Lesson 4.3 - Night and Day

Overview

During this lesson, students will gain understanding of how the Earth rotates on its axis around the sun, creating day and night in different parts of the world. Students will demonstrate and exhibit learning by creating an orrery and a sunrise.

Key Information

Level 4: (Ages 11-12) US Grades 5 or 6

Time: 45/90 minutes

Warm-Up	5 minutes
Mini-lesson	10 minutes
Worked Example	7 minutes
Challenge 1	7 minutes
Challenge 1 - Debug	5 minutes
Challenge 2	7 minutes
Tidy Up / Exit Ticket	4 minutes

Lesson Topics

- **Science**
  - The movement of the Earth and other planets relative to the Sun in the solar system; the movement of the moon relative to the Earth
  - Seasons
  - Night and day
- **Scientific Thinking**
  - Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- **Art and Design**
  - Making a model Earth and Sun
- **Design and Technology**
  - Making a robust system to enable a model of the Earth to revolve and observe shadow
- **Computing**
  - Variable inputs, outputs, debugging
- **English Language Arts**
  - Oral presentation
- **History**
  - People used to think the Sun went round the Earth

Learning Objectives

- ***As a result of this lesson, students will be able to***
  - Explain and demonstrate that the Earth rotates cyclically, 1 cycle = 1 day
  - Explain that. as the Sun rotates. different parts of the Earth experience light and darkness, day and night
  - Demonstrate the use of shadows to tell the time of day
  - Create a system to show day and night
  - Create a system to show a sunrise

Materials

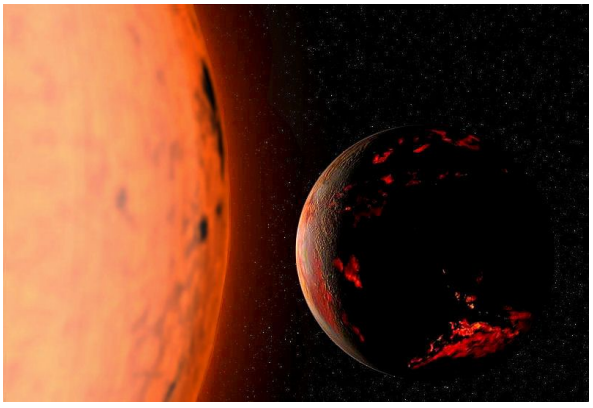
- Styrofoam or other light rigid ball
- Markers
- Glue or plasticine
- Yellow card
- Thin dowel or similar
- Protractor
- SAM Labs Kit
- SAM Labs Student Workbook

Warm Up - The Earth Spins: 5 minutes

How do people around the world experience Day and Night?

Objective: Students understand that the Earth spins on its axis within the orbit of the sun and how this brings about Night and Day. They will also understand that the Earth's axis is tilted relative to the Sun and that this causes constant day or night at the North and South poles at different time of the year, depending on the Earth's orbit around the Sun.

Procedures: Explain or elicit that the Earth is tilted and spins (north and south pole). All stand up and look at the teacher and turn slowly trying to keep your eyes on the teacher - at a point you have to move your head and you can not see the teacher for a time. Use this as an example of the earth spinning and there are times that certain parts of the earth can not see the sun - when it is dark and night time. Introduce that this is why it is daytime in places like Australia when it is night-time for the UK and parts of the US



Sample photo ideas: Earth, a planet next to the sun

Link forward: Link to creating systems to understanding the apparent movement of the Sun across the sky during the course of the day

Mini-lesson - The Sun 10 minutes

Objective: Students should develop a clear understanding of the positioning of the sun in relation to the time and the concept that the Earth spins and this affects the sunlight reaching the planet.

Procedures: The teacher queries, *Where is the Sun during the day*? Look at a sundial. How does the Sun's position and shadow show the time? If it is a sunny day go out and stand with East on your left and west on your right. Work out position of shadow and time it represents.

http://www.liverpoolmuseums.org.uk/kids/games-quizzes/sun/suntracker.html this tracker allows students to change the date and location to see the motion of the sun.

