things that might have been led by some adult-initiated play. And sitting over the top of all that activity there is working scientifically. It's not called that in the Early Years' curriculum, but children are doing the stuff as well as learning the stuff, and I think that's a massively important journey.

Let's say you've got an Early Years group. Tell us what a piece of learning might look like when you've got your ladybird, or you've got your car falling down the ramp. What happens?

We might have a ladybird or an earthworm, and a child comes along and says, 'Oh, I found this.' 'Well, where did it come from?' the adult might say. 'Well, it came from the ground.' 'Well, how did it get in the ground?' There is a lot of opportunity for the adult to support with questions.

Then some other children are likely to join your conversation about that because someone has got a wiggly worm, and the teacher is having a conversation about it, and the conversations grow. Then, before you know it, we are all worm charming and we are all jumping up and down on the grass to find more worms. And then we start to talk about what other types of wriggly things we know… 'Where else could you find wriggly things? Do they all live in the ground like earthworms? Do they all come to the ground if you stomp?' Then somebody else might have discussed a ladybird, and that's got wings. 'Why hasn't a worm got wings?' All the time we're building up this narrative about the stuff, and that relies on incredibly talented practitioners being able to turn on a hair's breadth to be able to change the conversation, or quickly having to go and find out some stuff. Then, the following day, we can provide some additional resources. We will have put the worms in a pot. We might look at them under a digital microscope, start to talk about segments, different types of worms, 'Where do they come from? What are they for?' Then we might make a wormery and we'll put some layers in the wormery, and if it's great we'll have one of those clear-sided, thin plastic containers with layers of sand and we'll put our earthworms in and we'll watch them over time. The children will come at all times of the day and observe: 'It's moved… I can see the colour changing.' Then we might end up looking at stories around earthworms, or some factual books around earthworms, and talking about them. Darwin commented that 'before the plough, the earthworm was the earth's best tiller.' The observation skills are there, perhaps this leads to an observation over time in terms of creating a wormery, but it's alongside facts and knowledge about the everyday object.

When they go into Year 1 and Year 2 then, what are the building blocks? What's the first thing you'd want them to learn in Year 1, and then in Year 2?

In lots of ways that's predetermined by the fact that we need to assess against a framework by the end of Year 6. They need to learn about materials. They need to learn about their senses. They need to learn about changes and lifecycles, and plants and how they grow. Let's take plants as a thread. In Year 1, we would start by asking, 'What is a plant? What makes a plant a plant? Are all plants green? Do all plants have flowers? Do they all have leaves? Do they all have trunks? Is a tree a plant? What if they don't lose their leaves, does that mean it's not a plant?' All of those sorts of things, and we would want to name different plants and identify different parts of plants. That requires a lot of looking at plants, and a lot of being outside and a lot of exploring, and a lot of touching and a lot of microscopes and looking at root systems under a microscope. 'Let's look at a carrot versus a dandelion and get the roots out and explore them. Why has a carrot got that type of root system, and why has a dandelion got that type of root system?' 'I don't know, why has it?' 'We could find out.' It's not about necessarily having all those answers, but exploring a wide variety can't be done on a PowerPoint, or on a worksheet, it's got to be done with children holding plants.

Going outside and noticing plants, combined with an expectation that they will look at seasonal change in Year 1, means you can go outside and look over and over again at the same tree in your school field, or in the park around the corner – even something growing in the quad, or in the corner of the classroom. The opportunity for children to leave Year 1 knowing the main parts of a plant or flower is sufficient: trunk, leaf, stem, root, that's what I want them to know, and I want them to know what grows around them. I want them to know that that's an oak tree in the school field. I want them to know that that's called a dandelion and that's a daffodil, and that's a snowdrop. There is no list of exactly what plants you need to learn because it should be based on where you live. If you're teaching in Scarborough, that's going to be different to the plants you're going to see in inner-city Leeds.

They take that knowledge about what a plant is with them into Year 2, and they start to look at different types of plant. They look at how seeds grow versus how bulbs grow. Bulbs have a period of dormancy, 'Oh, that's a bit weird, it's gone to sleep. It's sleeping for a very long time. What else sleeps for a long time? Is it really sleeping? Is it the same as a hedgehog hibernating?' There are all those opportunities. Then, as they move into Year 3, they start to think about flowering plants and pollination, and how that starts to build. You can see how that's built on a solid foundation of what makes a plant a plant. Then how do different plants grow? Then how important is pollination? That plant strand, if you like, moves more into living things, their habitats or classification as you move through school.

