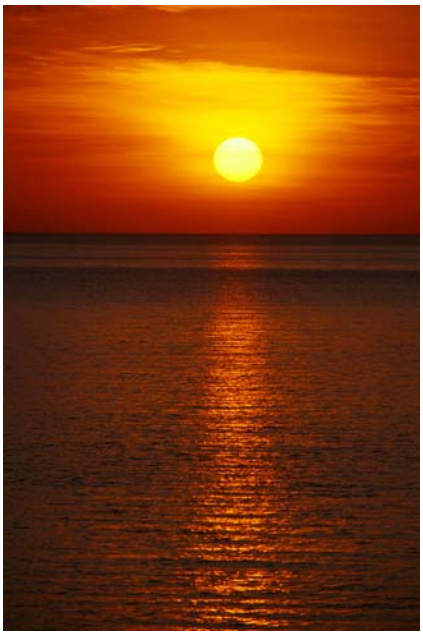
Seasons and Eclipses

Earth and Space Sciences

Year 7



This unit has been developed to meet the needs of Year 7 teachers. It is currently in draft form. Any feedback via the Moodle is appreciated.
http://dlb.sa.edu.au/pmssmoodle/

Science: Year 7 Unit – Earth and Space Science: Part 1– Seasons and Eclipses

Links to the Australian Curriculum

Achievement Standard

By the end of Year 7, students describe techniques to separate pure substances from mixtures. They represent and predict the effects of unbalanced forces, including Earth's gravity, on motion. ***They explain how the relative positions of the Earth, sun and moon affect phenomena on Earth.*** They analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems. They predict the effect of environmental changes on feeding relationships and classify and organise diverse organisms based on observable differences. Students describe situations where scientific knowledge from different science disciplines has been used to solve a real world problem. They explain how the solution was viewed by, and impacted on, different groups in society.

Students identify questions that can be investigated scientifically. They plan fair experimental methods, identifying variables to be changed and measured. They select equipment that improves fairness and accuracy and describe how they considered safety. ***Students draw on evidence to support their conclusions. They summarise data from different sources, describe trends and refer to the quality of their data when suggesting improvements to their methods. They communicate their ideas, methods and findings using scientific language and appropriate representations***

Science Understanding

- Predictable phenomena on Earth, including seasons and eclipses, are caused by the relative positions of the sun, Earth and the moon

Science as a Human Endeavour

- Scientific knowledge changes as new evidence becomes available and some scientific discoveries have significantly changed people's understandings of the world

Science Inquiry Skills

- Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge
- Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed
- Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate
- Summarise data, from secondary sources, and use scientific understanding to identify relationships and draw conclusions
- Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method
- Use scientific knowledge and findings from investigations to evaluate claims
- Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

Links to General Capabilities

Literacy

The interdependence of science and literacy is demonstrated throughout this unit as students engage in a variety of different literacies of science. The language and literacy demands specific to the study of science develop along with scientific understanding and skills. This unit provides opportunities for students to develop their literacy skills as they:

- Engage in discussions
- Record their thinking, ideas and questions in journals
- Draw labelled diagrams
- Write written explanations of their science understandings

Numeracy

Within this unit students engage in tasks involving the collection, representation and interpretation of data from investigations. This unit provides opportunities for students to develop their mathematical understanding in the following ways:

- Collection of secondary data around sunrise and sunset time
- Analysis of data and drawing conclusions

Information and Communication Technology (ICT) Competence

Within this unit students' information technologies are used to research a science concept. Communication technologies offer opportunities for the communication and sharing of students' ideas and results both within and beyond the classroom. This unit provides opportunities for students to develop their ICT skills in the following ways:

- Use ICT to research information – search for websites with relevant information
- Use Scootle simulations to develop understandings of science concepts

Critical and Creative Thinking

Within this unit students are asked to pose questions, make predictions, solve problems through investigation, analyse and evaluate evidence and summarise information. Students are asked to think in new ways about observations of the world. This unit provides opportunities for students to develop their critical and creative thinking skills in the following ways:

- Determining the best way to present information
- Drawing conclusions from data gathered
- Reflecting on historical beliefs

Ethical Behaviour

Ethical behaviour is relevant to experimental science and the use of scientific information. Within this unit students apply ethical guidelines in the gathering of evidence, including considering the implications of their investigation on others, on the environment and on other living organisms. This unit provides opportunities for students to develop their ethical behaviour in the following ways:

- Working as part of a team on an investigation
- Gathering evidence to support their claims

Personal and Social Competence

Within this unit students further develop their teamwork skills by working together, sharing ideas and discussing their work. They develop self management skills such as planning effectively, following procedures and working safely. This unit provides opportunities for students to develop their personal and social competence in the following ways:

- Working together in teams to complete tasks

Intercultural Understanding

Within this unit students learn to value their own cultures and beliefs and those of others. They recognise commonalities and differences and cultivate respect between people. This unit provides opportunities for students to develop intercultural understandings in the following ways:

- Research beliefs, myths and information about seasons and eclipses from other cultures' points of view

Links to Cross-Curriculum Priorities

Aboriginal and Torres Strait Islander histories and culture

This priority involves understanding Aboriginal and Torres Strait Islander ways of interpreting and being in the world and appreciating that Aboriginal and Torres Strait Islander histories and cultures are intrinsically linked to living and learning in Aboriginal and Torres Strait Islander communities. The Australian Curriculum: Science provides opportunities for students to become aware that Aboriginal and Torres Strait Islander peoples have particular ways of knowing about the world and continue to provide significant contributions to developments in science. Within this unit students will:

- Investigate the seasons from an Aboriginal and Torres Strait Islander perspective
- Engage in discussions around the seasonal implications for Aboriginal and Torres Strait Islander communities.

Unit at a glance	Science

Phase	Lesson	At a glance
ENGAGE	**Lesson 1** ***Session 1*** What do you know? ***Session 2*** **What do you notice?**	To capture students' interest and find out what they think they know about how the relative positions of the sun, Earth and moon cause observable phenomena on Earth
EXPLORE	**Lesson 2** **Seasonal events**	To provide opportunities for students to show what they know about seasonal events
EXPLAIN	**Lesson 3** **What causes the seasons?**	To support students understanding of what causes the seasons
	Lesson 4 **What causes solar and lunar eclipses?**	To support students understanding of what causes eclipses
	Lesson 5 **Differing beliefs**	To support students understanding of how beliefs change and differ over time and across cultures
ELABORATE	**Lesson 6** **What is the impact?** **Session 1 and 2**	To provide students with the opportunity to develop an investigation into the observable phenomena on Earth caused by the relative positions of the sun, Earth and the moon
EVALUATE	**Lesson 7** **Sharing the learning** **Session 1 and 2**	To provide opportunities for students to represent their understandings about what causes observable phenomena on Earth

Teacher Note
This unit focuses specifically on seasons and eclipses. Other observable phenomena which could be covered include the phases of the moon and tides.

Lesson 1
Session 1: What Do You Know?

ENGAGE

At a Glance:
To find out what students think they know about how the relative positions of the sun, Earth and moon cause seasons and eclipses.

Assessment Focus:
Diagnostic Assessment is an important aspect of the Engage phase. This lesson will elicit what students already know and understand about seasons, eclipses and day and night. This allows teachers to take into account students' existing ideas when planning future learning experiences.

Assessment Opportunities: Diagnostic Assessment
- Participation in discussions
- Journal entries
- Completed responses to questions

Science Outcomes:
Students will be able to:
- Record their current understanding about how the relative positions of the sun, Earth and moon cause seasons, eclipses and day and night.

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Use written text to record their experiences and current understandings

Session 1: What Do You Know?

