Medium Term Plan - The Sky Above Us - Bath Astronomers

All of our lessons tie in with our incredible free loan boxes - contact us to arrange a loan in Bath and surrounding areas. Can’t get our loan box? Don’t worry! Our lesson packs explain what resources you will need to substitute instead, with minimal adaptation. Don’t forget that many local astronomy groups will happily visit schools or even loan equipment that can be used with these lessons.

These lessons were created by Bath Astronomers, a group of amateur astronomers sharing a passion for observing the sky. Please continue to support our free space education for all by giving credit where work is shared, visiting our social media sites, or even becoming a member of our group.

This medium term plan is designed to help teachers plan efficiently - feel free to copy and paste! A detailed short term plan for each lesson can be found at the end of this document, and at the end of each lesson’s presentation. Each lesson includes differentiation, to both support less able pupils and challenge more able pupils.

If you see any errors - do get in touch! We are keen to do our best for space education. <https://bathastronomers.org.uk/contact/>

| **Lesson Description** | **UK National Curriculum (2014)  Key Stages and Objectives** | **Resources required** |
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| 1. **Navigating the Night Sky**[Online presentation](https://docs.google.com/presentation/d/e/2PACX-1vSa2VzSistuMfrnbkTTltJv2w0V4dtZUlCAvcsYqBQ-P48x0LU5gqwhCHxn4GMNBd_uM_-s9f0soXyM/pub?start=false&loop=false&delayms=3000)[PowerPoint presentation to download](https://stem.bathastronomers.org.uk/lessons/navigating-the-night-sky/)Work out where popular constellations and planets might be found tonight and on your birthday by making your own planisphere and learning how to use it.*This lesson is targeted at the Northern Hemisphere, you can get a custom planisphere for your location easily here:* [*https://in-the-sky.org/planisphere/*](https://in-the-sky.org/planisphere/) | **KS4****Space physics**The main features of the solar system**KS3** **Magnetism**Earth’s magnetism, compass and navigation**KS2****Earth and Space**Use the idea of the Earth’s rotation to explain day and night and the apparent movement of the sun across the sky***Extension;***Describe the movement of the Earth and other planets relative to the sun in the solar systemDescribe the movement of the moon relative to the EarthDescribe the sun, Earth and moon as approximately spherical bodies | Our free loan box, which includes pre-printed planisphere sheets! You will still need; scissors, glue, and sellotape, and access to view the horizon and sky.OrOur free downloadable planisphere printable, thin card to print it on, scissors, glue, and sellotape, access to view the horizon and sky. A compass is handy, but optional.For locations beyond the south of the UK: <https://in-the-sky.org/planisphere/>  |
| 2. **Using Binoculars**[Online presentation](https://docs.google.com/presentation/d/e/2PACX-1vSTXJ_oji2NRKrRMZ3P86zOL4ujbM0vqziNMTTZ4A8xyqR0LdDfYCvUTakpnsguytIIiXus_EJprpms/pub?start=false&loop=false&delayms=3000)[PowerPoint presentation to download](https://stem.bathastronomers.org.uk/lessons/using-binoculars/)Put your night sky navigation skills to the test and seek out some targets best suited to binoculars! | **EYFS** - Understanding the world; Know some similarities and differences between the natural world around them and contrasting environments**KS1 Year 2 Science**Observe and describe weather associated with the seasons and how day length varies**KS2 Year 5 Science**, Earth and Space; describe the movement of the Earth and other planets relative to the sun in the solar system, describe the movement of the moon relative to the Earth**KS3 Space physics;** our Sun as a star, other stars in our galaxy, other galaxies | Our free loan box, which includes a collection of binoculars!Access to view the horizon and night sky.OrAccess to a collection of binoculars for your pupils to try. Contact local astronomy groups who may be able to help.Access to view the horizon and night sky. |
| 3. **Gravity Well**[Online presentation](https://docs.google.com/presentation/d/e/2PACX-1vSFgfvAEKqfMSWTvFHQ1mlRWCOLziGR-ih8kFIO8m4_J-uFZEiODcoRrNNmKXcQfFp1eN486bTkvmlT/pub?start=false&loop=false&delayms=3000)[PowerPoint presentation to download](https://stem.bathastronomers.org.uk/lessons/gravity-well/)Why do our solar system’s planets all travel in the same direction around the sun? Why do comets curve into our solar system? How did Apollo 13 slingshot around the moon? Explore the answers to these questions in a hands-on exploration of gravity and mass with the gravity well. | **KS4 Science Forces**- forces and fields: electrostatic, magnetic, gravity - Acceleration caused by Forces, Newton’s First Law**KS3 Science Space** Physics - gravity force, gravity forces between Earth and moon, and between Earth and Sun**KS2 Science** - describe the movement of Earth and other planets relative to the sun | Our free loan box, which includes a gravity well, marbles and heavy mass weights.OrCraft your own gravity well from stretchy fabric clipped to the back of a circle of school chairs. Add a few marbles and a weight from your maths department, and you’re set! |
| 4. **Tellurium**[Online presentation](https://docs.google.com/presentation/d/e/2PACX-1vSHQ18Y6Yzq6wXV2oxakIZSPt57XMyLWJV4QK5BJ6hDUWht5aAnNYKd_UV2u8Y23OHRuxfWtSbp8EEH/pub?start=false&loop=false&delayms=3000)[PowerPoint presentation to download](https://stem.bathastronomers.org.uk/lessons/tellurium/)Pupils use a tellurium (or similar resources) to explore the movement of the Sun, moon and Earth. A tellurium is an orrery, modelling the movements of the sun, moon and Earth.Learn all about the seasons and phases of the moon. | EYFS - Understand important processes and changes in the natural world around them, including the seasons.KS1 - Observe the changes across the 4 seasonsKS2 (Y5/6) Earth and Space (all)KS3 Space physics - The seasons and the Earth’s tilt, day lengths at different times of year, in different hemispheres | Our free loan box, which includes a Tellurium!The means to make your teaching space dark, to view light and shadow.OrAccess to an orrery, or use a torch and different sized balls to recreate this lesson’s demonstrations. |
| 5. **Spectroscopy**[Online presentation](https://docs.google.com/presentation/d/e/2PACX-1vSFW-uedYuQ-Bw0N6uV_dm3hHlZekLPpej_CNMw-I6r_fhxL1g0t75QERLVXf1zgHISic23_61kxcJb/pub?start=false&loop=false&delayms=3000)[PowerPoint presentation to download](https://stem.bathastronomers.org.uk/lessons/spectroscopy/) How do we know the atmospheres and chemical makeup of distant stars and planets? Create your own spectroscope to find out! | **KS3 Science****Light Waves**light waves travelling through a vacuum; speed of light  the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface  colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection. | Our free loan box, which includes pre-printed spectroscope box sheets, and a collection of old CD discs.You will still need; Glue, sellotape, and scissors, access to sunlight, an incandescent bulb, or even neon lights.OrOur free PDF printable of the spectroscopy box, thin card to print it from, and a collection of old CDs. Glue, sellotape, and scissors. Access to sunlight, an incandescent bulb, or even neon lights. |

