



Curtin University

PLANTING THE SEEDS OF SCIENCE

A flexible, integrated and engaging resource for teachers of 3 to 8 year olds

EDITED BY CHRISTINE HOWITT AND ELAINE BLAKE

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ACKNOWLEDGEMENTS

The pre-service early childhood teachers who participated in Science Education 225, School of Education, Curtin University in 2008 and 2009 are acknowledged for their outstanding contributions during the development of this book.

The early childhood consultants, Natalie Birrell, Mary Morris, Heidi Mullender and Karen Wood, are sincerely thanked for their professional feedback throughout the development of the book.

Teachers and children in the following schools are especially thanked for their time, expertise, commitment and feedback in trialling the modules that make up this book: Ellenbrook Christian College, John Calvin Kelmscott School, Lake Joondalup Baptist College, Perth College and Woodlupine Primary School. Thanks are extended to all children who allowed their work to be photographed for this book.

Professor Lesley Parker, Chair of the Reference Group, for her wisdom, and support organisations that provided sage advice throughout the project, are sincerely thanked for their contributions. Representatives from the following organisations are especially thanked for their time and support:

Wendy Gorman: Association of Independent Schools, Western Australia

Don Watts: Australian Academy of Technological Sciences and Engineering, Western Australian Division

Crescentia Anthony: Catholic Education Office in Western Australia

Louise Neilson, Gail Clark, Margaret Waterton: Department of Education, Western Australia

Janice Lake: Engineers Australia

John Clarke: Science Teachers Association of Western Australia

Denise Kirkpatrick, Paul Nicholls: Scitech

Photographs have been contributed by many educators including: Jacqui Arnold, Natalie Birrell, Elaine Blake, Martina Calais, Jessica Deed, Shelley Forbes, Sandra Frid, Christine Howitt, Emily Upson, and Louise Vanderlecq. Their dedication to recording and generosity of sharing is acknowledged with thanks.

The Project Team express thanks to Curtin University for the opportunity to undertake this project.

Permission has been obtained from parents for all photographs that identify children.

Support for the production of this publication has been provided by the Australian Learning and Teaching Council, an initiative of the Australian Government Department of Education, Employment and Workplace Relations. The views expressed in this publication do not necessarily reflect the views of the Australian Learning and Teaching Council Ltd.

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2010

ISBN 978-0-646-53937-9

Printed and bound in Western Australia
Graphic design by m3design, Fremantle

The information presented in this book is part of the Australian Learning and Teaching Council Project CG8-724 Science for early childhood teacher education students: Collaboration between teacher educators, scientists and engineers

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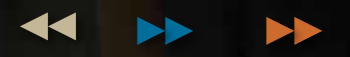
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Wherever there is a child
there is curiosity
and where there is curiosity
there is science.





IS THE GRASS STILL GREEN AT NIGHT?

Astrophysics of the dark

CHRISTINE HOWITT, ELAINE BLAKE AND MARJAN ZADNIK



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OVERVIEW



The rhythm of day and night is a part of everyone’s life and children can easily relate their experiences of day light and night time dark. *Is the grass still green at night? Astrophysics of the dark* introduces children to scientific concepts related to day and night.

This module is designed to expand a child’s knowledge of why there is a light and a dark part of every day through developing a greater understanding of the characteristics of day and night, exploring shadows, and observing the relationship between Earth and the Sun.

There are seven sub-themes presented in this module, each with a different number of ideas and activities. *Is the grass still green at night? Astrophysics of the dark* begins with children discussing living and working during day time, and living and working at night time. The night time discussion acknowledges that some children are afraid of the dark and sensitively addresses this issue. It also discusses monsters, and allows children to confidently experience being in the dark. A comparison between day and night is then made. Children investigate how shadows are made, by examining shadows of themselves, the changing shapes of shadows, and shadows on balls. Using the relationship between the Sun and the Earth, children explore day and night with various hand-held models. Finally, they answer the question ‘Is the grass still green at night?’

As a consequence of children developing their own explanations to everyday phenomena, they may hold many alternative conceptions in astronomy. For instance when a question as simple as, ‘Where does the Sun go at

night?’ is not factually or satisfactorily answered, children will construct their own explanation. Further, the use of everyday terms such as ‘sunrise’ and ‘sunset’ reinforces a belief that the Sun actually moves and Earth is at the centre of the Solar System. Expressions such as ‘the Sun is going down’ and ‘the stars are coming out’ illustrate how familiar language contrasts with scientific views.

This module relates only to day and night, providing many learning opportunities and different representations to reinforce scientific concepts associated with day and night. While the Moon will become a part of the children’s discussion of night, no attempt is made to explain the phases of the Moon here. Presenting young children with models of day and night, phases of the moon, seasons of the year, and the apparent motion of the stars all at the same time can leave them confused. Such abstract concepts should only be presented when children are mature enough in thought to construct the true understanding of these phenomena.

Health and safety issues, such as never look directly into a bright light or into the Sun should be introduced before the commencement of activities in this module. If teaching Indigenous students, there is a need to liaise with parents or the community, as the children may have strong beliefs about night spirits.

MODULE OUTLINE

An outline of *Is the grass still green at night? Astrophysics of the dark* is provided in the following table, demonstrating opportunities to integrate the module within the curriculum. Many of the activities presented in this module also have links with The Environment and Living Things within the Science learning area.

Ideas and activities presented in *Is the grass still green at night? Astrophysics of the dark* are suggestions to engage children in science learning. Allow them to guide the direction their learning takes. Flexibility is the key to working with young children, and for using this resource.

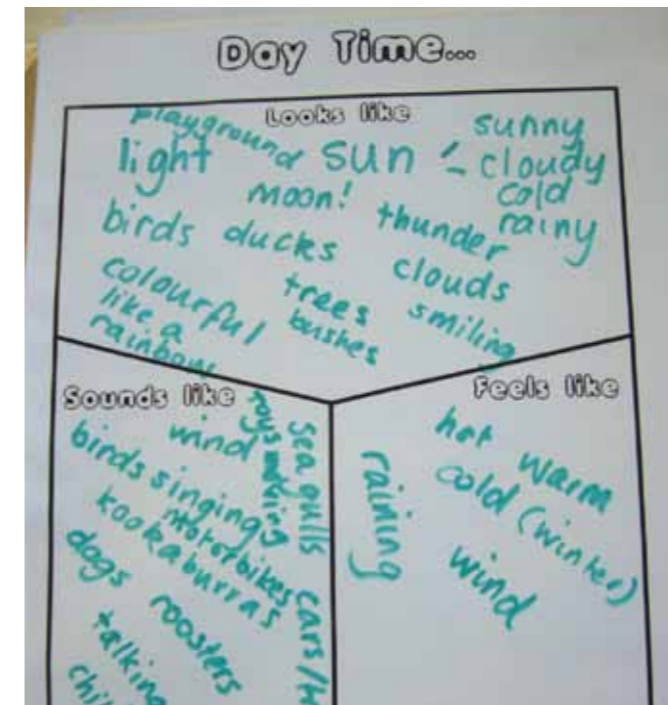
| IS THE GRASS STILL GREEN AT NIGHT? ASTROPHYSICS OF THE DARK | | | | | | | | | |
|---|--------------------------------------|---------------------------|---|---|------|------|---|-----|-----|
| | | POSSIBLE CURRICULUM LINKS | | | | | | | |
| SUB-THEME | IDEA | A | E | M | H&PE | LOTE | S | S&E | T&E |
| Living and working in day time | The feel of day time | | • | • | | | • | • | • |
| | Day time routine | | • | • | | | • | • | |
| Living and working in night time | The feel of night time | • | • | • | | | • | • | • |
| | Monsters and make believe | • | • | | • | • | • | • | • |
| | Night works! | | • | | • | | • | | |
| Things to do in the dark | Let's make it dark! | • | • | | • | • | • | • | |
| | The dark room | • | • | | | | • | | • |
| | Animals: nocturnal and diurnal | | • | | | | • | • | |
| Comparing day and night | Night walks | | • | | | | • | • | |
| | Day and night journal | • | • | • | | | • | • | • |
| | Day and night role play | • | • | • | | | • | | |
| Exploring shadows | Shadow games | • | • | • | • | | • | | • |
| | Changing shadows | • | • | • | | | • | | • |
| | Shadow art | • | • | • | • | | • | • | • |
| Why do we have a day time and night time? | Children's ideas about day and night | • | • | • | | • | • | • | • |
| | Modelling day and night | • | • | | | | • | | |
| | Shoe box model | • | • | • | | | • | • | • |
| Celebrating day and night | The night is just the Earth's shadow | • | • | | | • | • | • | |
| | Is the grass still green at night? | | • | | | | • | | |
| | Star gazing | • | • | | • | • | • | • | |