Equipment for each student:
- Copy of Resource Sheet 1

Teacher background information

http://wiki.naturalfrequency.com/wiki/Seasonal_variation - a useful website with information relating to seasons, equinoxes and solstices.

Day and night
Day and night is caused by the rotation of the Earth on its axis. At any time half of the Earth is facing the sun and is receiving daylight while the other half of the Earth is receiving no sun so it is night. As the Earth rotates on its axis it moves through day into night and then back into day. It takes 24 hours for the Earth to complete one full rotation.

Seasons
A year is divided into 4 seasons – summer, autumn, winter and spring. Each season lasts three months.
In Australia we base our seasons on the calendar months. The seasons are:
Summer – 1 December – 28 February
Autumn – 1 March – 31 May
Winter – 1 June, - 31 August
Spring – 1 September – 30 November

ENGAGE

In the Northern hemisphere the seasons are:

- Summer starts on 20/21 June and finishes on 21/22 September.
- Autumn starts on 22/23 September and finishes on 19/20 December.
- Winter starts on 20/21 December and finishes on 18/19 March.
- Spring starts on 19/20 March and finishes on 19/20 June.

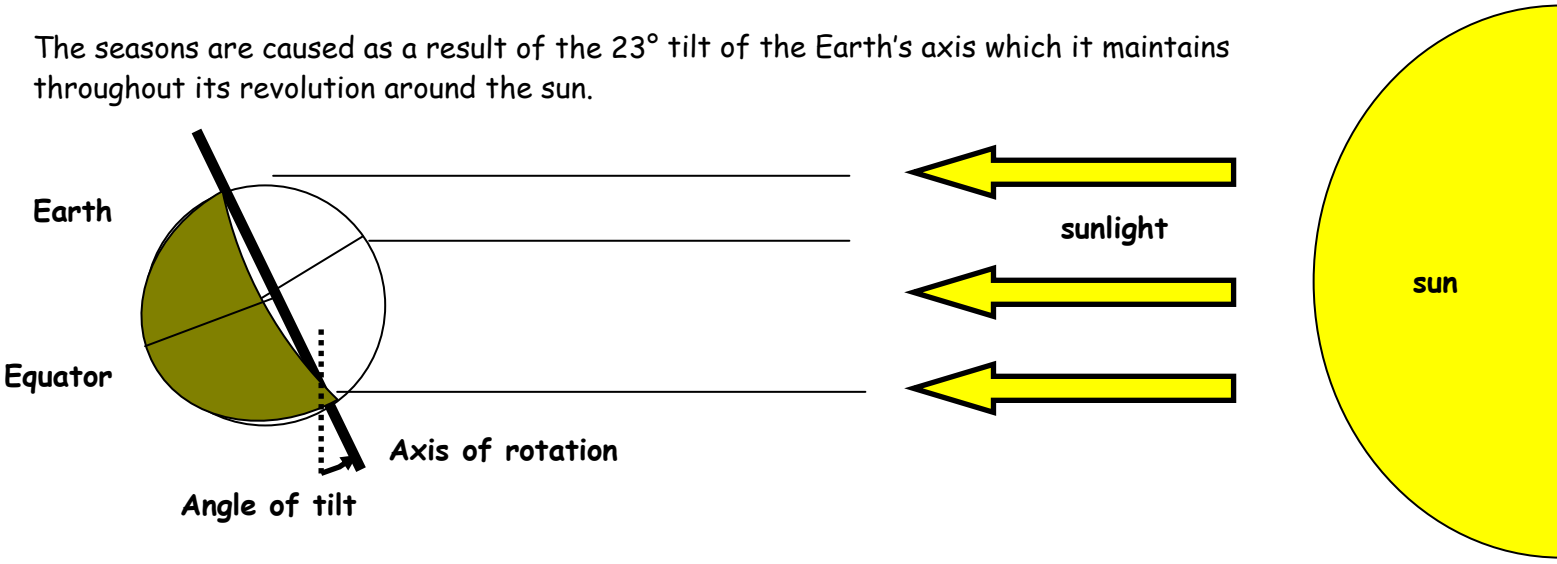
These dates are based on the summer and winter solstices and the spring and autumn equinox and can therefore vary slightly from year to year. There are also variations between particular countries and when they officially start each season.

Note

These seasons are in line with western cultures' calendars. Other cultures recognise variations in seasons but they are based on predictable annual phenomena.

Generally, it is colder in winter and warmer in summer but this depends on the local weather and climate. Also as you get closer to the equator there is less distinction between seasons.

The seasons are caused as a result of the 23° tilt of the Earth's axis which it maintains throughout its revolution around the sun.



In the diagram above you can see the axis of rotation. The southern hemisphere is in summer and is receiving a great deal more sunlight than the northern hemisphere which is currently experiencing winter. As you can also see the North Pole is receiving no sunlight and is experiencing 24 hours of darkness. It is this tilt of the axis which causes an unequal distribution of sunlight at various times of the year which causes the seasons.

As the Earth revolves around to the other side of the sun the reverse is true. The northern hemisphere receives more sunlight and is therefore in summer whilst the southern hemisphere receives less sunlight and is therefore experiencing winter.

http://www.youtube.com/watch?v=DuiQvPLWziQ Animation showing the seasons

Eclipses

Lunar Eclipse

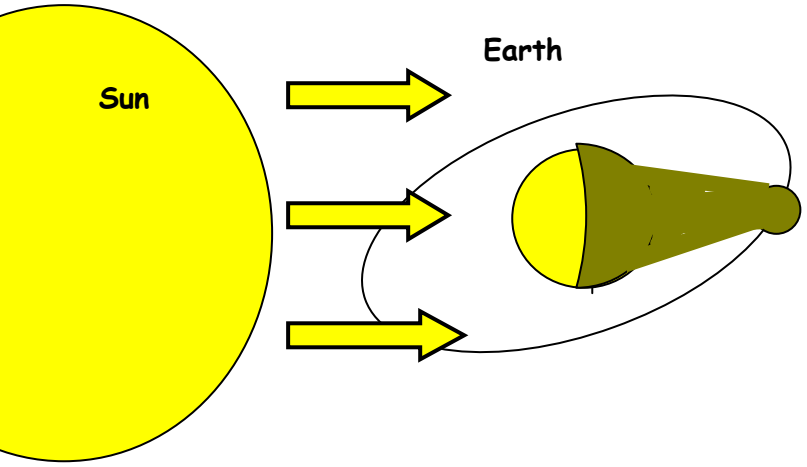
ENGAGE

The moon orbits the earth about once every 27.3 days. A lunar eclipse occurs when the sun, Earth and moon are in direct alignment and the Earth comes between the sun and the moon. The Earth blocks the sun's rays and its shadow is cast across the moon. A lunar eclipse can be viewed from anywhere that is experiencing night at the time.

Lunar eclipses can only happen when the moon is full and falls directly into the Earth's shadow. Although we have a full moon every month we do not have a lunar eclipse each time. This is because the moon's orbit is tilted about 5 degrees in comparison with the Earth's orbit. This means the Earth, moon and sun are not in direct alignment each month.

http://www.youtube.com/watch?v=wHxcWSiD_4E What causes a lunar eclipse?