Detailed lesson plans, as found at the end of each presentation:

| 1. **Navigating the Night Sky**
 | **LO: To be able to navigate the night sky, using key features to orient themselves.** |
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| **NC objectives** | **Introduction** | **Differentiation - support** | **Main Activities** | **Differentiation - extension** | **Plenary** |
| **KS4****Space physics**The main features of the solar system**KS3** **Magnetism**Earth’s magnetism, compass and navigation**KS2****Earth and Space**Use the idea of the Earth’s rotation to explain day and night and the apparent movement of the sun across the sky***Extension;***Describe the movement of the Earth and other planets relative to the sun in the solar systemDescribe the movement of the moon relative to the EarthDescribe the sun, Earth and moon as approximately spherical bodies | Enable pupils to deduce where north, south, east and west are at their current location and at their homes, by considering where the sun rises and sets. Confirm by use of google maps, or a traditional compass | Get pupils to physically move to observe where the sun rises and sets, where the horizon and zenith are and how to use ‘the dipper’ to find Polaris. Relate NSEW to local knowledge (for example, the park is to the south of our town) Key objective; Know NSEW, where the sun rises, and sets, and how to find Polaris using ‘the dipper’. | Pupils makes a planisphere and take the time to look at where Polaris, or a recognised constellation, will be tonight and on their birthday, at their ‘bedtime’. Pupils learn how to adjust their view to the angle of elevation a viewing target (constellation, or a planet) will be at. Test the pupils’ descriptive answers by using Stellarium, set it to the desired date and time. Stellarium will also show the planets - when will we next see Jupiter or Venus? What will their elevation be? Show me where you will look.Key objective: As ‘support’, and can name constellations of interest and say/show/point where they will appear tonight and on their birthday  | Show pupils a monthly sky map, have them explore the list of recommended viewing targets by date and difficulty, particularly by contrasting Jupiter and Andromeda.Consider ‘magnitude’ and what this might mean, when reading a sky map. Consider how light pollution, or the moon’s phase, might affect efforts to see faint objects in the night sky.Key objective; As previous, and can verbally explain why some objects are easier to see than others, using the term ‘magnitude’  | Take the time to find out where the ISS may next appear, and point in the sky where to look for it, using our knowledge of horizon, zenith, and angle of elevation.Find out who your local astronomy group are and share their details with the class, or contact them to arrange an evening’s observation.Further points you could explore; How a compass works with the Earth’s magnetosphere, how a planet’s magnetosphere is linked to aurora across the solar system. |