Possible curriculum links: A (Arts), E (English), M (Mathematics), H&PE (Health & Physical Education), LOTE (Languages other than English), S (Science), S&E (Society and Environment), T&E (Technology and Enterprise)

INTRODUCTION: LIVING AND WORKING IN DAY TIME

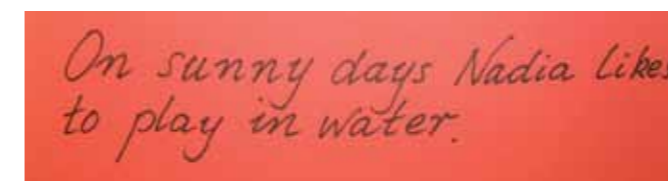
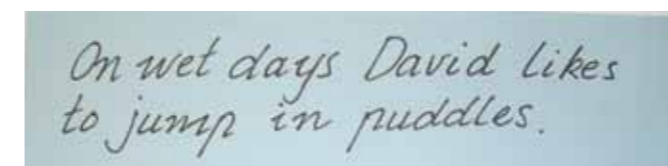
The feel of day time

Brainstorm as a class what day time looks like, sounds like, feels like and smells like. Record these responses to ascertain what the children know about day time. Take the children into the playground and ask them again what day time looks like, sounds like, feels like and smells like. Allow them to observe and discuss the things that are happening around them in the school yard, outside the school yard, and in the sky. Perhaps the Moon will be visible during the day. Incorporate children's responses into a Y-chart.



While outside, discuss the Sun and what we get from the Sun: heat and light energy. How could the children test that heat comes from the Sun? How do they feel when they stand in the Sun? Do they feel the same when they stand in shadows? With their eyes closed, can they describe a difference between standing in the Sun and standing in the shade? Let the children take photos of day time objects, for example birds, shadows, clouds, teachers and students at school. Print out the photos as a reminder of day time activities.

Sitting outside, invite children to tell stories about what they best like to do in the day time when they are not at school. How does this differ on hot, sunny days compared to cold, wet days?



Day time routine

What is a routine? Engage children in conversations about things that happen in their homes during day time. What is the routine of the children during the day? Is it the same routine on hot days and on cold days, school days and holidays? Develop a timeline of a child's school day: get up and get dressed, have breakfast, come to school, have recess and lunch, go home, play, have dinner, have a bath and, go to bed. Children learn this is called a routine and a clock helps establish a routine. Talk about how a clock is related to the passing of time, and how different things happen at different times. Reinforce the cyclical rhythm of day time and night time through the use of a simple circular diagram such as that given below.



Encourage children to write a short story that matches their timeline, starting with 'A day in the life of (child's name)'. Alternatively, have the children give a recount using hoops to step out the sequence of events.



Make lists of the following: What animals can be seen at day time? What can be seen in the sky on fine days and on cloudy or wet days? Who works in the day time? Have children draw a picture of their house during day time. Write a caption sentence about what is happening in their house during the day. List the things we do in the day time that we don't usually do during the night time (wear school clothes, play, stay awake).

FOCUS QUESTIONS RELATING TO THE INTRODUCTION

Possible focus questions to direct student thinking

1. How can you tell if it is day time or night time?
2. What things do you see during the day time?
3. What does day time look, sound, feel and smell like?
4. What things happen in your home during the day time?
5. Why do these things happen during the day?
6. What things do you see at night time?
7. What does night time look, sound, feel and smell like?
8. What things happen in your house at night time?
9. Who do you think works at night?
10. Why do some people work at night?
11. What causes day time and night time?

LIVING AND WORKING IN NIGHT TIME

The feel of night time

Repeat the process with night time, asking the children what night time looks like, sounds like, feels like and smells like. How do they know when it is night time? Ask children to recall what can be seen in the night sky. What things happen at night in their house? Record all responses. What is the routine of the children at night? What clothes do they wear at night time?



Develop a class timeline of night activities. Draw a picture to match their day time house, this time showing it at night time. How will they make the picture look dark like night time? Write a sentence about what is happening in their house at night. Ask the children to visualise what they can see through their bedroom window at night time. To create their own night picture, cut a window from white paper and draw what they see using a white or yellow pencil/crayon onto black paper.



Monsters and make believe

Sensitively acknowledge that sometimes people are afraid of the dark. As this is a real fear for some children, teachers should judge the appropriateness of the following activities.

Read the book *Where the wild things are* by Maurice Sendak or a similar story that show activities taking place at night (see Resources). How do the children know the story is taking place at night? What pictures in the book indicate the story is taking place at night?

If children start talking about monsters in the dark, then the following ideas may be helpful. Talk about monsters and other things that children might see or imagine in the dark. Read books like *The owl that was afraid of the dark* or *There's a monster in the house* (see Resources). Explain that monsters are make-believe. It is our imagination that makes up the monster. Suggest that each child think up their own monster and draw it for others to see. Make this monster in 3D form, using recycled materials. What materials do the children require to make their monster? Why have they chosen those materials? Give their monster a name. Display the finished monsters among books about monsters and make believe. Make up a whole class monster poem. Get the children to describe all the good things that they will do with their monster. Have a monster parade where children dress as monsters or carry their new 3D monster friend.



Night works!

Who works at night time? Make a list with the children. Such night workers could include miners, nurses, police, firemen, ambulance drivers, pilots, radio and television announcers, rubbish collectors, taxi drivers, truck drivers, people who fix roads, newspaper deliverers and street sweepers. Arrange for a 'night time worker' to come to school and tell the children about working at night and sleeping during the day. Ask children to develop a range of questions to ask the speaker. How do some people dress at night to be safe and seen? What is the best colour to wear at night to be safe and seen? When do night workers eat their breakfast?

From the list of 'Who works at night time?' each child chooses a person and, with assistance, researches what that person does at work. What clothes do they wear at their job? Findings are contributed to a class book about 'Living and working at night time'. The children could come to school dressed as that person and/or wear a label such as, 'If I was a night time taxi driver I would have to sleep in the day time'.