Lunar Eclipse

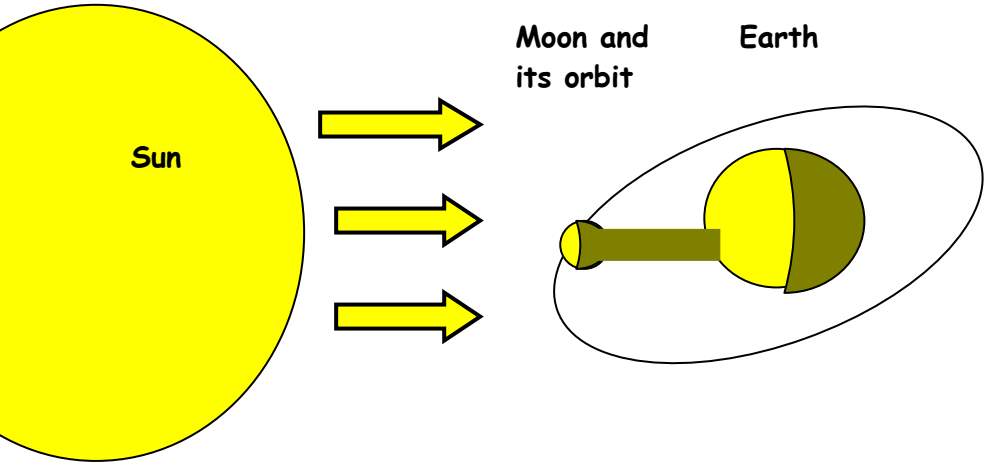


In this diagram (not to scale) the moon, Earth and sun are in alignment which means the Earth blocks the sun's light and casts a shadow across the moon causing a lunar eclipse.

Solar Eclipse

A solar eclipse occurs when the moon passes between the Earth and the sun. The moon blocks the sun's rays and the moon's shadow is cast upon the surface of the Earth. A solar eclipse is only visible from a very narrow track on the Earth's surface. A solar eclipse can only occur during the new moon phase of the moon. Although we have a new moon every month we do not have a solar eclipse each time. This is because the moon's orbit is tilted about 5 degrees in comparison with the Earth's orbit. This means the Earth, moon and sun are not in direct alignment each month.

When you look at the sun and the moon in the sky they appear to be a similar size. This is because although the sun's diameter is about 400x greater than that of the moon, it is also about 400x further from Earth.



In this diagram (not to scale) the moon, Earth and sun are in alignment which means the moon blocks the sun's light and casts a shadow across the Earth causing a solar eclipse.

http://www.youtube.com/watch?v=1Gs02YQNckE solar eclipse

Preparation

Cut up enough individual pieces of paper so that is there is one piece for each child in your class. On each piece write one of the following words; summer, winter, autumn or spring. Ensure you have an even distribution of the four words. Place the pieces of paper inside a container.

Photocopy Resource Sheet 1 for each student. You may wish to copy the page as an A3 page to give students more room to record their information. This page will be used again at the end of the unit as a summative form of assessment.

Lesson outline

Key words: rotate, revolve, revolution, orbit, eclipse, season, day, night, phenomena

1. Introduce students to the key question - ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?*** Explain that this is the question students will be focussing on throughout the unit. Display the question and continually refer back to it whilst working through this unit. Discuss the meaning of the key words within this question and see if students can create a list of possible phenomena on Earth that they think may be caused by the relative positions of the sun, Earth and moon.

2. Pass the container you prepared earlier around the room and ask the students to each take one of the pieces of paper from the container. Explain to the students that they will be given 15 minutes to create a representation in response to the word they have drawn out of the container. This could be a picture, a poem, a written text, a short play etc

3. Have them read the word on the piece of paper and then organise themselves into groups according to the word they have. E.g. all the students with the word summer meet together.

4. Once in groups give the students a few minutes to discuss the main features of their season and the sorts of things that could be covered in a presentation.

5. Provide students with 15 minutes to create their representation on the season they have drawn from the box. Students could work on this individually, in pairs or small groups if preferred.

6. Meet together as a class to share representations. Then give each student a copy of Resource Sheet 1 – What Do You Know? Explain to the students that you are attempting to find out their current understandings around seasons, eclipses and day and night. Ask students to discuss the questions in small groups and then have them individually record their current understandings on the sheet.

7. Share some of the responses. At this stage it is not about having the 'right' answer. It is about identifying the students' current understandings. Ask the class to consider how seasons, eclipses and day and night relate to the unit question. Add words and meanings to a word wall.

Teacher tip:

If students are unclear about what causes day and night you may need to briefly revisit this idea as this idea is assumed knowledge from the year 3 science curriculum.

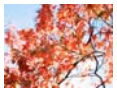
It would also be beneficial to incorporate the concepts of day and night into discussions throughout the unit as a way of revising previous learning and putting such learning into other contexts.

What Do You Know?

Record your thoughts on the following:

Describe what you think is happening in this picture. What happens to the amount of daylight at a particular location throughout the year?

Explain your current understanding of what causes the seasons?



Record your understanding about the causes of solar and lunar eclipses?

Lesson 1
Session 2: What Do You Notice?

ENGAGE

At a Glance:
To provide opportunities for students to show what they know about seasonal events

Assessment Focus:
Diagnostic Assessment is an important aspect of the Engage phase. This lesson will elicit what students already know and understand about how the relative positions of the sun, Earth and moon cause recognisable phenomena on Earth.

Assessment Opportunities: Diagnostic Assessment
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Discuss changes they notice in their local environment at different times of the year
- Record their current understanding about how the relative positions of the sun, Earth and moon cause phenomena on Earth

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Use written text to record their experiences and current understandings

Session 2: What Do You Notice?

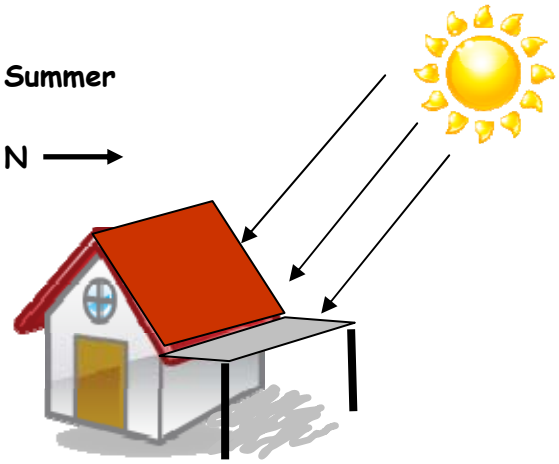
Equipment for the class:
- A copy of Resource Sheet 2

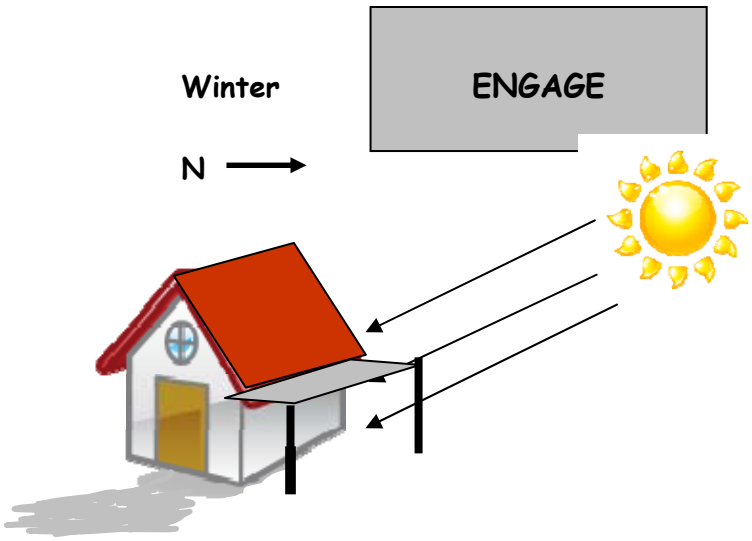
Equipment for each student:
- Science journals

Teacher background information

Changes in sun's position throughout the year

In the winter the days are shorter and the sun is lower in the sky while in summer the days are longer and the sun is higher in the sky. This is why homes in Australia that have a northern facing aspect often have verandas on this side of the house. This allows the veranda to block out the harsh summer sun (When the sun is higher in the sky) but allow the winter sun to come through and help heat the house. The sun in winter is lower in the sky so the suns' rays in winter come below the veranda.