Key Words

- Axis
- Tilt
- Sun
- Day
- Night
- Earth

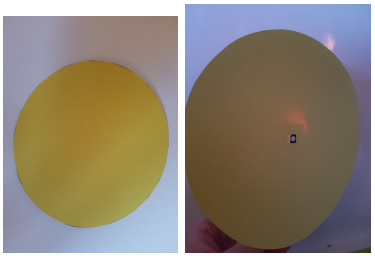
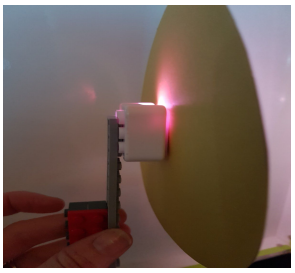
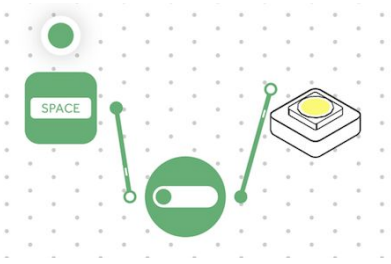
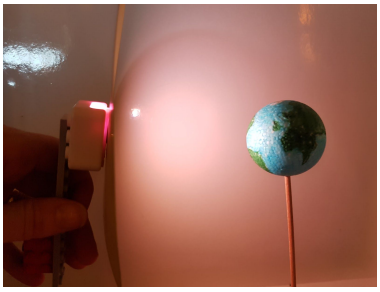
Let's Discuss: *In your workbooks or with a partner, record, discuss, or share how the Earth spins and how the phenomena Day and Night come about, in your own words. Draw a diagram.*

Link forward: Link to creating systems to show day and night and make a 'sunrise'

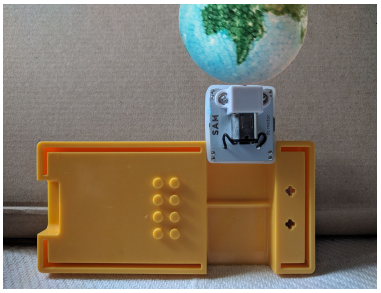
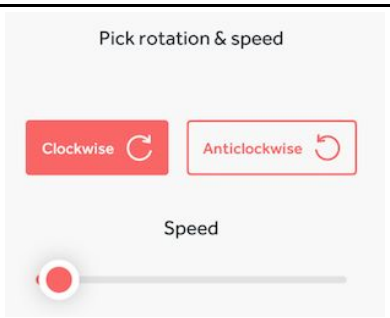
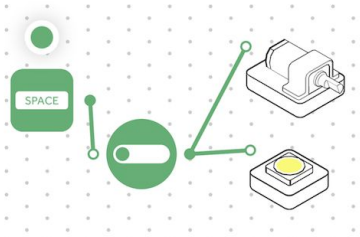
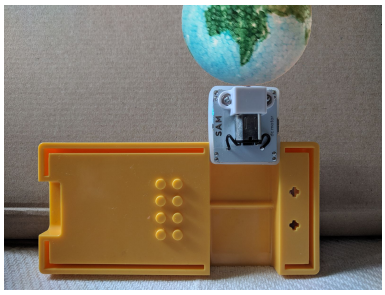
Worked Example — 7 minutes

Create a system to show Day and Night

Instructions	Workspace	Notes for Teachers
Step 1. Color a small styrofoam ball to represent the Earth.		*This could be a separate Art and Geography lesson,eg:* *Students conduct an Internet search to find a globe pattern to mount on a paper mache (or other light but rigid material) ball and mount it on an axis. The structure should be light but rigid*