If you're looking at classification of plants, I would always talk about using classification keys. There are great field study guides out there teachers can download for free; places like the Woodland Trust offer amazing ID cards as well as classification keys. By Year 6, I want the children to make the classification keys that the younger children use because then they're about the plants in the school grounds that they learned about in Year 1 and Year 2 and Year 3. They have taken the plant strand all the way through. Now, not all strands are as beautifully coherent as that. The plant strand has so many curriculum connections but others are less connected. Some appear less frequently, such as sound, because it only appears in Year 4. With sound the connections can be made around senses in Year 1; we can talk about how we hear things. We can talk about our bodies in Year 2, naming the parts of our bodies, like the ear, and their functions. We can talk about digestive systems and teeth and eating in Year 3, and somehow sound can be mentioned again, particularly if you're aware that it's only coming as a topic in Year 4. Teachers have to know that Year 4 is their one and only time to get the sound stuff right. Space only occurs once, but you can talk about space in the context of seasonal change. Evolution in Year 6 only happens once, but there are connections to fossil formation in Year 3.

As a science subject leader, it's important to ensure that your colleagues understand the importance and relevance of what they're teaching, and when they're teaching it. Science is one of the few subjects within the primary national curriculum currently that has effective progression built into it; I would credit the authors for that, who know their stuff about primary science. That's because it comes from good research. The *Principles and Big Ideas of Science Education* by Wynne Harlen is the foundation of the science national curriculum, along with deep-rooted connections with those learned societies like the Royal Society of Chemistry, Royal Society of Biology, Institute of Physics, which all had a say in what should be taught at primary. The Institute of Physics were quite clear about there not being any physics in KS1 because they found there's a lot of unteaching required later on. Although you're not going to stop younger children running things down ramps and opening and closing drawers, and playing with magnets, when we come to teach the knowledge and skills of physics, they need to have some maturity. I like to think about this in terms of concrete and abstract; concrete things like plants are well suited to young children who need concrete things to help them learn. But space is really abstract. You can't touch it. You can't see it. You can't feel it. It's weird. We need to have a certain element of maturity to be ready for that stuff.

I think it's about deciding what needs to be taught when. It's about pupil readiness, and if the children are finding the thing that you're teaching them too challenging, there are a couple of things you can do: firstly, park it and come back to it later in the year when they're a bit older, or, secondly, try to make it more concrete. It could be that you're being too abstract, you're using too many video clips, or you're using too many paper-based resources. You need to do something more concrete and tangible to help the children understand the scientific knowledge and understanding better. There is not actually very much in the space curriculum, but as primary teachers we tend to make it fill the half-term. We could probably get the *stuff* taught much quicker if we just focused on the *stuff*, but, as we all know, the curriculum is the minimum entitlement, not the whole curriculum. Consider approximately spherical shapes. We don't need to spend a long time talking about whether the planets are approximately spherical, we can do that pretty quickly, but if we're talking about orbital paths and relations to the moon and the sun, we probably need to feel that, whether that be through a model or children wearing things and turning round and torches, and all that sort of messy practical stuff. Take another example – the circulatory system in Year 6. That's an easy topic to find yourself teaching KS3 content if you're not careful. All it says is that we need to understand that we have a circulatory system, and it's the thing that transports important stuff, nutrients, blood, etc., around our bodies. We don't need to talk about oxygenated and deoxygenated blood. That doesn't mean we can't. It just means we don't have to. For children to understand that there is stuff going around their body is a bit weird! You can only look at videos or animations made to show those sorts of things; but, if we turn it into a story, the blood travelling around our body and we make some big chalk things on the playground and people are wearing different coloured tabards to represent different substances in the blood, they can start to feel what it's like to be a blood cell. We can make bags of blood soup where the children have done some research looking at the different bits of blood, different parts of blood, so red blood cells, white blood cells, platelets, etc., but they're not just making blood soup for that being a bit of fun, they're doing it because it helps them understand why we need white blood cells. What do they do? What percentage do they make up of the blood? Now, that stuff isn't necessarily in the curriculum, but it's the enrichment that gives breadth to the bare minimum, if that makes sense, so it goes beyond that and it's in a concrete way: 'I'm not just going to talk about blood, but when I'm a bit older and I'm 13 I can cope with you talking about it in an abstract way because I'm older and I get it a bit more, but when I'm nine or 10, it's not always that straightforward.'