ENGAGE

Preparation

- Photocopy Resource Sheet 2 for the teacher

Lesson outline

Key words: summer, winter, autumn, spring, orbit

1. Read the first example of local evidence of a change in the sun's position – "Grassed Area of the Garden" to the class. Allow time at the discussion points for students to engage in discussion around the given questions.

2. Engage in a class discussion around the implications for changes in the relative positions of the sun, Earth and moon.

    - What could have been happening in the garden to cause the problems with the lawn?
    - What other implications are there for gardeners and others?
    - What other things have students noticed in their own gardens or local area?

> **Teacher tip:** To generate greater discussion students could be asked to share this example with their family and see if they have any other examples that they can think of before you discuss the third section.
>
> Possible implications include:
> Placement of things such as compost bins, vegetable gardens, plants that need full sun all year, plants that need shade all year etc.

3. Continue by reading example two to the students. Allow time for students to discuss the questions related to part 2 and ask them to record their responses to the questions in their journals.

4. Meet together as a class to share responses and update the word wall.

EXAMPLES OF LOCAL EVIDENCE OF A CHANGE IN THE SUN'S POSITION

PART 1 - Grassed Area of the Garden

Mark and Cathy moved into their new home in November. When they moved in the back lawn was growing well and needed regular mowing to keep it neat and tidy. Throughout the summer months the lawn flourished and always looked good. It even tolerated the dry conditions. As the winter months approached they began to notice that the parts of their lawn that were closest to the house were not doing so well even though they were receiving the same amount of water and fertiliser as the rest of the lawn. These sections were becoming barer, some weeds were starting to grow and the grass just didn't look as good.

Once winter arrived things got even worse. These particular sections were always damp and there was now no lawn growing there. The area was boggy underfoot and even the weeds didn't grow as well as they did in other parts of the lawn.

Discussion point
What are some possible explanations for what was happening to the lawn?

It soon became obvious that this part of the lawn received no direct sunlight during the winter months. As the sun was lower in the sky in winter the lawn was constantly being shaded by the house. This meant the lawn did not receive sufficient light to continue to grow.

Mark and Cathy were confident this was the reason for the lack of lawn near the house as the lawn was rejuvenated once spring arrived and the sun was higher in the sky which meant the house no longer blocked the sun's rays and the whole lawn got all the sunlight it needed to grow.

Discussion point
Discuss other possible implications for gardeners of changes to the sun's position during the year. What other things have you noticed in your home or local area in relation to this?

PART 2 - Classroom at a Local Primary School

Students in the year 5/6 class at a local primary school began to notice that those people sitting at the back of the room were having difficulty working at their desks due to the direct sunlight that was coming through the windows. They needed to cover the windows to reduce the amount of light coming through. The interesting thing was that this was only a problem during some months of the year and at other times the sunlight was not a problem.

Discussion points

- *What time of the year do you think this might have been a problem? Why?*
- *What direction do you think the windows were most likely to be facing? Why?*
- *What other things have you noticed in your home or local area in relation to this?*

Lesson 2: Seasonal Events

EXPLORE

At a Glance:
To find out what students think they know about different seasonal events.

Assessment Focus:
Formative Assessment is an important aspect of the Explore phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries
- Brainstormed list

Science Outcomes:
Students will be able to:
- Engage in discussions around seasonal changes and the impact this can have on events and activities

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Use written text to record their experiences and current understandings

Lesson 2: Seasonal Events

Equipment for each student:
- Science journals

Equipment for each team:
- A copy of Resource Sheets 3 and 4

Teacher background information
The different events listed on resource Sheet 4 do not always occur on particular dates. They rely on the changing climatic conditions which can vary slightly from year to year and location to location. e.g. soil temperature, daylight hours, daytime temperatures, amount of rainfall etc For example trees do not drop their leaves at exactly the same time on exactly the same day each year, animals do not always leave their homes and migrate on the same day each year, animals do not all go into hibernation on the same day. These things are dependent on a variety of climatic conditions at the time.

Winter solstice
The winter solstice occurs on December 20 or 21 in the northern hemisphere, and June 21 or 22 in the southern hemisphere. This is the day of the year that has the least amount of day light hours as the length of time between sunrise and sunset is the shortest of the year.

Summer Solstice
The summer solstice occurs on December 21 or 22 in the southern hemisphere and June 20 or 21 in the northern hemisphere. This is the day of the year that has the greatest amount of daylight hours as the length of time between sunrise and sunset is the longest for the year.

Equinox

There are two times of the year when the length of day and night are approximately the same length. This is when the sun appears to be directly over the equator and is equal distance from the North and South poles. These days are known as the equinox. In the northern hemisphere these days mark the first days of autumn and spring. The equinox usually occurs around 19, 20 and 21 March and 22 and 23 September each year.

Hibernation

Hibernation is a way that animals adapt to the harsh realities of the cold climates in which they live. In order to survive the extreme cold and the lack of available food over winter some animals hibernate – they go into an extremely deep sleep.

Hibernation is different from regular sleep. When an animal is hibernating there is no movement and it takes a long time for it to wake up and move around again. In autumn, to prepare for hibernation, animals get winter burrows ready and they eat more food than usual. When hibernating, the animals store their food as body fat which they can then live off throughout winter. They have the ability to slow down their heart rates and breathing and their body temperature drops. This means they need less energy to survive the winter months.

Examples of animals that hibernate include: some bat species, short beaked echidnas and mountain pygmy possums. Lizards and snakes become dormant in the winter months. This is similar to hibernation,

Aestivation

Animals that live in extremely hot, dry climates aestivate as a way to survive the conditions. Aestivation is when animals "slow down" their bodies to survive the extreme climatic conditions in summer. Like animals that hibernate in winter, animals that aestivate in summer can slow down their breathing and their heart rate in order to conserve energy. During this time the animals don't grow, eat or move. Animals that aestivate find a safe place to sleep – often underground, where it is cooler.

Examples of animals that aestivate include: some snails, frogs, toads, and yabbies. (Not all snails, frogs, toads and yabbies aestivate)

Deciduous

Deciduous plants are plants that completely lose their foliage during the winter season. This loss of foliage is an adaptation to suit the environment in which the tree is living. Trees lose their leaves before winter as a way of conserving energy and protecting themselves from the harsh weather to come. The trees are in a state of dormancy and need less energy to survive. Losing the leaves also enables the trees to conserve moisture as they have a much smaller surface area when the leaves are removed from the tree.

Examples of trees that are deciduous include maple, ash, willow, oak and poplar

Most Australian native trees are evergreen. This means they lose some of their leaves continuously throughout the year.

Migration

Migration is the large scale movement of an animal species from one place to another. Migration is usually tied to seasonal changes, feeding patterns and breeding cycles. Migration allows a species to survive by leaving an area where there isn't enough food or the weather is too harsh for another area where the food is more plentiful or the weather conditions are not as harsh. When animals migrate for breeding purposes this enables the young to be born in a region where it is more likely to survive the first few months due to better weather conditions and a greater food supply.

Examples of animals that migrate include monarch butterfly, southern right whale, dugong, sandpiper, and whale shark

Daylight saving

EXPLORE

Daylight saving is a way that some states / countries use to get more daylight hours in the afternoon of the summer months by moving the clocks forward one hour. (Though of course the total number of daylight hours is not being changed!) By putting the clocks forward one hour the sun seems to rise one hour later in the morning, when most people are asleep anyway, and set one hour later in the evening, giving the appearance of an extra hour of daylight, allowing us to undertake extra activities during daylight.