THINGS TO DO IN THE DARK

The dark room

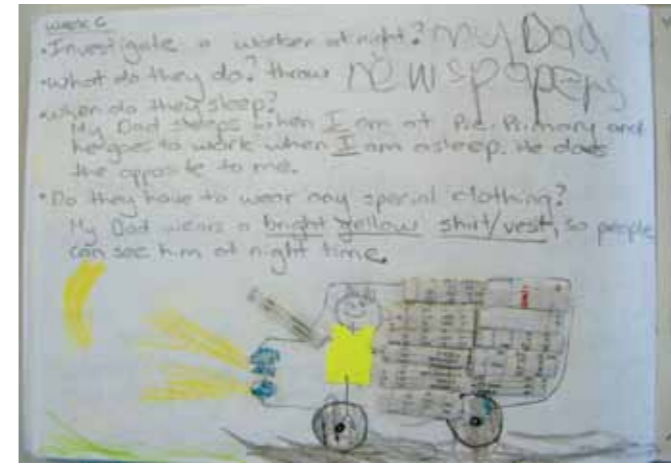
Have a discussion circle to find out how children feel in the dark? Is it scary, frightening or fun? Ask them to substantiate their responses – why it is scary, frightening or fun? Simulate the dark in the classroom by having the children sit in small groups under dark blankets placed over a table or in big boxes (such as those from fridges or washing machines). Alternatively, use a tent or beach shelter with a blanket over the front. This place could be called the 'dark room' or any other name the children prefer. Place cushions and puppets of nocturnal animals inside the box or tent to make it more comfortable for the children. What other items would the children like to add to the dark room?



To become accustomed to the dark space, have torches and allow children to move in and out of the 'dark room' until they are comfortable in the dark without a torch. Talk about how the torch gets its energy from a battery to create light, whereas during the day time we get light energy from the Sun. Play a game of 'Guess who's hiding under the blanket (or in a box)?' by asking questions to the hidden child that can only be answered using 'Yes' or 'No'.



Once children are comfortable to sit in the dark get them to sit very still. What do they feel? What do they see? What do they hear? Do they start to listen more carefully? Do their eyes become accustomed to the dark? They could write individual thoughts about 'What I can do in the dark' or 'I like the dark because...'



Let's make it dark!

How can you make a room dark so you can sleep during the day? List ideas presented by the children so they can be tested later. What can you place over your eyes to make it seem dark? Investigate children's different ideas (hands, sun glasses, hat, beanie, scarf) to see which is the darkest and the most comfortable to place over their eyes to help them sleep during the day. Could you fall asleep with your hands over your eyes? Play 'Blind man's bluff'.

Investigate how different materials such as black plastic, thick material or alfoil block out light by taping the material to a classroom window and observing how much light shines through. Investigate which coloured fabrics can be seen best at night using different materials (coloured, white, reflective) in a classroom cave.

Create Sgraffito artworks of the night sky. Sgraffito (Italian meaning 'to scratch') is created by covering the entire surface of paper using oil crayons in a range of sun-rise and sun-set colours from light to dark. Details are not drawn, just bold stripes of various colours, with the exception of black. The picture is then covered entirely using black wax crayons or thick black paint. Then using a pointed stick children create their own nightscape by scratching a scene through the black surface.

Introduce famous works of art depicting the night. For example, *Starry Night* by Vincent Van Gogh (1888).



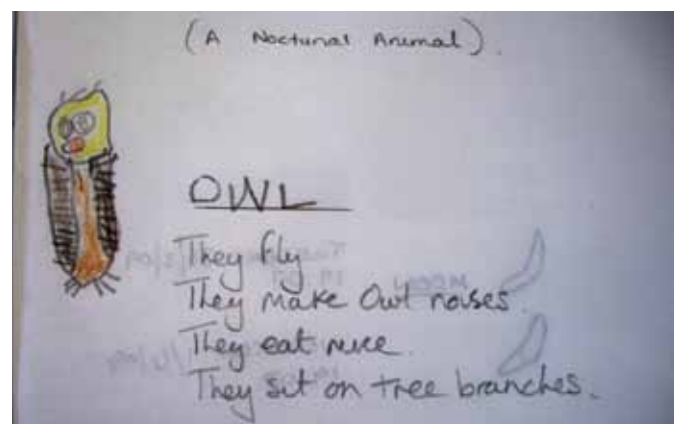
COMPARING DAY AND NIGHT

EXPLORING SHADOWS

Animals: nocturnal and diurnal

Revisit the list of which animals the children are familiar with seeing in the day time and ask – where do these animals sleep at night time?

Nocturnal animals can be introduced by reading *Animals awake: While you are asleep* or *Eyes in the dark* (see Resources). Match the animals in the stories with toys or puppets. Discuss nocturnal animals that mostly come out at night: owls, possums, mice, cockroaches, moths and bats. Discuss animals that can be seen at twilight or dusk: mosquitoes, kangaroos, rabbits, and birds. How do nocturnal animals see at night? What do nocturnal animals do at night? What do nocturnal animals do during the day time? Where do nocturnal animals sleep during the day?



Take a trip to a zoo's Nocturnal House. During the visit children will be required to remain very still and quiet, so as not to frighten the animals. They will need to adjust their sight to 'see in the dark'. They will also have the opportunity to see how red lights work to help humans see in the dark. Other occupations that use red lights in the dark include astronomers and submariners.

Night walks

Invite children and their families to participate in 'The Great Australian Marsupial Night Stalk' (see Resources). Select a local bushland, park, or simply the school grounds to walk through at night. Make sure everyone brings a torch. What can be seen at night time that could not be seen during the day time? Will they find sleeping animals? The children will probably be making that much noise that they are unlikely to see many animals. However, they will be having a wonderful time playing with the torches in the dark.



Day and night journal

Develop a class day and night journal and ask each child to complete their pages at home. Over the weekend, with the help of an adult, children keep a two day journal. Two A3 pages stapled together is perfect for this journal. Using front and back of pages provides four sections for entries: Saturday day time, Saturday night time, Sunday day time, and Sunday night time. On each section, depending on the child's ability, they record (write, draw, paint or photograph) four things that signify day time or night time at their home. Once children have all presented their findings to class, the journals are collated and made into a class book.



These suggestions could be made for parents to assist their children in the journal keeping: noticing transition times such as dusk and dawn; the difference between a clear day and a cloudy day; looking for different shaped clouds; recording the time of day they see day light and when it gets dark; describing what sounds they can hear at different times of day or night; making observations twice during one night to see how things change (for example, changes noticed with the position of the Moon, clouds and/or planets and stars); or looking at the way clouds move (for example, is the Moon moving or are the clouds moving?). Other suggestions include finding birds and animals in day time and night time and recording where they are seen and what they are doing.