Take the digestive system in Year 3. Now, what often happens there is teachers think, 'We must do the poo lesson,' because all the children love the poo lesson – the stuff in the tights and the orange juice. I see that as a hook, as an exciting way of bringing this topic to life. The thing is, the children run out of school to their parents and shout, 'We did the poo lesson today. It was amazing!', but all they remember is the poo lesson. If you want to teach the poo lesson, do it right at the end of the unit, after learning about the digestive system and what it is, and what different parts play. You will have explored mechanical and chemical digestion by letting the whole class put a water cracker in their mouths and letting the chemicals in their saliva break it down by doing nothing. Then you give them another bit of cracker and let them exercise mechanical digestion by chomping their teeth and feeling the differences. That makes the learning really concrete. Then we've learned about the different parts of the body. We might have found out about it by using some secondary sources. We've looked at some books. We've drawn some diagrams, and we've talked about what happens at each stage. We've looked at what the oesophagus does, and the oesophagus plays a role in mechanical digestion, and then some enzymes start to appear at different stages, and we've started to just think about it. Then, if we want to do the poo lesson, we do the poo much later, when the children understand what it's about. I have been in plenty of lessons where the poo lesson comes near the beginning of the unit on the digestive system and the children don't understand why they're doing it. It sounds like a great lesson, but they have no context. They don't know what the orange juice is for. They don't know it's there as a model to represent acid because it's too much. It's not appropriate. What they need to know about digestion is that it's a process, it's a body system. In primary we learn about the muscular system, the skeletal system, the digestive system and the circulatory system, and then they add to that with the respiratory system etc., when they go into KS3. If you end up leaving primary knowing all about poo, that's not good. What you need to know is your digestive system is the process by which our body takes what it needs and expels what it doesn't. That's ultimately what I want them to know. It's like having a science unit called 'Formula One', and what the children tell their parents about when they get home is the video of Lewis Hamilton, not the fact that acceleration is metres per second per second.

It's hard because we're expecting a lot from primary teachers, many of whom don't have a science degree, yet we're expected to make those lessons exciting and engaging. So we read something on Twitter or we see a link to something on Facebook, and we say, 'Oh, that's great.' I see people doing things like evolution with Mr Men… 'That's a great, exciting activity to look at Little Miss so-and-so, and Mr so-and-so, and what might their offspring be!' But does that actually help children understand inheritance? Inheritance is an incredibly complicated set of facts and information; it's not necessarily something we need to go into in masses of detail, nor is it as simple as, 'Mr so-and-so and Little Miss so-and-so make Little Mini so-and-so'.

Do we do practical work at primary?

We absolutely do, but it's got a really different meaning at primary. It's one of those phrases that, whenever I'm working with secondary colleagues, we always have to establish at secondary schools we do a practical in science, in primary school we do practical science. A practical is a particular set of things that have to happen, that children have to learn and do as part of their GCSE, but practical science is how we do science at primary school. It's all of the examples I've been giving, and so it happens all the time in every lesson. It's not a prescriptive set of instructions that they follow. You wouldn't do a practical, but you would probably call it an inquiry. Normally, in a standard primary science lesson, we would have a question that the children would be trying to answer through their two separate objectives.

Can you give me any examples?

Yes, so if we think about it, the question I often find comes last, because if we're going to carefully construct a learning experience I need to think about the objectives first, not the question, because if we start with the question we can end up on a tangent and having a fun lesson, not that I'm adverse to fun. For example, here is a Year 1 materials example; we want the children to explore and describe simple physical properties of a variety of everyday materials. That's the stuff they need to know. Then, working scientifically, I would pair that with observing closely using simple equipment. You've got the stuff, the scientific content, and the scientific method, observing closely. That might even involve a digital microscope. Then I'm going to layer in a type of inquiry, and in this case I'm going to connect it in with observing over time. There are five types of scientific inquiry recognised in primary science. We've got observing over time, comparative of fair testing, identifying and classifying grouping, research using secondary sources, and pattern seeking, so I'm just picking 'observing over time' for this example. Then my question in this case is, 'How long do the different alien pants take to dry?' That's my question I want you to answer.