Preparation

Organise copies of Resource Sheet 3 so that each cooperative learning team receives 3 calendar months. A3 copies would be best as they would provide more room to add information.

Organise a copy of Resource Sheet 4 for each team

Lesson outline

Key words: summer, winter, autumn, spring, hibernation, aestivation, deciduous, migration, seasonal, solstice, equinox

1. Organise students into cooperative learning teams and assign roles. Give each team a copy of Resource Sheet 4 and give them time to read what is written on the sheet. Discuss the meaning of any unknown words with the class before students begin discussing where they think events best fit on a calendar.

2. Assign each team 3 consecutive months from the calendar. Ensure teams receive the months that go together to create a season. E.g. December, January and February

> **Teacher Tip**: The calendar does not have to contain specific dates. It is more about getting a sense of what generally happens across different months. That way the calendar can be used at any time and does not have to be updated each year the unit is taught. Students can fill in specific dates if they think they are important or relevant.

3. Explain to the students that they are about to engage in a Hot Potato exercise.

   Hot potato involves students starting with 3 months of the year and then giving them a short period of time to record their responses on the calendar. At the end of the time period the pieces of paper are passed on to the next group and students receive 3 different months to add new information to. Prior to doing any recording on these sheets they spend time reading the comments that have already been placed on the sheet by the previous group. Students then add any new information which will support or deepen the understanding around the concept or question. This rotation continues until students have received all four seasons.

   Ask students to think about their earlier discussions around the information that was written on Resource Sheet 4. They now have 10 minutes to mark information on the appropriate section of the calendar. Students need to record information about different events that occur at the particular time of year on the calendar months they have in front of them. E.g. what sorts of events from the list might occur in the summer months?

   Students have the opportunity to record reasons or the basis for their thinking on sticky notes to go alongside the calendar or in the notes section underneath. Students can also add any other relevant information that they think links into specific seasons or times of the year even if it is not recorded on the resource sheet they were looking at earlier.

4. Display finished calendars and provide time for discussions around the differences.

EXPLORE

   - What, if anything, made it difficult to decide where to place the events?
   - What are some of the reasons for the differences?
   - Can you be entirely accurate from year to year about when things are most likely to happen?
   - What factors may impact on these events?

5. Remind students of the key question: ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?*** Ask students to think about what they have just done and how this may relate to the question. Update the word wall.

Month:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Notes

Month:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Notes

Deciduous trees losing their leaves	Budding of flowers
Snow season in Victoria and New South Wales	Playing football
Daylight saving	Birth of lambs
Pruning grape vines	Migration of birds
Picking cherries	Planting beans
Picking apples	Pruning roses
Migration of southern right whales	Aestivation of animals
Magpie nesting season	Hibernation of animals
Fire season	Longest day of the year
Solstice	Equinox
Holidaying in the tropics	Shortest day of the year
Heaters	Swimming at the beach
Snakes are active	Flies are more active

Lesson 3: What Causes the Seasons?

EXPLAIN

At a Glance:
To support students understanding of what causes the seasons

Assessment Focus:
Formative Assessment is an important aspect of the Explain phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries
- Scootle assessment tasks

Science Outcomes:
Students will be able to:
- Engage in discussions around what causes the seasons
- Explain their thinking about what causes seasons using an annotated diagram

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Use annotated diagrams explain their current understandings

Lesson 3: What Causes the Seasons?

Equipment for each student:
- Science journals

Equipment for each pair:
- Access to a computer – Scootle Learning Objects

Preparation
You may wish to download the Scootle Learning Objects directly to your school's computer system prior to the lesson so you do not need direct access to the internet for the lessons themselves.

Teacher background information
Seasons
A year is divided into 4 seasons – summer, autumn, winter and spring. Each season lasts three months. In Australia we base our seasons on the calendar months.
The seasons are:
Summer – 1 December – 28 February
Autumn – 1 March – 31 May
Winter – 1 June - 31 August
Spring – 1 September – 30 November

In the Northern hemisphere the seasons are:
- Summer starts on 20/21 June and finishes on 21/22 September.
- Autumn starts on 22/23 September and finishes on 19/20 December.
- Winter starts on 20/21 December and finishes on 18/19 March.
- Spring starts on 19/20 March and finishes on 19/20 June.

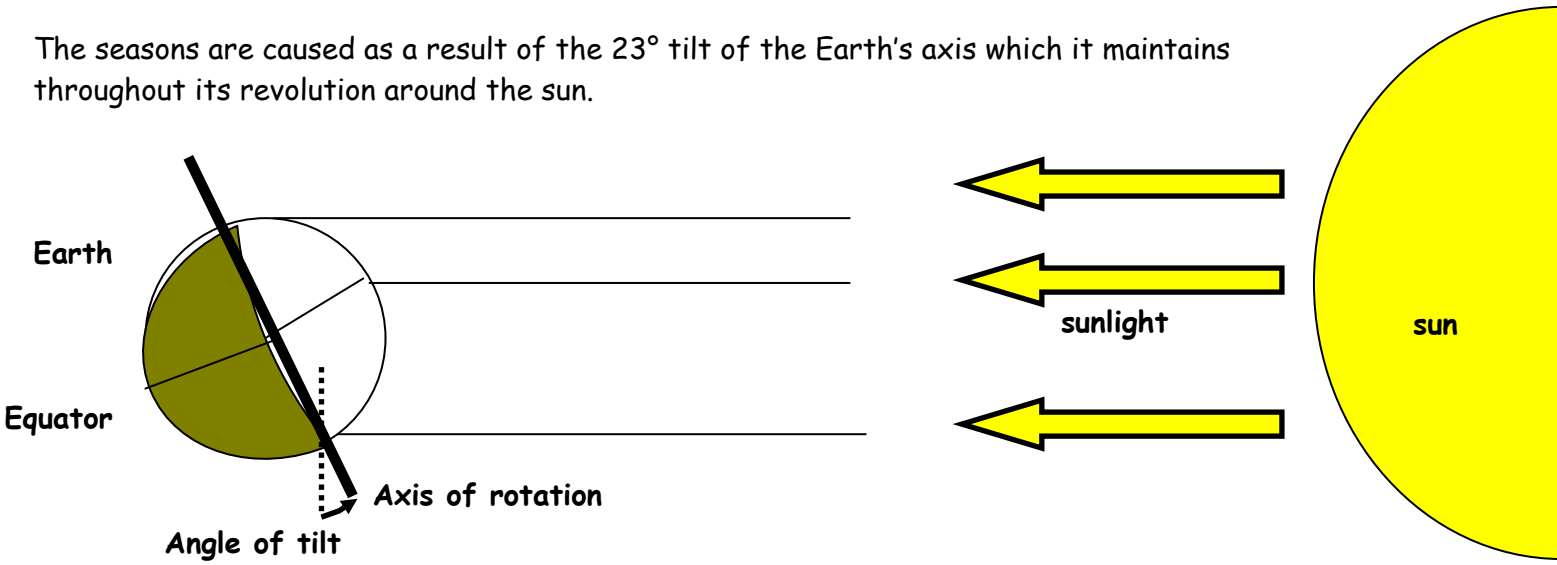
EXPLAIN

These dates are based on the summer and winter solstices and the spring and autumn equinox and can therefore vary slightly from year to year. There are also variations between particular countries and when they officially start each season.

Generally, it is colder in winter and warmer in summer but this depends on the local weather and climate. Also as you get closer to the equator there is less distinction between seasons.

Note
These seasons are in line with western cultures' calendars. Other cultures recognise variations in seasons but they are based on predictable annual phenomena.