Step 2. Using a wooden stick or pencil - place the ball so that the Earth is on a stick.		*If students have used another, heavier material for the ball, they may have to use glue or plasticine to attach the Earth to the top of the stick. The axis can traverse the Earth if this makes things more robust*
Step 3. Cut out a circle on yellow cardstock and pierce the middle. The RGB LED will be placed through the hole.		*The yellow circle is a 2D representation of the Sun* *Math/Science: calculate the size we would actually have to make our circle based on the size of our Earth, if we wanted to make everything to scale. Note: If we chose a 1/8 inch diameter circle to represent the Earth, we would require a circle bigger than one foot in diameter to represent the Sun*
Step 4. Mount the RGB LED onto a Lego to make the 'sun' free standing.		*From the front, the 'sun' will be a large yellow disk emitting light. If you want to make this more realistic, use a paper lampshade. Students can be encourage to come up with other ideas to make a 'sun'.*
Step 5. Turn on and pair: • RGB LED Light Drag and connect a Key Press block and a Toggle block to the RGB LED.		*This will make the light from the 'Sun' constant without having to hold down the Key Press.*
Step 6. Hold the 'sun' a hands-length away from the sphere. Activate the system!		*This needs a dark room with a white background in order to see the shadow effect on the Earth showing day and night*

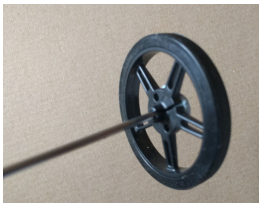
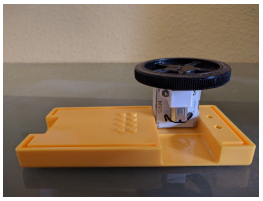
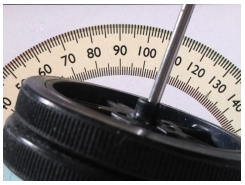
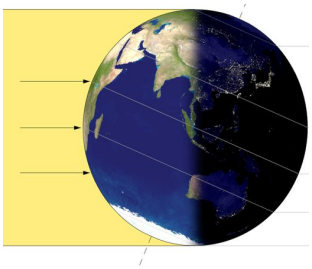
Design a system which makes the Earth revolve

Instructions	Workspace	Notes for Teachers
Step 1. Mount the Earth on a motor.		*The Motor axle will the the axis of our Earth*
Step 2. Turn on and pair the DC Motor block. Drag the DC Motor block onto the Workspace. Open the motor Settings to make the motor as slow as possible without stopping.		*It may be difficult to make the Earth spin slowly enough. It will certainly be impossible to make it revolve only once a day, as is in fact the case*
Step 3. Connect the Toggle block to the DC Motor block.		*The Toggle block allows us to turn the system on and off using the Key Press*
Step 4. Start the Motor and switch on the light.		*Get suggestions from students as to how to make the Earth revolve more slowly. If they have access to Lego, they will be able to use gears*

Checks for understanding: *The motor in our system imitates? The Motor does not imitate…?*

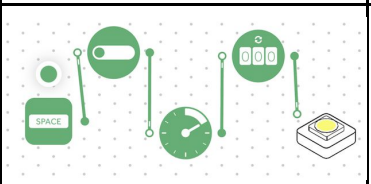
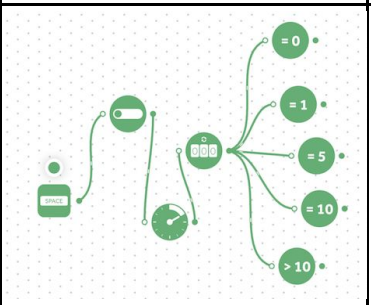
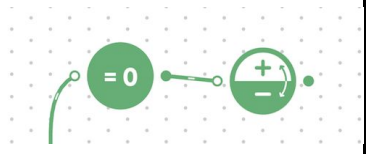
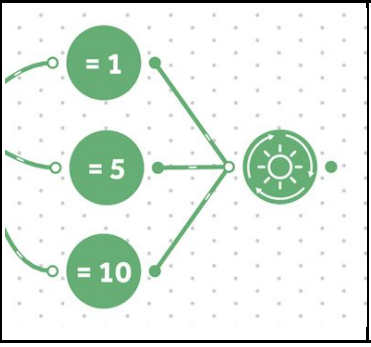
Challenge 1: Debug it! **5 minutes**