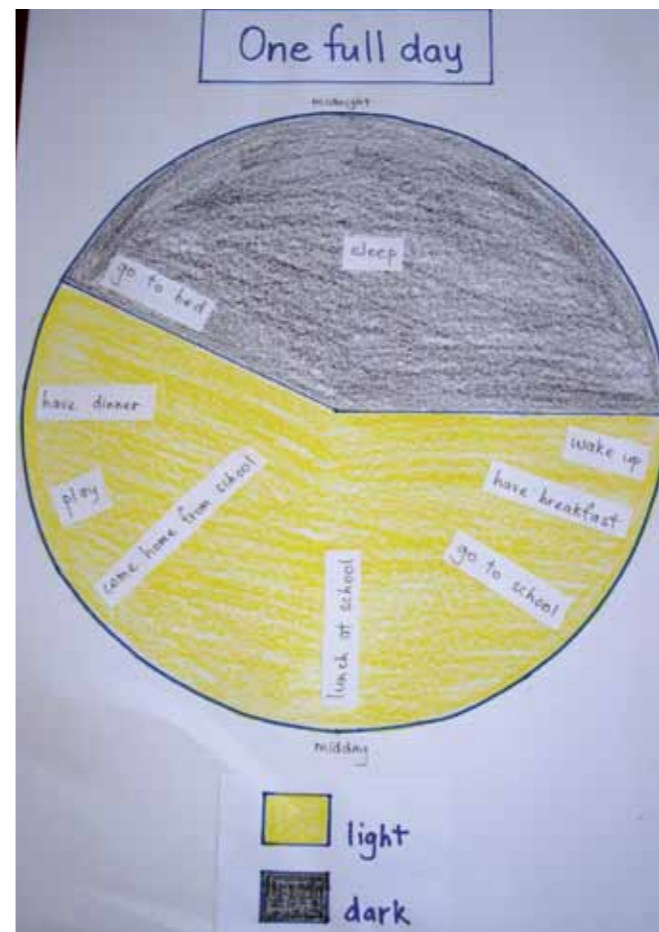
Parents are encouraged to resist providing answers to their child's questions about natural phenomena. Rather, provide time to wonder about the possibilities and research answers with others. The children's questions could also be written into the journal.

As a class discuss different aspects of day and night at home rather than at school. Develop a Venn diagram that compares the features of day and night.



Day and night role play

Refer back to the children's diagrams of a day in their life. Discuss the rhythm of day and night with the children. What sorts of things do people do at different times of the day and night? Illustrate with a clock to demonstrate the link between time and the passing of day and night.



Dance or use dramatic play to role play different things that happen during day time or night time. Provide picture cards for children to randomly select and act out, such as eating breakfast, cleaning teeth, getting dressed, walking to school, showering, or going to bed. Listen to different music and ask them to describe if the music feels like day time or night time music. Have children elaborate these feelings – why does the music feel like day time or night time music?



Shadow games

Introduce with a shadow puppet story. Brainstorm and record children's ideas about what makes a shadow. Ask questions such as: What makes a shadow? When do we see shadows? What happens to a shadow if you tread on it? Can we see shadows at night time? Are shadows visible on cloudy days? These will help gain some insight into the children's understandings of shadows.

On a sunny day, take the children outside to investigate their own shadow. How can they make their shadow change its shape? Play shadow games: treading on another's shadow, making shadows long and short. Can they make their shadow completely disappear? Can they jump on their own shadow? Can they catch another child's shadow? How can three people make just one shadow? Can they make a shadow on the ground and then on a wall? Is a shadow connected to your body? What happens to the shadow when they jump off the ground? What happens to the shadow when they are on a swing? Can they find shadows of buildings, trees, clouds or aeroplanes on the ground?

Children dress up to try and change their shadow, for example wear a hat or fairy wings. Get them to predict the shape of their shadow before they test it. Take photos of the children's shadows, and produce a class booklet of shadow photos. Can the children identify each other's shadow in the book?

Ask a group of 3 or 4 children to make up a simple story. They then use their own shadows to dramatise this story. Take photographs of the shadows the children make, or let them take their own photographs. Back in the classroom and using PowerPoint, show the photographs to the class. What story does the class come up with from the photographs? Compare this to the original story.



Changing shadows

Using chalk and working in pairs, have children draw around each other's feet and then the shadow on the footpath. Ask them to go and stand in the same place at different times of the day and see if their shadow shape and position are still the same. Record one of these as a class example by taking photos to produce a PowerPoint of how their shadows change with time. At the end of the day have a 'sharing circle' so changes may be discussed and explanations offered as to why these changes occurred. This exercise can be repeated with a range of stationary objects such as tree, poles, or buildings. What would happen to their shadow if a cloud moved in front of the Sun?

Can shadows have holes in them? Investigate shadows of a variety of non-solid objects such as strainers, or loosely woven objects. Can there be shadows in the dark? Do the children have a shadow in the dark room?

Investigate what happens as you move an object closer to or further away from a light source? Use different light sources (such as torches, lamps or an overhead projector), a wide range of objects, and a light coloured wall. Investigate if an object can have more than one shadow, by using several torches.

WHY DO WE HAVE A DAY TIME AND A NIGHT TIME?

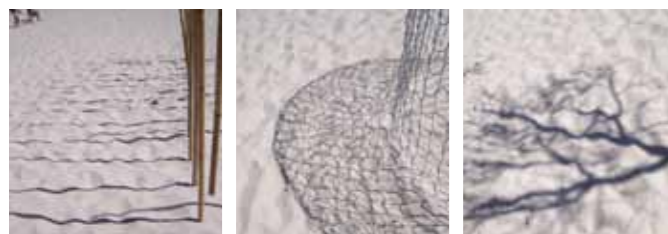
Can you place shadows on top of each other? What shadows can you make with your hands? Place different objects on the overhead projector, or hang a range of objects from the overhead projector, to explore the different shadows produced.



Using the overhead projector and solid 3D shapes observe different shadow shapes as the 3D shape is turned. Different sides may reveal alternative shadow perspectives. Draw and discuss changes in shape of the shadow.

Shadow art

Encourage families to visit the annual *Sculptures by the sea* exhibition or sculptures in other locations to experience the changing shadows and shapes created when art work is viewed from different perspectives. Alternatively look at the way light falls through the leaves of a tree and creates moving shadows on the ground or path.



Produce a shadow puppet show of a favourite story. Children design and produce their own puppets by cutting out shapes, gluing them to pop-sticks and then creating a tale that uses their puppets to illustrate the story line. Allow them to retell the story in as many different ways as they wish.

Introduce children to silhouettes. Place each child side on in front of an overhead projector to create a silhouette of their profile. Capture the silhouette onto paper on the wall by tracing around the shadow. Cut out the result and glue onto black paper. Alternatively, draw the shadow onto black paper using a white pen. Can the children guess which silhouette is theirs? Do they recognise anyone else? What is distinctive about each child's silhouette?

Develop a class concept map of shadows. Discuss what things are needed to produce shadows – a light source and an object to block the light. Have children draw a picture of how shadows are formed and write or describe their own definition of a shadow.

Children's ideas about day and night

Without dispelling the joy of childhood, ask the children to explain what happens to the Sun at night? Get them to draw pictures and explain their ideas to an adult. The explanation could be scribed for the children if necessary. Introduce other cultures' myths and legends of how day and night came about. In particular, consider Aboriginal stories of day and night time. Allow the children to dramatise these legends.

Use Google Earth to show pictures of the Earth from space, and the NASA website for pictures of the Sun (see Resources).

Modelling day and night

Provide torches for the children and a variety of different sized balls. In pairs, ask them to explore the shadows on the ball by using the torch. For greater results they could do this inside the dark room. One child shines the torch at the ball, while the other child looks at the ball from different positions. What shadows do they see on the ball? What caused the shadow? Develop a class discussion explaining how you can have shadows on balls. (The ball blocks the light and causes the shadow. See Q&A)



If children are ready, explore their views of how day and night occur, using models. The torch would represent the Sun, a ball represents Earth, and a sticker on the ball represents a person on Earth. In small groups, allow the children time to discuss how they think day and night occur. Then have each group present their explanation of night and day by using their model. Encourage discussion of each model and questions. Are children able to use a model and explain day and night adequately to other children?