In my lesson I've made a lot of pants, just carboard cut-outs – not cardboard obviously – but I've made them out of lots of different materials. We've got some paper ones. We've got some foil ones. We've got some clingfilm ones. We've got some wallpaper ones. We've got some stretchy fabric ones. We've got some high-vis ones. We've got all sorts of different pants because we're reading *Aliens Love Underpants*. We're going to wash all our pants, and we're going to hang them on the line and we're going to time how long it takes them to dry, and then we might organise them by the ones that dried the fastest at this end of the line, the ones that are still wet three days later at this end of the line. So, we've done all that, that's great, let's go back to what our intentions were: 'Describing the simple physical properties of a variety of everyday materials.' 'So tell me about these ones. They dried quickly. What have these got in common?' 'They're shiny, or they're slippy or they don't let water go through them' and we could start to talk to them about, perhaps, permeability. Then we might talk about the soggy ones three days later, but we've been observing closely, so we might have looked with our eyes, we might have used a magnifier, we might have felt things. We've been observing over time because we've been looking at how long things take to happen. When I'm working with science leaders and their colleagues within school, that's how I suggest people plan their lessons; think about these four elements. Don't start with your questions, finish with your question:

1. What do I want them to learn? The substantive knowledge.
2. How do I want them to learn it? The disciplinary knowledge.
3. What inquiry type? (If appropriate, because it's not always appropriate to have a type of inquiry.)
4. Then your question, or if you've got your question first, can you match it to the other three? Otherwise, it's perhaps not the most appropriate question.

What do you do with microscopes in a primary school?

What *don't* you do with microscopes? My favourite ones are the little plug-in USB ones, because most teachers have their laptop plugged into a screen in the primary classroom at all times, and I always have a microscope plugged in as well. I've got these lovely little egg ones that are just plug and play, but they are suitable for tiny hands as you can twist the top to focus the lens. Once you've introduced the children to a microscope, particularly a digital one that they can have on the big screen, there's very little they won't look at under it, and that includes the materials task I mentioned earlier. One of the things I would do with that example I just gave you about the alien's underpants, would be to look at the structure of the fabric under the microscope, because that will give the children a good understanding of each material's structure. You can look more closely, observing closely using simple equipment. Plants are great fun to look at. I like root systems. I don't use slides in the way we would at secondary. At primary we are looking at an object and focusing on its structure, perhaps, particularly comparing rather than looking at cell structure, etc. Different types of leaves work well – the waxy leaf compared to a non-waxy leaf – because they look so wonderfully different under a microscope.

Biology, chemistry, physics or just 'science' at primary?

I generally do refer to them as biology, chemistry, physics with adults, absolutely in primary, and that's something we didn't used to do, and I am increasingly finding people who are doing that with children as well. I think the barrier in primary is getting children, particularly younger ones, to know that they're doing science because so much of our carefully crafted, exciting curriculum in primary is taught under the umbrella of a 'topic', that children don't always know that they're doing science. They think they're doing poo! They think they're doing whatever creative, exciting topic title the teachers come up with. In terms of communicating with children, getting them to know they're doing science is really important, they're being scientists, they're working scientifically. I think there's a great connection perhaps with careers as opposed to the three disciplines of biology and chemistry and physics, so we might talk about, 'Today we're being a marine biologist,' when we're looking at animals that live under the sea. We might make more of a connection with careers in science as opposed to labelling them particularly with children.

Science: background

Biology was identified as a distinct field of inquiry in the 19th century, but it has its origins in early medicine and natural history from the ayurvedic and ancient Egyptian medicine, through the insights of Aristotle and Galen. The field was extended by the work of Muslim scholars, including Avicenna and later by Vesalius, Harvey, Linnaeus, and Buffon.

Aristotle, working in Greece in the 4th century BCE, is considered by many to be the first scientist in the west. He developed the principles of logic, observation, inquiry and demonstration, which shaped Western philosophical and scientific culture. After the fall of the Roman Empire, much scientific knowledge was lost before being recovered during the Islamic Golden Age.

Physics developed as a discipline from astronomy, optics, mechanics and geometry. These disciplines began with the Babylonians and with Greek writers such as Archimedes and Ptolemy.