| 1. **Using binoculars**
 | **LO: To try using binoculars to good affect, to observe something better by using binoculars** |
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| **NC objectives** | **Introduction** | **Differentiation - support** | **Main Activities** | **Differentiation - extend** | **Plenary** |
| **EYFS** - Understanding the world; Know some similarities and differences between the natural world around them and contrasting environments**KS1 Year 2 Science**Observe and describe weather associated with the seasons and how day length varies**KS2 Year 5 Science**, Earth and Space; describe the movement of the Earth and other planets relative to the sun in the solar system, describe the movement of the moon relative to the Earth**KS3 Space physics;** our Sun as a star, other stars in our galaxy, other galaxies | Use the quick quiz to discuss what binoculars are, what they are similar to and how they are different to items such as telescopes or microscopes. *Extend this by discussing binocular vision and depth perception with older pupils.*Look at the binoculars available and approach viewing through them, adjusting to face and target by moving the binoculars and the focus wheel. Pupils may expect the ‘circles’ in their view to perfectly overlap or remain separate - the image will almost seem like a venn diagram. Aim to focus for the center of it. | The moon is a great beginner’s target for younger pupils.Observe it when it is waxing and waning to see the shadows cast by rugged mountains and craters, avoid observing it near the full moon as it is so bright as to appear quite ‘plain’. | Make a planPupils should plan out an observation event, taking the date, time and weather into account.Use the previous lesson ‘2. Navigating the night sky’ to better plan observations in detail, as appropriate.Use the top targets list to make binocular specific observation plans.  | Extension: Use the binocular specific list of observations for the current month at [skymaps.com](https://skymaps.com/downloads.html) (learn how to read skymaps in lesson 2, navigating the night sky)Older pupils could plan and organise a family friendly observation evening at their school. | Review what pupils have learned or experience that is new.For further questions or support, do get in touch with Bath Astronomers. |

| 1. **Gravity Well**
 | **LO: To understand the force of gravity and all it affects.** |
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| **NC objectives** | **Introduction** | **Differentiation - support** | **Main Activities** | **Differentiation - extend** | **Plenary** |
| **KS4 Science Forces**- forces and fields: electrostatic, magnetic, gravity - Acceleration caused by Forces, Newton’s First Law**KS3 Science Space** Physics - gravity force, gravity forces between Earth and moon, and between Earth and Sun**KS2 Science** - describe the movement of Earth and other planets relative to the sun | Take time to assemble the gravity well with pupils focusing on slide 5 - what is a gravity well? Discuss and explore how the fabric reacts visually to masses placed on it, which affects their behaviour, link this to space-time and gravity,On slide 6, discuss how the demonstrations might work, how to use the resources safely, and how we should verbalise our observations to help us better understand them. | Most pupils will enjoy slides 7-9 the most. Allow pupils plenty of time to try to find their own observations to prove or disprove their understanding of how gravity works in the solar system.For particular children, ask them to verbalise their understanding before they try a particular orbit demo, have them state exactly what they saw, and ask them if this supports or disproves their original idea. | Slide 7 - 9: Explore how the solar system was made and formed over time. Discuss the different masses found within it, planets, dwarf planets, asteroids, and of course our star. Pupils can spend plenty of time recreating orbits and discussing what exactly makes a planet and a dwarf planet.Slide 10 - 12: Explore different paths as affected by gravity, such as the paths of comets and rockets as they negotiate high speeds, large masses, or multiple masses. | You can take time on slides 7-9 to discuss **heliocentrism** and how the gravity well might struggle to show **geocentrism**. Research route: Kepler, and the work Tycho Brahe left behind for him.More in depth videos, graphics and questions for gravity wells can be found here: <https://www.jpl.nasa.gov/edu/teach/activity/modeling-the-orbits-of-planets/>  | Slide 13: Reflect on how all of the demonstrations typically end, and what this could model - black holes.Slide 14: A quick quiz! |