Introduce a globe (of Earth) to the children and show how the globe spins around. Place a plasticine model of a person on Australia. Using a torch or the overhead projector as the light source to represent the Sun, demonstrate that when Australia faces this 'Sun', it is day time. As the Earth turns, it causes Australia to move away from the Sun and Australia falls into shadow. This is night time in Australia. The length of the day and night depends largely on the seasons. The Earth takes 24 hours to spin around once. A part of each day is called twilight. See if children can identify when it would be twilight. Encourage the children to look at the globe from different positions to observe the shadows. Night is a big shadow. What caused the shadow? The Earth itself!

CONCLUSION: CELEBRATING DAY AND NIGHT

Is the grass still green at night?

Arrange an evening class to investigate if the grass is still green at night. Ask children to predict the colour of the grass at night. In the dark, observe the colour of the grass. Then give the children a torch and ask the question again. Can they explain why the grass is still green at night?

If an evening class is not possible, then use an opened box to answer the question 'Is the grass still green at night?' Cut a hole in the bottom of the box about 10 cm square. Place the box upside down over real or fake grass. Have the children look through the hole, trying to block out as much light as possible. What colour is the grass? Now let a second child shine a torch into the hole as the first child observes. What differences do they notice? What colour is the grass this time? The light from the torch should show the true colour of the grass. Is the grass still green at night? The use of this box in a classroom is presented in Case Study 2.

Star gazing

If possible, have a whole class evening, or sleepover (with parents), to celebrate and share the children's understanding of day and night. Children lie on mats on the ground and look up at the night sky. Adult supervisors ask what they see. Can they find patterns in the sky as they draw imaginary lines to connect the stars? Can they make stories from their imaginary patterns, like people did in ancient times? Do they see any 'shooting stars' (meteors), satellites or the International Space Station? Use binoculars to enhance the experience. Invite an astronomer with a telescope, or take the children to a planetarium to discover more about the night sky. These experiences provide rich conversation to embed the knowledge.

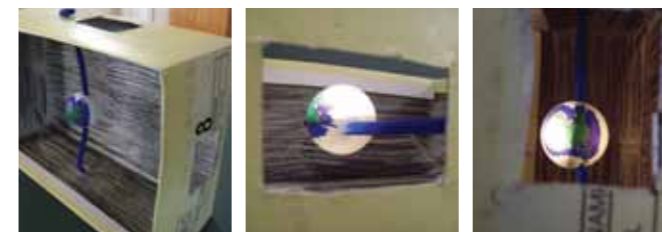


Repeat this model using children to represent Earth and the Sun. One person is the Sun and holds a torch. A second person is the Earth and turns around slowly. As 'Earth' faces the Sun, what do the others see? As 'Earth' turns away from the Sun, what do they notice?

Construct a list of people known to the children who live in other countries of the world. Use this information to reiterate the knowledge that Earth is in both day time and night time simultaneously: When it is night in Australia, it can be day time in other countries. Place a different plasticine person in another country on the globe. Slowly turn the globe and allow children to explain what is happening in relation to day and night in the two countries.

Shoe box model

Depending on capability of children and adult help, a model of day and night could be produced using a shoe box painted black on the inside to represent the night sky, a table tennis ball and a pipe cleaner. Poke two holes in the table tennis ball to allow the pipe cleaner to pass straight through the ball. Hook the ends of the pipe cleaner to the top and bottom of the box. Draw some countries on the ball, making sure that Australia is present. Using a torch as the Sun, demonstrate the phenomena of how Australia has day and night because the Earth is spinning. Cut slits in the sides and on top of the box, to allow children to peep through the slits to see both the light and shadow on the 'Earth' at the same time. Alternatively, older children in the school could make this model and demonstrate it to your class.



Allow the children back into the dark room to demonstrate day and night with a torch and ball. Can they explain what is happening to another child or adult?

The night is just the Earth's shadow

To assess learning, ask the children 'What causes night?' Get them to draw pictures again and to explain their ideas in detail. Refer back to the myths and legends around the origins of day and night time. How do these myths and legends differ to the science of day and night time?

Q&A

WHY DO WE HAVE A DAY TIME AND NIGHT TIME?

As the Earth spins (rotates), on its axis, the Sun shines on one side at any one time. The side facing the Sun is day time. On the shaded side it is night time, as light from the Sun does not reach that side of the Earth. As the Earth continues to turn, the shaded side moves into the Sun's light (morning). At the same time the sunlit side turns away from the light into shadow (evening). Night time is a shadow caused by the Earth itself. Dawn and dusk are on the outer edges of that shadow.

HOW LONG IS DAY TIME AND NIGHT TIME?

The Earth takes 24 hours to fully rotate or turn once. Depending where you live on Earth, and the season of the year, you will experience different lengths of day time and night time. There are more hours of day time in summer than in winter. The closer you live to the equator, the more similar the amount of day time and night time. In contrast, people living close to the poles (at latitudes greater than 66.5°) will experience 24 hours of day time for part of the summer and 24 hours of night time for part of the winter. The varying length of day and night is a result of the Earth's axis of rotation being 23.5° at an angle to its plane of orbit around the Sun.

WHAT IS THE SUN?

The Sun is a star. This means that the Sun generates (makes) its own energy by nuclear fusion (converting hydrogen into helium). The Sun is the nearest star to Earth and appears to be the biggest. Light from the Sun heats our world and makes life possible on Earth. The next nearest star is Proxima Centaurus, part of the Alpha Centaurus System.

WHERE IS THE SUN IN DAY TIME WHEN I CAN'T SEE IT?

The Sun is still there. However, clouds in the sky can prevent you from seeing the Sun directly.

WHAT IS A SHADOW?

Light travels in straight lines. This means that it cannot bend around objects. When light rays cannot travel through an object, you see a dark image or a shadow of that object. Hence, shadows require a light source and an object.

WHY DOES A SHADOW CHANGE SHAPE?

The shape of a shadow depends upon the shape of the object that has blocked the light, the angle of the surface upon which the shadow falls, and the distance between the object and the light source. Hence shadows can and do change shape, especially if the object or light source moves.

CAN YOU HAVE MORE THAN ONE SHADOW?

A light source is needed in order to produce a shadow. One light source will produce one shadow. Two light sources will produce two shadows. Look at footballers playing under lights at night time. How many shadows do you see?

WHY CAN'T I FIND MY SHADOW SOMETIMES?

If there is no light source, there is no shadow or it is so cloudy that sunlight is too diffuse. So if you move from a light area into a dark area, you will not see your shadow. If you move your shadow into a bigger shadow, then you will not be able to see your shadow.

CAN YOU HAVE A SHADOW AT NIGHT TIME?

Shadows require a light source and an object. At night time that light source could be street lights, car lights, or even light from the Moon. So, yes, you can have shadows at night time.

WHY DOES THE MOON APPEAR TO SHINE?

The only reason that we can see the Moon from Earth, or that it appears to 'shine', is because light from the Sun strikes the Moon's surface and is reflected to us on Earth.

WHY CAN THE MOON SOMETIMES BE SEEN DURING THE DAY?

The Moon is easy to see at night as it is so bright compared with the dark night sky. For half the month the Moon can be seen during the day time.

WHY CAN'T I SEE THE SUN AT NIGHT?

Your place on Earth is facing away from the Sun at night. This is why we have day time and night time.

WHY CAN'T I LOOK DIRECTLY AT THE SUN?