It is worth quoting the purpose of science from the national curriculum programme of study:

> '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 and concepts, pupils should be encouraged to recognise the power of

> rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.
>
> 'The national curriculum for science aims to ensure that all pupils: develop scientific knowledge and conceptual understanding 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.'[1]

Once the importance statements have been revisited, it is helpful for subject leaders and co-ordinators to discuss and agree with colleagues the reason why their subject, in this case science, is important for the pupils in their school. One way of doing this, is to draw on a quote, in this case from Elon Musk: 'It is important to view knowledge as sort of a semantic tree – make sure you understand the fundamental principles, i.e., the trunk and big branches, before you get into the leaves/details or there is nothing for them to hang on to.' This kind of prompt allows us to formulate our way of stating the importance of the subject. We might agree or disagree with such a statement and in doing so come to a form of words which expresses our view of the importance of this subject, in this school. This moves us away from the territory of 'we teach this subject because of the SATs or GCSEs'. While the external tests and exams are important, they are not the totality of the subject.

Professional communities

Subject associations are important because at the heart of their work is curriculum thinking, development and resources. The subject association

1 Department for Education. (2015) *National curriculum in England: science programmes of study*. Available at: https://bit.ly/364IFS7 (Accessed: 9 March 2022).

for science is the Association for Science Education and it should be the case that any member of staff with responsibility for a subject should be a member of the relevant subject association, and this should be paid for by the school.

Twitter subject communities are important for the development of subject knowledge because it is here that there are lively debates about what to teach, how to teach and the kinds of resources that are helpful. For science, it is worth following ASE on Twitter and the hashtags #ASEchat #scichat #stem #primaryscience #physicschat #biochat #physchat.

Other Twitter accounts worth following: @CogSciSci @ChatPhysics @ ChatBiology @ChatChemistry

Links

CogSciSci – https://cogscisci.wordpress.com
The Wellcome Trust – https://wellcome.org/what-we-do/our-work/transforming-primary-science
Explorify – https://explorify.uk/our-story
STEM resources – https://bit.ly/3sUIDFD
The Association for Science in Education – https://www.ase.org.uk/home/
Primary Science Quality Mark – http://www.psqm.org.uk/psqm
BBC Terrific Scientific – https://www.bbc.co.uk/teach/terrific-scientific
NASA – https://go.nasa.gov/34qdBfd
Core Knowledge – http://www.coreknowledge.org.uk/science.php

An addendum to the science chapter: Christopher Such's primary science curriculum

Christopher Such is one of the most generous-spirited educators you could ever wish to meet. To supplement this chapter, we wanted to direct you to his website where he gives away for free a primary science curriculum, which is structured around 'The Big Ideas' in science.

He delineates the science content and the 'working scientifically' strands in the same way as Bryony. The fundamentals of his curriculum structure are laid out below.

Whole-school definition of science: Science is a way to understand our world by carefully thinking about it and testing our guesses with observations and experiments.

'The Big Ideas of science' are recurring themes that appear throughout the curriculum in all series. Each learning point that is taught will link to a 'Big Idea'. The 'Big Ideas' focus on the four main components of scientific knowledge: physics, chemistry, biology and earth science.

The Big Ideas of biology:

- B1: Living things are special collections of matter that make copies of themselves, use energy and grow.
- B2: Living things on Earth come in a huge variety of different forms that are *all related* because they all came from the same starting point 4.5 billion years ago.
- B3: The different kinds of life, animals, plants and microorganisms, have evolved over millions of generations into different forms in order to survive in the environments in which they live.

The Big Ideas of chemistry:

- C1: All matter (stuff) in the universe is made up of tiny building blocks.
- C2: The arrangement, movement and type of the building blocks of matter and the forces that hold them together or push them apart explain all the properties of matter (e.g. hot/cold, soft/hard, light/heavy, etc.).
- C3: Matter can change if the arrangement of these building blocks changes.

The Big Ideas of earth science:

- E1: The Earth is one of eight planets that orbit the sun.
- E2: The Earth is tilted and spins on its axis leading to day and night, the seasons and the climate.
- E3: The Earth is made up of several layers, including a relatively thin, rocky surface, which is divided into tectonic plates, and the movement of these plates leads to many geologic events (such as earthquakes and volcanoes) and geographical features (such as mountains).

The Big Ideas of physics:

- P1: The universe follows unbreakable rules that are all about forces, matter and energy.
- P2: Forces are different kinds of pushes and pulls that act on all the matter that is in the universe. Matter is all the stuff, or mass, in the universe.
- P3: Energy, which cannot be created or destroyed, comes in many different forms and tends to move away from objects that have lots of it.

The whole of Chris' primary science curriculum materials can be found here: https://primarycolour.home.blog/2021/04/07/curriculum-giveaway-2-0-science/