The seasons are caused as a result of the 23° tilt of the Earth's axis which it maintains throughout its revolution around the sun.



In the diagram above you can see the axis of rotation. The southern hemisphere is in summer and is receiving a great deal more sunlight than the northern hemisphere which is currently experiencing winter. As you can also see the North Pole is receiving no sunlight and is experiencing 24 hours of darkness. It is this tilt of the axis which causes an unequal distribution of sunlight at various times of the year which causes the seasons.

As the Earth revolves around the sun the reverse is true. The northern hemisphere receives more sunlight and is therefore in summer whilst the southern hemisphere receives less sunlight and is therefore experiencing winter.

http://www.youtube.com/watch?v=DuiQvPLWziQ Animation showing the seasons

Lesson outline
Key words: season, rotation, revolution, axis, orbit, tilt, hemispheres

1. Organise students into pairs and explain to them that are about to spend time investigating the cause of seasons through using an interactive Scootle Learning Object.

2. Introduce students to the following Scootle Learning Object which explains the causes of seasons. This learning object is a combination of four objects in the same series.

Seasons TLF ID **L5774**

EXPLAIN

Control the motion of the Earth in its orbit around the Sun. Work out how the Earth's orbit and the tilt of its axis determine seasons in the different hemispheres. Work out how the Earth's orbit and the tilt of its axis determine day length in the different hemispheres. Examine the heating effect of the Sun. Compare seasons at different locations on the Earth. For example, work out that when it is summer in China, it is winter in Australia.

At this stage you may like to get your students to complete the introduction as well as Earth and Sun and the Earth's Orbit. The other two sections could be used as extension material for those students who quickly develop an understanding of seasons.

Teacher Tip: These simulations will allow students to experience what causes the seasons and they will be able to manipulate the experience to see things over and over again if necessary.

3. Provide students with the time needed to work through the Scootle Learning Object on seasons.

4. Once students have had enough time to work through the Scootle Learning Object engage in a class discussion around their understanding of what causes the seasons. Ask students to work with a partner to come up with a list of at least 4 key things they think people need to know in order to understand what causes the seasons.

Teacher Tip: Examples of key pieces of information needed to explain the cause of the seasons.

- The Earth (planets) revolves around the sun.
- This revolution around the sun takes one year – 365 $\frac{1}{4}$ days
- The Earth rotates on its axis. This takes 24 hours.
- The axis is tilted 23°.

5. Share these lists with the class and try to determine the class top 4 pieces of information people need to know in order to understand what causes the seasons.

6. Ask the students to work individually or with a partner to create an annotated diagram that clearly explains how the seasons occur. Encourage them to include the top 4 points as determined by the class as part of their diagrams.

7. Discuss how the explanation of what causes the seasons links back to the key unit question: ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?***

Lesson 4: What Causes Solar and Lunar Eclipses?

EXPLAIN

At a Glance:
To support students' understanding of what causes solar and lunar eclipses.

Assessment Focus:
Formative Assessment is an important aspect of the Explain phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Engage in discussions around what causes solar and lunar eclipses
- Explain and share their understanding of solar or lunar eclipses with other students

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Use annotated diagrams, written explanations, models or role play to demonstrate their current understandings around eclipses

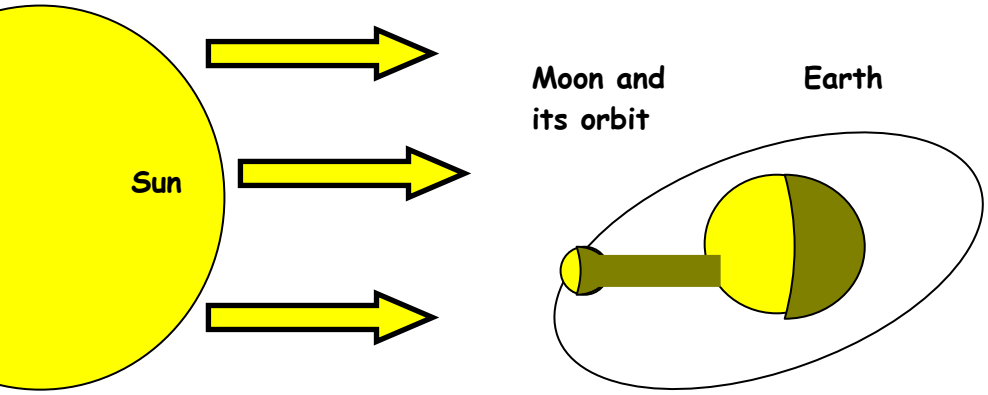
Lesson 4: What Causes Solar and Lunar Eclipses?

Equipment for each student:
- Science journals

Equipment for each pair:
- Access to a computer – Scootle Learning Objects

Teacher background information

Solar Eclipse
A solar eclipse occurs when the moon passes between the Earth and the sun. The moon blocks the sun's rays and the moon's shadow is cast upon the surface of the Earth. A solar eclipse is only visible from a very narrow track on the Earth's surface. A solar eclipse can only occur during the new moon phase of the moon. Although we have a new moon every month we do not always have a solar eclipse each time. This is because the moon's orbit is tilted about 5 degrees in comparison with the Earth's orbit. This means the Earth, moon and sun are not in direct alignment each month.
When you look at the sun and the moon in the sky they appear to be a similar size. This is because the sun's diameter is about 400x greater than that of the moon and it is also about 400x further from Earth.



In this diagram (not to scale) the moon, Earth and sun are in alignment which means the moon blocks the sun's light and casts a shadow across the Earth causing a solar eclipse.

http://www.youtube.com/watch?v=1Gs02YQNckE - solar eclipse

Lunar Eclipse

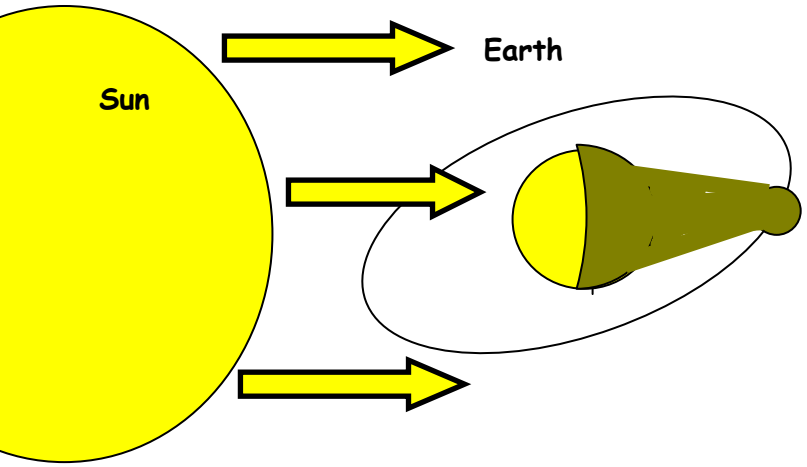
EXPLAIN

The moon orbits the earth about once every 27.3 days. A lunar eclipse occurs when the sun, Earth and moon are in direct alignment and the Earth comes between the sun and the moon. The Earth blocks the sun's rays and its shadow is cast across the moon. A lunar eclipse can be viewed from anywhere that is experiencing night at the time.

Lunar eclipses can only happen when the moon is full and falls directly into the Earth's shadow. Although we have a full moon every month we do not have a lunar eclipse each time. This is because the moon's orbit is tilted about 5 degrees in comparison with the Earth's orbit. This means the Earth, moon and sun are not in direct alignment each month.

http://www.youtube.com/watch?v=wHxcWSiD_4E What causes a lunar eclipse?