| 1. **Tellurium**
 | **LO: To link movements of the Earth, moon and sun to natural everyday phenomena on Earth** |
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| **NC 2014 Science objectives** | **Introduction** | **Differentiation - support** | **Main Activities** | **Differentiation - extend** | **Plenary** |
| EYFS - Understand important processes and changes in the natural world around them, including the seasons.KS1 - Observe the changes across the 4 seasonsKS2 (Y5/6) Earth and Space (all)KS3 Space physics - The seasons and the Earth’s tilt, day lengths at different times of year, in different hemispheres | Use the presentation to guide teachers and pupils through the use of the Tellurium, or orrery, or use of practical items such as torches and balls.Start with slide 3, Meet the Tellurium, and introduce the resources available to students, establishing safe handling on slide 4.  | Allow particular pupils time as needed to observe concepts closely when modelled on the tellurium. Allow them to revisit the model and move it when explaining back themselves.Mirror talk, repeat their explanations back but include the target vocabulary relating to the concept being discussed. | Progress through the following slides as required, which will demonstrate the concepts visually and physically for pupils.Regularly swap pupils in and out to handle the resources under your instruction, ideally pupils should manipulate the resources under the teacher’s guidance, and verbally explain what they observe back to the class.Use a visualiser to enable all pupils to see and draw focus and attention to key parts of the demonstration.Daylight hours, a rotation of the Earth, shadows, slides 6+7The seasons, slides 8-11Phases of the moon, slides 12 - 19Months, the moon and festivals - slide 20Our solar system through space, slide 21 | Record questions from pupils and revisit these during the reflection (slide 22)There are additional extension questions, research opportunities or puzzlers throughout;What does equinox and solstice look like at the poles? (Slide 12)Are crescent and gibbous shapes the same when viewed from the North or Southern Hemisphere? (Slide 20)Research the difference between lunar and calendar months (slide 22). | Reflection, slide 22Pupils should explain key learning points back verbally, or by drawing diagrams or manipulating objects/resources. Pupils could record this in writing or digitally.Homework, slide 23Pupils and teachers may choose one of the suggested longitudinal studies that allow pupils to observe, record and conclude their own ideas and experiences of natural phenomena involving the Earth in space. |

| 1. **Spectroscopy**
 | **LO: To consider how spectroscopy informs us** |
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| **National Curriculum objectives** | **Introduction** | **Differentiation - support** | **Main Activities** | **Differentiation - extend** | **Plenary** |
| **KS3 Science****Light Waves**light waves travelling through a vacuum; speed of light  the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface  colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection. | Slides 4-6 introduce the idea behind spectroscopy and a brief history of its development.Link this learning to their experience of light, KS2 science (white light, the colours within it, and how colours are absorbed and reflected) and the idea of frequencies and wavelengths of light across the wider electromagnetic spectrum also being absorbed, reflected or emitted by different matter across space. | Pupils may need support in creating the card box for their CD.Spotting the fine Fraunhofer lines might be tricky, describe them as absences or missing light, rather than ‘black lines’. | Slides 7-8: Pupils create a spectroscopy box using card and an old CD.Pupils take time to carefully observe the colours viewed via the box.Pupils use a key to help them deduce the atmospheric makeup of the atmosphere, best completed with natural sunlight. An incandescent bulb will also work.Neon or plasma lights will show different spectral signatures, based on the often noble gases within the bulb. | Slide 11 shows an opportunity for pupils to take part in a citizen science project. Pupils would need to register, but they can analyse the spectral signatures of stars and classify them. | Slides 9-10: Link the experience of observing spectral signatures to the James Webb telescope, and how we know the makeup of distant stars, atmospheres and nebulae because of spectroscopy. |