You can look directly at the Sun, but you would permanently damage your eyes and go blind. This happens because the Sun is an intense light source, plus our eyes' lenses focus on this intense light into the back of the eye retina, damaging it. So never, ever look directly at the Sun.

WHY DO STARS TWINKLE?

All light entering our atmosphere appears to twinkle. Turbulence in Earth's atmosphere causes the light to appear to twinkle. As stars are so far away from Earth, they look like a twinkling dot. The planets are much closer to Earth, and do not appear to twinkle because they have a 'disc' shape.

WHY ARE SOME STARS BRIGHTER THAN OTHERS?

The brightness of stars differs enormously depending on their original masses and stage of evolution. Generally, stars closer to Earth 'appear' to be brighter.

WHY ARE STARS DIFFERENT COLOURS?

The colour of a star relates to the size, mass and the temperature of the star. Blue coloured stars are hot (20,000°C surface temperature) and are burning their fuel rapidly. In contrast, red coloured stars are cool (about 2000°C surface temperature). The more massive the star, the faster it uses its fuel, the brighter it is, and the shorter will be its life.

DOES THE NIGHT SKY ALWAYS STAY THE SAME?

The night sky is constantly changing. Because the Earth is moving around the Sun, we see different stars and patterns (constellations) at different times of the year. We also see different phases of the Moon over a month. Planets too move around the Sun and so they appear to 'wander' against the background stars. Occasionally we see comets. 'Shooting stars' are really meteors burning up in Earth's atmosphere. If a meteor lands on Earth it is called a meteorite.

WHAT IS THE SOUTHERN CROSS?

The Southern Cross is a constellation that can only be seen in the Southern Hemisphere. A representation of the Southern Cross appears on the Australian and New Zealand flags.

ASSESSMENT

Acknowledging children's many ways of knowing and reporting their information, the following suggestions for diagnostic, formative and summative assessment are presented. Please note that these are suggestions and not prescriptive for the module. Using professional judgement, teachers should decide what is appropriate for their children, their class context, and the specific outcomes hoped to be achieved.

Diagnostic assessment

What are the children's initial ideas about day and night? How aware are they of their daily routine? What examples were provided of people who work during the night? What nocturnal animals were listed by the children? What information could children supply in their descriptions of day and night?

What were the children's initial understandings of shadows?

What initial ideas/models could the children present to explain day time and night time?



Formative assessment

Do the children have an understanding that some people work at night and why they work at night? Can the children tell their own day/night sequence of events?

What are the children's understandings of shadows? Can they accurately predict the shape of shadows from a range of objects? Test their predictions. Can they explain why they were correct or incorrect?

How well can the children explain day and night using themselves as a model of the Earth?

What differences and similarities do the children notice when comparing the Earth and the Sun?



Summative assessment

Children develop a story or design a poster based on people who work during the day and night. Identify and name work that is usually done during day or night.

Children create a shadow story. Make shadow puppets to go with the story, incorporating certain characteristics of shadows. For example, shadows can have holes in them and shadows can change shape.

Ask the children to draw a diagram of how day time and night time occur, with a detailed explanation of what they drew. Compare this with the original ideas the children presented.

For extension: children write an acrostic using the letters from N.I.G.H.T. T.I.M.E.



RESOURCES

This list of resources is not exhaustive and should be considered a starting point for finding more information. It is a good idea to also check the parent list as there can be some very useful resources readily available among the families in the school. While many of these resources are Western Australian, teachers are encouraged to find the equivalent resources within other states.



People

Parents or friends who work at night time

Astronomer, or expert on the night sky from a high school, university, planetarium or observatory

Someone from the zoo who looks after nocturnal animals

A member of an astronomy club



Websites

Fear of the Dark
www.betterhealth.vic.gov.au

Perth Observatory
www.perthobservatory.wa.gov.au/education

Gravity Discovery Centre (Perth)
www.gdc.asn.au

Perth Zoo – nocturnal house
www.perthzoo.wa.gov.au/animals/nocturnal.house

Perth Zoo – The Great Australian Marsupial Night Stalk
www.perthzoo.wa.gov.au/nightstalk

Google Earth
http://www.google.com/educators/p_earth.html

NASA – education
www.nasa.gov

Planetarium for your computer
www.stellarium.org

Scitech – planetarium (Perth)
www.scitech.org.au

Bob Miller's Light Walk
http://www.exploratorium.edu/light_walk/lw_main.html

Interactive story books, for use with computers and/or whiteboard

The Moon and the Rabbit
<http://www.bbc.co.uk/cbeebies/fimbles/comfycorner/story10.shtml>

Interactive stories for kids. Goodnight Bird
www.woodlands-junior.kent.sch.uk/interactive/onlinestory.htm

KS Bite Size. Light and Shadows
www.bbc.co.uk/schools/ks2bitesize/science/physical_processes.shtml



Books

Factual texts

Couper, H. & Henbest, N. (1999). *Space encyclopaedia*. London: Dorling Kindersley.

Stott, C. (1993). *I wonder why stars twinkle and other questions about space*. London: Kingfisher Books.

Levy, D. H. (1996). *Stars and Planets*. NSW: Allen & Unwin.

Perth Observatory (every year) produces the *Western Australian Astronomy Almanac: The really useful guide to the wonders of the night sky*.

Narrative texts

(Beware of the alternative conceptions that can be presented in these books)

Allen, J. (2007). *I'm not scared*. Mascot, Australia: Koala Books.

Base, G. (1983). *My grandma lived in Gooligulch*. Melbourne: Nelson.

Baumgart, K. (1997). *Laura's star*. Mascot, Australia: Koala Books.

Butler, C. & Chapman, J. (2008). *Dark, dark night*. Intercourse PA: Good Books.

Cartwright, S. (1997). *There's a monster in the house*. Sydney: Usborne Publishing

Dale, K. (2001). *Eyes in the dark*. Port Melbourne, Victoria: Lothian.

Dodd, L. (1990). *Slinky Malinki*. Auckland, New Zealand: Penguin.

Gray, N. (2008). *Don't be afraid*. Mascot, Australia: Koala Books.

Murphy, J. (2003). *Peace at last*. London: MacMillan

Nottingham, F. (2000). *Animals awake: While you are asleep*. Victoria: Over the Fence

Petterson, C. (2007). *Yongka, Miyak. Kangaroo and Moon*. Northern Territory: Batchelor Press.

Petterson, C. (2007). *Koodjal-Koodjal Djookan. Four sisters. The legend of the Southern Cross*. Northern Territory: Batchelor Press.

Sendak, M. (2001). *Where the wild things are*. London: Bodley Head

Taylor, A. (1987). *Lights off, lights on*. Oxford: Oxford University Press.

Tomlinson, J. (2002). *The owl who was afraid of the dark*. London: Egmont Books.

Waddell, M. (1990). *Can't you sleep little bear?* Port Melbourne: Little Mammoth.

Waddell, M. (1992). *Owl babies*. (Big book). London: Walker books.

Wang, M. (2006). *Monster mix-up*. Victoria: Hinkler Books.

Raps and rhymes

Twinkle, twinkle, little star (traditional rhyme)

Twinkle, twinkle, little star
How I wonder what you are.
Up above the world so high,
Like a diamond in the sky.
Twinkle, twinkle little star.
How I wonder what you are.

Sally go round the stars (Clark, 1995, p. 74)

Sally go round the stars
Sally go round the Moon
Sally go round the chimney pots
On a Saturday afternoon.