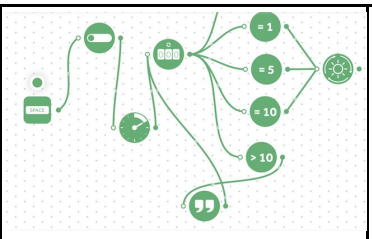
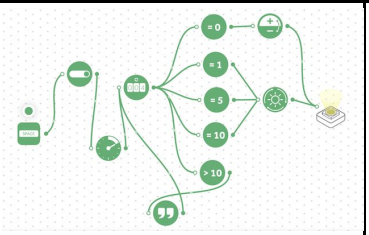
- *Is your Earth revolving too fast or in the wrong direction?*
- *Is the Sun's vertical?*
- *Why, at some times of year does it never gets dark at the North Pole and at others, at the South Pole?*

Instructions	Workspace	Notes for Teachers
Step 1. Mount the Earth on the stick again.		*Mounting the Earth directly on the motor doesn't allow us to see the effect of the sunlight properly. It is better to mount the Earth on a stick and mount this to the motor*
Step 2. Mount a wheel on the stick.		*The stick should fit in the hole in the centre of the wheel*
Step 3. Mount another wheel on the Motor.		*The added weight of the two wheels should help slow down the entire system. Not enough, but somewhat*
Step 4. Stick the two wheels together.		*Blue tack or plasticine are the easiest way to connect the two wheels* *Now we have a rotating motorised Earth on a stick and we can see the effect of the sunlight properly*
Step 5. The Earth isn't completely upright. Incline it to about 23º.		*Students may need help, depending on the protractor they use, to deduct 23º from 90º*
Step 6. Now you can see that the South pole never gets dark when you rotate the Earth.		*Extension idea: the inclination of the Earth's axis is the reason we have seasons, As the earth orbits the Sun, the Northern and then the Southern hemispheres receive longer periods of daylight. If the axis were vertical then days would always be 12 hours long everywhere. See, for example, the Lahaina Noon phenomenon*

Challenge 2 **7 minutes**

Create a sunrise

Instructions	Workspace	Notes for Teachers
Step 1. Go back to the solution to Challenge 1 and add an Interval block after the Toggle.		*The Interval block is going to send a pulse to the counter in order to vary the brightness of the Light*
Step 2. Set the delay on the interval by selecting the settings and set it to 1 second.		*The Interval block will send a pulse once every second*
Step 3. Add a Counter block and connect the output of the interval block.		*The Counter block will keep count of the pulses coming from the Interval block*
Step 4. Add 5 x Compare blocks and connect all to output of the counter block and set them to: = 0 = 1 = 5 = 10 > 10		*Each of the Compare blocks will send a signal when the Counter reaches the level set*
Step 5. Add an Inverse block and connect to the output of the Compare block with = 0 on.		*The Invert block will switch the light:* • *On if it is off* • *Off if it is on*
Step 6. Add a Cycle Brightness block. Connect it to the output of the Compare blocks =1, =5, =10.		*When the Counter reaches* • *1 the Cycle Brightness block will illuminate the Light at its lowest level* • *5 the Cycle Brightness block will illuminate the Light at its medium level* • *10 the Cycle Brightness block will illuminate the Light at its highest level*

Step 7. Add a Text block and connect it to the output of the Compare block. Set the Compare block to '>10' and the output of the Text block to the input of the Counter block Set the text to 'reset' in the settings.	 	*The Reset block will set the Counter to '0'*
Step 8. Connect the output of the Inverse block to the RGB LED. Connect the output of the Brightness block to the RGB LED.		*When the Counter is reset to '0' it will send a send a signal to the Invert block to switch the light on or off*
Step 9. Present your experiment!		*Students can write a short account of their experiment*

Extension Ideas:

- **History**
  - People used to think the Earth went around the Sun
- **Earth and Space Science**
  - Seasons
  - How long is the 'day' in Challenge 2? Can we make the system mimic the actual rising and setting of the Sun today?
  - Which direction does the Earth revolve? How does this give the impression that The sun rises in the east and sets in the west?
  - Arctic and Antarctic Summer and Winter

Checks for understanding: *If the North pole never got dark... what might be happening?*

Tidy Up / Exit Ticket — 4 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.