Lunar Eclipse



In this diagram (not to scale) the moon, Earth and sun are in alignment which means the Earth blocks the sun's light and casts a shadow across the moon causing a lunar eclipse.

Teacher Tip

To help students develop a better understanding of the relative sizes of the moon and the sun briefly revisit a task that they may have undertaken in year 3 when investigating day and night.

Take the class to the school oval with a tennis ball and a basket ball. The tennis ball will represent the moon and the basketball will represent the sun. Have one student hold the tennis ball and another hold the basketball about 10m away from the class. Ask the student with the basketball to begin moving away from the class until the class observes that the basketball appears to be the same size as the tennis ball.

This represents what happens when we view the moon and the sun and why we see them as roughly the same size.

Lesson outline

Key words: rotation, revolution, axis, solar eclipse, orbit, lunar eclipse, phases of the moon

1. Organise students into pairs and explain to them that are about to spend time investigating the cause of **either** solar or lunar eclipses through using an interactive Scootle Learning Object.

2. Introduce students to the following Scootle Learning Object which explains solar and lunar eclipses. This learning object is a combination of two objects in the same series.

EXPLAIN

See how the Moon orbits the Earth as the Earth orbits the Sun. Control the motion of the Moon in its orbit around the Earth. Work out how the Moon goes through different phases during a lunar month. Work out how solar eclipses and lunar eclipses happen. Find out why different types of eclipses can occur. See why solar eclipses are much rarer than lunar eclipses. Find the connection between Moon phases and eclipses – for example, work out that a lunar eclipse can happen only when there is a full moon. This learning object is a combination of two objects in the same series.

3. Divide the class into half and assign half the class the task of investigating solar eclipses and the other half of the class can investigate lunar eclipses. Allow students time to work with a partner to complete the simulation on the appropriate eclipse.

4. Ask students to work with their partner to develop a representation that clearly explains what causes either a solar or lunar eclipse depending on which eclipse they focussed on during the lesson. This could include a written script, a series of diagrams, a simulation etc. Students should be encouraged to find a way that best suits them in developing a clear and accurate explanation.

5. Once students have developed their explanation create new partnerships – one person who investigated solar eclipses with one person who investigated lunar eclipses. The students then need to use the representation they developed to 'teach' their new partner about the different eclipse.

6. Then ask students to record responses to the following in their journals:
   - Make a list of the similarities and differences between solar and lunar eclipses?
   - Explain how seasons and eclipses link with the key unit question: ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?*** Use the key points to help you with your explanation. Show your understanding about both solar and lunar eclipses.

7. Meet together to discuss any new additions to the word wall.

Lesson 5: Differing Beliefs

EXPLAIN

At a Glance:
To investigate different cultural and religious beliefs around seasons and eclipses.

Assessment Focus:
Formative Assessment is an important aspect of the Explain phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Diagnostic Assessment
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Engage in discussions around differing beliefs around seasons and eclipses
- Explain their understanding of some of the historical beliefs around seasons and eclipses

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Record different cultural beliefs in an appropriate written format

Lesson 5: Differing Beliefs

Equipment for each student:
- Science journals

Equipment for each pair:
- Access to a computer

Teacher Background Information
Indigenous Australian cultures have their own seasonal calendars based on local events around the climate. The link below is an excellent resource when looking for more information around these calendars and the comparison to the seasons of western cultures.

http://www.bom.gov.au/iwk/index.shtml

Across the centuries and across cultures both solar and lunar eclipses have been associated with many different beliefs. The link below provides a brief insight into some of these beliefs.

http://www.bibalex.org/eclipse2006/HistoricalObservationsofSolarEclipses.htm

Across the centuries the summer solstice has been associated with many traditions and continues to be celebrated today. The link below provides examples of some of these beliefs.

http://www.timeanddate.com/calendar/june-solstice-customs.html

Lesson Outline

1. Review students' current understanding with regards to the question – ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?*** by placing them in pairs and asking them to spend three minutes revisiting their understanding of what causes the seasons and eclipses. Meet together as a class to revisit the key points from the previous lessons?

2. Ask the students if anyone has any knowledge about different cultural beliefs and understandings around seasons and eclipses. Share any prior knowledge they may already have. Discuss why it may be that different cultures have different beliefs and how some of our beliefs and understandings about seasons and eclipses may have changed over time.

3. Organise students into pairs and arrange access to computers. Explain to the students that they are going to be spending time researching beliefs about seasons and eclipses from different cultures and across the ages. If needed provide them with examples of questions that could be used to guide the discussion at the end of the research time. (see below)

   Teacher Tip
   The websites in teacher background information may be a useful starting point for some students

4. Give students time to undertake the research and ask them to record at least 5 different facts / pieces of information in relation to the topic. This is intended to be a short term research task that can happen within one lesson. It is the discussion that will be generated from the research that is the critical component.

5. Meet together as a class to share the information collected either in small group or whole class discussions. Once the information has been shared engage in whole class discussions around the information. The following questions could be used to guide the discussion if needed.
   - What examples do you have about cultural beliefs and celebrations with regards to eclipses and why they occur?
   - What evidence do you have to support the fact that people's beliefs about eclipses has changed over time?
   - What do you think has caused people to change / maintain their opinions or beliefs about eclipses?
   - What new evidence has become available that allows us to change and develop our scientific knowledge?
   - What examples have you found with regards to seasonal variations within cultures? What could be an explanation for these differences?

6. Ask students to record their responses to the above questions and the class discussion in their journals.

Lesson 6: What is the Impact?

ELABORATE

At a Glance:
To provide opportunities for students to develop an investigation into observable events that occur on Earth due to the relative positions of the sun, Earth and moon.

Assessment Focus:
Summative Assessment of the investigating outcomes is an important aspect of the Elaborate phase. It involves monitoring students' developing skills and understandings of the Science Inquiry Skills and the investigative process.

Assessment Opportunities:
- Participation in discussions
- Journal entries
- Investigation results and conclusions

Science Outcomes:
Students will be able to:
- Identify questions appropriate for investigation
- Make predictions based on their current understandings
- Plan and conduct an investigation
- Summarise their data and represent their findings
- Evaluate their investigation
- Communicate their findings using scientific language
- Discuss how science knowledge has developed over time and changed people's understanding of the world

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Communicate their investigation finding in an appropriate way
- Use science terminology in their writing and discussions

Lesson 6: What is the Impact?

Equipment for each team:
- Access to computers for research purposes

Equipment for each student:
- Journal
- Investigation planner – Resource Sheet 5

Teacher Background Information

ELABORATE

The investigations in this unit rely heavily on secondary source data and the analysis of this information. Secondary source data is data that involves the research of others. It uses data that has already been collected and collated by others for other purposes. E.g. the collection of data around sunset times has already been collated and published by other people. This is secondary source data. If students were to collect this data themselves they would have limited data to work with.

Some of these investigations do allow the opportunity to identify variables to help develop an investigable question. One way for students to identify an investigable question is for them to first identify the possible variables within their investigation. E.g. if they are developing an investigation around sunrise and sunset times some possible variables are the time of the year and the location (latitude).

Students then determine which variable it is they are going to change. (Independent variable). They then need to decide what it is they are going to observe or measure. (Dependent variable)

Once they are clear on these two variables the investigable question can be developed using the following guide:

What happens to ___ (dependent variable) ___ when we change ___ (independent variable) ____?

What happens to the sunrise and sunset times when we change the time of the year?

Lesson Outline

Key Words: questioning, predicting, planning, fair testing, variables, rotation, revolution, sunrise, sunset, equinox, solstice,

1. Review students' current understanding with regards to the question – ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?*** Spend time discussing the different activities they have done so far and how these relate to the question.