Starlight, star bright (traditional rhyme)

Starlight, star bright, first star I see tonight
Wish I may, wish I might
Have the wish I wish tonight.

Games

Echo game

Have you heard the ...(cat)...at night? *Miaow, miaow, miaow*
Have you heard the ...(owl)...at night? *Woohoo, woohoo, woohoo*

Continue and add night time animals such as fox, beetle, dingo, Tasmanian Devil, mice, bats until all sections of the class are making night time animal noises!

Someone is hiding

Here is a box,
Put on the lid
I wonder whoever inside is hid?
Why it's.....without any doubt
Open the box and let him (her) out.

Blind man's bluff

Child A has eyes covered with a blindfold. Five other children remain in a predetermined and uncluttered space. Child A tries to catch one of the others while they try to avoid being caught. Child A has to guess which child has been caught. The person caught is the next blindfolded child.



CURRICULUM INTEGRATION

Is the grass still green at night?
Astrophysics of the dark.

Science

- Difference between day time and night time
- Rhythms of day time and night time
- How do my senses change in a dark place?
- Researching nocturnal animals
- Exploring shadows; what causes a shadow?
- Relationship between the Earth and the Sun
- Earth takes 24 hours to rotate
- How eyes adjust to seeing in the dark (dilation of the pupils)

English

- Make a night and day book or poster
- Determine fact and fiction in stories written to help understand phenomena (ie sunset/sunrise)
- Reading monster stories
- Write monster poems
- Expressions associated with feelings about the dark
- Lists, captions, pictures, words, or questions for a Day and Night Word Wall
- Developing questions for invited speaker
- Descriptions of shadows
- Stories created for puppet shows
- The days of the week are related to astronomical objects (Saturday – Saturn; Sunday – Sun; Monday – Moon)

Languages Other Than English

- Make associated word charts in English and the school's LOTE curriculum
- The names of the Earth and Sun in different languages
- Cultural stories of the origins of day and night including Dreamtime stories
- Aboriginal story of 'The emu in the sky'
- Monster stories associated with other cultures
- Greetings for 'good morning' and 'good evening' in other languages

Mathematics

- Time: Hours/minutes/seconds
- Time: Calendars/days/weeks/months/years
- Size and shape of Earth and the Moon
- Distance from the Earth to the Moon
- Measurement: perspective of near and far
- Measurement: lengths of shadows
- Measurement: shorter and longer (days/nights)
- Record sunrise and sunset times
- Problem solve: How many times has the Earth moved around the Sun since you were born?
- Personal timeline of day time and night time in your 24 hours
- What is the shape of the Earth and the Sun

Health & Physical Education

- Changing body shapes, positions and postures to alter shadows
- Chasing, hopping and jumping shadows
- Shadows from swings
- Vitamin D for the skin
- Eye care – sunglasses and reading with a good light
- Skin care – protection against sun burn, cancer
- Free movement in and out of a dark place
- Explore emotions/feelings related to day time and night time
- Reinforce the 'No hat, no play' school policy
- What does 'Slip, slop, slap, seek, slide' mean?
- Eye pupils dilating in the dark

Society & Environment

- Different people have different jobs
- What people work at night, and why do they work at night?
- How do people dress if they work in the dark?
- How do people live and work in countries where they have long periods of day time or night time?
- Discuss the 'Land of the midnight sun', and why is it called that
- Adopt an Antarctica scientist, and find out what they do and how they cope working through long periods of day time or night time
- Compare day in Australia and night in New York

The Arts

- Sgraffito art
- Act out jobs people do during the day and night
- Role play the Sun and the movement of the Earth
- Create a recording of day and night noises
- Make shadow puppets and create stories to help explain day and night
- Dramatise myths and legends of origins of day and night from other cultures
- Paintings by famous artists, such as Turner's *Sun Sets* and Van Gogh's *Starry Night*

Technology & Enterprise

- Watches, clocks, calendars, sextants, geographic positioning satellite (GPS)
- Photographs of shadows over time
- Develop a shadow story PowerPoint using photographs
- Google Earth
- Explore the NASA website to find pictures of the Earth from space
- Making a monster from recycled materials
- Developing shadow puppets from a range of materials, including translucent and opaque
- How do telescopes work? Why is a telescope like a time machine?
- Satellite communication

CONNECTIONS TO EARLY YEARS LEARNING FRAMEWORK: LEARNING OUTCOMES

The five Learning Outcomes of the *Early Years Learning Framework* provide broad and observable outcomes of young children's learning and development. Examples of these outcomes in relation to *Is the grass still green at night? Astrophysics of the dark* are presented below. As there are many ways that children express their learning, these should be considered a guide only.

Outcome 1. Children have a strong sense of identity

Children feel safe, secure and supported

- use of daily routines of family members
- explore dark places through use of play and made constructions
- play with others in a darkened space

Children develop their emerging autonomy, inter-dependence, resilience and sense of agency

- make own shadow change shape
- play with others to make shadow stories
- explore nocturnal house at a zoo

Children develop knowledgeable and confident self identities

- accept and know that it is OK to be afraid
- use home language to contribute to class record of their weekend routine
- invite community members to class to share stories and culture

Children learn to interact in relation to others with care, empathy and respect

- role play night work of adults
- read stories, discuss and empathise emotions associated with the dark
- respect others' perspectives when playing in the darkened area

Outcome 2. Children are connected and contribute to their world

Children develop a sense of belonging to groups and communities and an understanding of the reciprocal rights and responsibilities necessary for active community participation

- tell stories of experiences on wet days and sunny days
- respectfully listen to and acknowledge others' stories
- cooperate with others when creating shadow games

Children respond to diversity with respect

- explore how different cultures respond to day time and night time activities
- listen to and respect others' ideas about what causes shadows
- hear Australian Aboriginal stories about constellations

Children become aware of fairness

- make choices about imitating people who work at night
- take turns playing in the darkened area
- invite others to share equipment when exploring shadow shapes

Children become socially responsible and show respect for the environment

- role play to demonstrate interdependence of people who work at night and people who work during daylight
- respond to changes of natural environment during day time and night time
- develop an appreciation of natural and constructed environments during the dark period of a day

Outcome 3. Children have a strong sense of well being

Children become strong in their social and emotional wellbeing

- make choices about safety and personal care while engaging in a night walk with family
- enjoy quiet times and playful times during light and dark times of the day
- confidently celebrate the beauty of the night

Children take increasing responsibility for their own health and physical wellbeing

- discuss personal requirements for an excursion to school at night time
- actively engage in safety requirements for playing in the sunshine
- acknowledge and accept affirmations about drawings created

Outcome 4. Children are confident and involved learners

Children develop dispositions for learning such as curiosity, cooperation, confidence, creativity, commitment, enthusiasm, persistence, imagination and reflexivity

- encourage others to contribute ideas for Venn diagrams
- ask questions to satisfy curiosity about night time
- explore shadows with torches and small objects

Children develop a range of skills and processes such as problem solving, enquiry, experimentation, hypothesising, researching and investigating

- express opinions and conduct experiments about finding the colour of grass at night
- construct a journal of day time and night time activities
- compare differences of day time and night time

Children transfer and adapt what they have learned from one context to another

- draw a representation of the view from a window at night
- make connections between their shadows and a drawn representation (silhouette)
- problem solve what causes night time dark by using a ball and a torch

Children research their own learning through connecting with people, place, technologies and natural and processed materials