2. Explain that the students will be working in cooperative learning teams to conduct an investigation into seasons, eclipses or the amount of daylight hours.

   - **NOTE:** Students could be presented with the different investigations and then allowed to make a choice about which one they will develop further **OR** the teacher could choose one investigation that the whole class will investigate.
   - The investigable questions listed below are examples only. Other questions could be developed. It is important that students go through a process such as the one described in the Teacher Background Information section to develop their own question

Possible Student Investigations include…..

What happens to sunrise and sunset times at different times of the year?

- Investigate the differences in sunrise and sunset times in Adelaide over a year.
  - Identify any patterns
  - Predict whether or not any of these patterns could be true for any city in the world and investigate these predictions
  - Plot some of the data to demonstrate your findings

ELABORATE

What happens to the amount of daylight hours when we change our location (latitude) on Earth?

- Investigate the differences in daylight hours between a city near the equator and a city near the North or South pole
- How does the amount of daylight hours vary across the year?
- Can you explain any differences?

How have people's beliefs and understandings around solar eclipses changed over time?

- Investigate the historical aspects, myths and beliefs related to solar eclipses. What did people believe? What beliefs are still current? How and why has peoples' thinking changed?

What are the similarities and differences between the seasons in different cultures?

- Compare the understanding of seasons across different cultures. Do all cultures identify with the same four seasons? What are the similarities and differences across cultures? What are the start and end points of seasons in different countries? Can you explain any differences?

What happens to the angle of the sun above the horizon at noon, at different times of the year?

- Investigate how the angle of the sun above the horizon changes throughout the year. When is the angle at its highest? When is at its lowest? Can you explain any differences?

Why do we have different time zones across countries and across the world?

- Investigate different time zones and the reasons for them. What would happen if we were all on one time zone? Could the number of time zones be reduced in Australia? Eg there is constant debate of aligning South Australia's time zone with the eastern states. What are the implications, if any, of this?

http://www.timeanddate.com/

This link is an excellent resource for many of these investigations. It includes information about sunrise and sunset times, solstices, eclipses, time zones etc. You have the ability to locate information from any where in the world for current dates, as well as dates in the past and in the future.

PHENOMENA ON EARTH INVESTIGATION PLANNER

Name:_____ **Date:**_____

Other members of your team:_____

What are you going to investigate?

Can you write it as a question?

What do you think you will find out? Explain why.

Give scientific explanations for your prediction(s)

How are you going to investigate this? What processes will you use?

What procedure will you follow?

RESULTS

What claims (if any) can you make based on the results of your investigation?

What evidence / data do you have to support your claims?

How can you represent and communicate your results in a way that others can easily understand?

Lesson 7: Sharing the Learning

EVALUATE

At a Glance:
To provide opportunities for students to share their learning and represent what they know about seasons and eclipses.

Assessment Focus:
Summative assessment of the conceptual learning outcomes is an important aspect of the Elaborate phase. It involves monitoring students' developing skills and understanding of the scientific concepts.

Assessment Opportunities:
- Participation in discussions
- Completed literacy of science

Science Outcomes:
Students will be able to:
- Clearly describe how the relative positions of the sun, Earth and moon affect phenomena on Earth such as: seasons, solar or lunar eclipses, differences in sunlight hours between locations at different times of the year or any other observable effect

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Communicate their understandings in an appropriate way
- Use science terminology in their writing and discussions

Lesson 7: Sharing the Learning

Equipment for each student:
- Journal
- Copy of Resource Sheet 6
- Original copy of Resource Sheet 1

Lesson Outline
Key words: solar eclipse, lunar eclipse, seasons, revolution, axis,

1. Revisit the key question - ***How does the relative positions of the sun, Earth and moon affect phenomena on Earth?*** Give students time to identify the key phenomena that have been covered throughout the unit and then let them know that they will be required to choose one of these phenomena and demonstrate their current level of understanding.

2. Brainstorm a variety of ways that students could use to demonstrate their understanding.
    - Poster
    - Explanation text
    - PowerPoint
    - Oral presentation
    - Video presentation
    - Animation
    - Peer teaching
    - Model etc

Discuss with the students the fact that they may choose to combine a variety of presentation techniques to successfully demonstrate their understanding. E.g. an oral presentation could be supported with a poster; a model could be supported with an annotated diagram etc.

3. Discuss with students the criteria for success. Rubrics could be developed around specific presentation techniques to enable greater opportunities for success.

4. Provide students with the time necessary to successfully complete the task. Share presentations with the class or a wider audience. This provides opportunities for peer and teacher assessment.

5. Ask student to revisit Resource Sheet 1 (completed in the Engage phase of the unit) and get them to make any changes / modifications to the information they presented at the start of the unit. Using a different coloured pen enables the teacher and the student to quickly see how much new learning has occurred.

Sharing your Learning

Choose an appropriate presentation format to clearly demonstrate your understanding of how the relative positions of the sun, Earth and moon affect phenomena on Earth.

Possible phenomena:

- Solar eclipse
- Lunar eclipse
- The seasons
- Difference in sunlight hours between locations at different times of the year
- Any other

Things to consider:

- What form of presentation would be best for you to represent your understandings?
- How clearly does your presentation explain the phenomena?
- Have you used scientific language where appropriate?
- Have you included all the relevant information needed to make your explanation clear?

Resource Sheet 6

Link to Learning		Beginning	Achieving	Advanced
Scootle Learning Objects Representation / Annotated diagram and explanations	<u>Science Understandings</u> Explains how the relative positions of the Earth, sun and moon causes the seasons	Attempts to explain what causes the seasons but lacks clarity and detail	Clearly explains the cause of seasons including the use of labelled diagrams to support understanding	Clear, concise explanation of what causes the seasons supported by clearly labelled diagrams and the correct use of scientific words
	Explains how the relative positions of the Earth, sun and moon causes lunar and solar eclipses	Attempts to explain what causes lunar and solar eclipses but lacks clarity and detail	Clearly explains the cause of lunar and solar eclipses including the use of labelled diagrams to support understanding	Clear, concise explanation of what causes lunar and solar eclipses supported by clearly labelled diagrams and the correct use of scientific words
Phenomena on Earth - Investigation	<u>Science Inquiry Skills</u> <u>Questioning and Predicting</u> Identifies questions that can be investigated scientifically Makes predictions based on scientific knowledge	With support, identifies a question to be investigated Makes a prediction with no or limited explanation as to why?	Is able to identify an investigable question Makes a realistic prediction and attempts to support it with scientific thinking	Can successfully develop their own investigable question Makes realistic predictions which are well supported with clear scientific thinking
	<u>Planning and Conducting</u> Plans and successfully conducts an investigation	Develops a basic plan for their investigation	Develops a plan for their investigation which includes all relevant details	Develops a well thought out, detailed plan for the investigation including all relevant information
	<u>Processing and analysing data and information</u> Summarises data from secondary sources	With assistance gathers data from secondary sources	Gathers data from secondary sources and uses the data to help answer the investigable question	Uses appropriate data from a variety of secondary sources, uses the data to help draw conclusions and answer the investigable question
	<u>Communicating</u> Communicates findings using scientific language	Communicates findings using some scientific terminology	Communicates findings using scientific terminology and attempts to link the results to the investigable question	Effectively communicates findings using scientific terminology with a high degree of accuracy, clearly linking the results and conclusions to the investigable question
Answers to questions - Journal entries	<u>Application – Science as a Human Endeavour</u> Gives examples of how scientific knowledge and people's understandings have changed over time	Attempts to describe a situation where scientific knowledge and people's understandings have changed over time	Explains a situation where scientific knowledge and people's understandings have changed over time	Gives an in depth example of where scientific knowledge and people's understandings have changed over time