- use their senses to describe how they feel in dark places
- investigate and discuss colour of the grass in a darkened situation
- apply generalisations to famous paintings of the night to own knowledge

Outcome 5. Children are effective communicators

Children interact verbally and non-verbally with others for a range of purposes

- demonstrate an increasing understanding that the night is just a shadow
- share paintings and drawings exposing perceived differences between night time and day time
- using movement and dance explore the habits of a nocturnal animal

Children engage with a range of texts and gain meaning from these texts

- co-construct a book that retells experiences with shadow play
- write and read day and night words such as Sun, stars, dark, spooky on a specific Word Wall
- share story books about animals that live in the dark

Children express ideas and make meaning using a range of media

- use toys to represent characters in stories
- create and photograph made monsters from recycled materials

- use photographs presented in a PowerPoint to relate where they found specific shadows

Children begin to understand how symbols and pattern systems work

- create a personal timetable of daily routines
- construct a classroom timetable
- notice how shadows change size and pattern throughout the day

Children use information and communication technologies to access information, investigate ideas and represent their thinking

- use watches and clocks to note passing of time
- listen to distinguish which music they feel represents day time and which represents night time
- draw the night sky using information and communication technologies

CONNECTIONS TO AUSTRALIAN CURRICULUM: SCIENCE

The *Australian Curriculum: Science* consists of three interrelated strands: Science Understanding, Science as a Human Endeavour, and Science Inquiry Skills. Examples of these strands in relation to *Is the grass still green at night? Astrophysics of the dark* are presented below.

NB Information based on the draft version of *Australian Curriculum: Science* (Draft Version 1.0.1, 8/3/2010).

Science Understanding

Living things

- What are nocturnal animals?
- How do nocturnal animals see in the dark?
- How do our senses change in the dark?
- How do people adjust their lives if they work during night time and sleep during day time?

The environment

- Day and night are caused by Earth rotating about its axis
- The Earth rotates once every 24 hours
- The relationship between the Earth and the Sun
- Night time is a shadow

Materials

- What materials are used to make a torch (or a clock)?
- What types of materials reflect light?
- What materials can block out heat and light?
- What is needed to make a shadow?

Energy

- What are shadows and how do they change?
- What causes torch light?
- What powers lights used at night time (street lights, car lights)
- How does the Sun produce light and heat?

Science as a Human Endeavour

Nature of science

- What does an astronomer do? (Do they only work at night?)
- How can an astronomer help people?
- How does a telescope work?
- Develop simple questions about day time and night time to explore as a class

Everyday science

- Compare human activity during day time with human activity during night time
- The importance of shade cloth over playground equipment
- Multiple shadows of sportspersons when playing under lights

- Awareness of the everyday dangers of the Sun: how to protect eyes and skin from the Sun

Science and culture

- How did the 'slip, slop, slap' campaign start?
- Investigate routines of children in countries where there is long periods of day time and night time
- How are homes illuminated at night when there is no electricity?
- Listen to myths about the explanation of day time and night time from other cultures

Science Inquiry Skills

Questioning and predicting

- Is the grass still green at night?
- What causes night time dark?
- What animals come out at night?
- Predict the shape of a shadow before testing

Investigation methods

- Investigate daily routines
- Research nocturnal animals
- Investigate if an object can have more than one shadow
- Compare the features of day time and night time

Using equipment

- Use torches responsibly
- Photograph own shadows to develop a PowerPoint
- Use table tennis ball and pipe cleaner to develop day/night model
- Convert a box into a darkroom

Observing and measuring

- Draw own perception of day time and night time
- Observe shadows of a range of objects
- Record the number of hours of day light and dark
- Draw around a shadow and observe how the shadow changes over time

Communicating

- Use the term 'rotation' or 'spinning' of the Earth to explain day and night
- Record observations in a day/night book
- Describe feelings when sitting in the 'dark room'
- Write myths about day time or night time

Using observation as evidence

- What evidence tells us that some animals are nocturnal?
- Observe and record changing shapes and positions of a shadow
- Explain day and night using the shoe box model and a torch
- Determine if the grass is still green at night

Reflecting on methods

- How else could it be proved that the grass is still green at night?
- What could be added to the 'dark room' to make it more effective?
- What detail could be added to silhouettes?
- How can a shadow puppet play be produced?

CASE STUDY 2. "I CAN SEE SOME GREEN WHERE THE 'MOON' IS SHINING ON THE GRASS!"

Background

Jill (a pseudonym) is teacher of a Pre-primary class of 26 girls in a Perth inner city independent school. Her history as an educator includes teaching in Junior Primary classrooms for 13 years and in her current position is the Early Learning Coordinator. Jill enjoys teaching science and finds it easy to integrate scientific concepts into her teaching and learning program.

How was the book used?

While looking through *Planting the Seeds of Science*, Jill was taken by the flexibility offered in the choice of activities, and the integrated curriculum learning areas associated with the book. She found this made planning science lessons easy. As she read each module she thought they would all be fun to implement.

After reading through the entire book, Jill chose to develop the science concepts associated with *Is the grass still green at night? Astrophysics of the dark*. She selected various ideas and activities from the book which were considered appropriate for her class. She started the module with a group discussion to find the girls' notions about whether or not the grass was green at night. Children's ideas ranged from the grass being blue, dark green, brown, silver and green at night. The children then made their own comparisons between day time activities and night time activities.

How was the module modified?

Without a consensus about whether or not the grass was in fact still green at night, and without the opportunity to have a sleep over or a late night at the school for the girls to test their ideas, the class discussed ways to remedy this conundrum.

The day time activity that met their needs was to place a box with a hole in it over some grass in the darkest place they could find at school. They looked through the hole in the box to check the colour of the grass. The girls soon realised they also needed a light source to test their ideas, and decided to use a torch to represent the Moon. (This simple yet effective modification made by Jill has now been added to the book.) Some of the conversation recorded at the testing is presented below.

Teacher: *What do you see when you look into the box? (with no light)*

Child A: *It's sort of greenish black.*

Child B: *A bit dark green.*

Child C: *I see black.*

Child D: *Dark and light green on there and dark blue.*

Teacher: *What do you see now? (with torch)*

Child A: *I can see some green where the 'Moon' is shining on the grass!*

Child B: *Some bits around it are dark greenish and bits away are real dark.*

Child C: *The Moon shines light at night.*

Teacher: *Where does the Moon get its light from?*

Child C: *The Sun.*

Teacher: *Yes, you are right, it is the Sun. The Sun's light shines on the Moon at night...we call this reflection.*

Child A: *Then the Moon shines so we can see it...but it can only make the grass shiny not green.*

Teacher: *But let's think...is the grass still green at night?*

Child A: *Yes, but the Moon can't shine much more light.*



An overview of the book

"I found the book very easy to use. It presents ideas that you can plan around and [it] actually acknowledges that even the youngest students have knowledge to build on. And I like the variety. The flexibility is best for my class because I know my students and what their interests are so I can adapt these ideas to suit their science needs."

Jill went on to explain how this particular resource did not expect a teacher to be rigid about what had to be taught for science in early childhood education. This enabled the teacher to move to where the children's interests were, and because of its early childhood appropriateness avoided the tendency to 'push down the curriculum'.

The Q & A section helped Jill with correct scientific facts so that alternative conceptions would be avoided. She thought the assessment ideas made tasks easier, and she enjoyed having a resource with a 'local' flavour. Overall, Jill found she could implement a good science program easily using the children's interests and *Planting the Seeds of Science*.