SPACE WEEK

Our Planet • Our Space • Our Time

Resource Book for Teachers
TOPIC: **The Sun and Shadows**

BCO The Space For Science

Ireland esero

Science Foundation Ireland sfi For what's next

World Space Week IRELAND

DPSM/ESERO Framework for Inquiry

Theme	The Sun & Shadows
Curriculum	SESE Science Strands: Energy & Forces Strand Unit: Light Curriculum Objectives: …discuss the differences between day and night, light and shade. …explore how shadows are formed. Skills Development: Observing, questioning, predicting, measuring, investigating and analysing. SESE Geography Strand: Natural environments Strand unit: Planet Earth in space Curriculum Objectives: …recognise the sun as a source of heat and light. …investigate shadows, directions and sunlight …investigate the relative lengths and directions of shadows and the intensity of sunlight at different times of the year

Engage

The Trigger	Wondering	Exploring
Pictures of a cloudy and sunny day (in the sunny day try to include shadows). My Furry Little Shadow (Sesame Street) https://www.youtube.com/watch?v=HCm7j-lZ-KQ	Why is it darker on a cloudy day? What does the Sun give us? Is the Sun important? If we had no Sun in the sky would it matter?	Go outside on a sunny day. Stand in a place where you can use chalk to mark out your shadow. Have children work in pairs to draw a shadow around each other. What does your shadow look like? Is it the exact shape of the person? Why? When can you see your shadow best of all? Do you always have a shadow? How do you think shadows are formed? Where is the light coming from?

Investigate: Where is the shadow?

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
Download ESERO Where is the shoadow? from here. What other shadows can you make on a sunny day in the school yard? If it is a cloudy day the children can make shadow puppets and draw the shadows of the puppets in the classroom. For older classes: How does your shadow change over the course of a day?	What will be the shape, size and colour of the shadows? Children should explain their understanding of shadows, not just guess.	Outside: Allow them play in school yard making shadows with their bodies or finding shadows made by other objects. Take time to examine their shapes, sizes, colour and the position of the Sun in relation to the object and its shadow. Inside: Set up a light source and use a variety of materials/blocks to make shadows. Observe the colour, shape and size of the shadows. Draw pictures of the shadows they observe. Measure the length and width of their shadows in units of cm. Record in a table or chart.	It is necessary that children understand that shadows are areas of complete darkness. Sometimes children draw faces on their shadows and colour them in with different colours other than black. Do not allow children to add faces to their shadows and all shadows should be coloured in using a black crayon only.

Considerations for inclusion

Words:
Shadow: A dark area where an object blocks light.

Standard and non-standard measurements of angles

DPSM/ESERO Framework for Inquiry

Investigate: Make a Sundial Activity

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
Download sundial activity from here. How can you design and make a sundial? (What will happen to a shadow from a shadow stick throughout the day?)	Children should apply their understanding of shadows throughout the day to design and make a stick sundial.	Children will have to find a suitable location (in sunlight for most of the day). Markings can be made each hour to show the time. Draw a graph to show how length of the stick's shadow changes over time.	How well does it keep time? Can the sundial be used all year long? What direction does the shadow point at mid-day? Can you use the sundial if you move it?

Take the Next Step

Applying Learning	Making Connections	Thoughtful Actions

Junior Classes:
Read the book 'What Makes a Shadow?' (Let's-Read-and-Find-Out Science 1) by Clyde Robert Bulla (Author), June Otani (Illustrator)
As a whole group ask them for ideas for a story entitled 'Me and my Shadow'. Ensure to incorporate the following words: Sun, Day, Night, Cloudy, Sunny, Summer and Winter. The children can draw pictures showing the different stages of the story including the Sun in their pictures.

Senior Classes:
What other ways are there to tell time?
Find out about when Ireland had a different time zone to other parts of Europe:
http://www.dublincity.ie/story/dublin-time

ESERO Activity: Night and Day in the World

Reflection	
	Did I meet my learning objectives? What went well, what would I change? Are the children moving on with their science skills? What questions worked very well? What questions didn't work well? Ask the children would they change anything or do anything differently. Are there cross curriculum opportunities here? What worked well? What further questions did students have?

INTRODUCTION

This section provides a summary of the key concepts about the Sun that we should teach to children for them to develop a deeper level of understanding about the Sun:

1. The Sun is a medium sized star producing light and heat energy.
2. Day and night happen because the Earth spins on its axis (rotation).
3. Shadows of still objects move during a sunny day because the Sun appears to travel in an arc across the sky.
4. We have the 12-month calendar due to the Earth moving around the Sun (revolution).
5. We have seasons due to the tilt of the Earth's axis as it orbits the Sun.
6. The Moon has phases as we see differing amounts of the side lit by the Sun.

Children's misunderstandings about the Solar System

The Earth lies at the centre of the solar system, with the Sun and the planets orbiting around it.
The Earth, Sun and Moon are of a similar size.
Rotation is the same as revolution.
The phenomenon of day and night is caused by the movement of the Earth around the Sun or the movement of the Sun around the Earth.
It is hotter in summer because the Earth is closer to the Sun.
We have longer days in summer because the Sun moves more slowly across the sky.
These misunderstandings can be addressed using diagrams, images, simulations and video clips of space, making models and role play.

Available from:
https://esero.ie/wp-content/uploads/2015/01/29_Where-is-the-shadow.pdf

Where is the shadow?
Light

29

time
70 minutes

learning outcomes
To:
- discover that light travels in a straight line; obstacles placed in the way of the light cause it to change direction
- know how a shadow is formed
- discover that the position of the shadow changes if the position of the light source changes
- discover that the length of the shadow changes if the position of the light source changes
- know that the shadow on Earth changes because the Earth moves

end product
- drawings of shadows in the playground

materials needed
- 12 pavement chalks
- 12 torches
- 12 square blocks
- vacuum cleaner hose
- ball
- sticker

Tip. For the activity **Drawing shadows** the sun needs to be shining.

Preparation
For the activity **Light travels in a straight line** you will need a vacuum cleaner hose and a torch.

Light travels in a straight line 15 min.
Take the torch and the vacuum cleaner hose. Ask one of the children to hold the end of the hose so that the hose forms a straight line. Shine the torch through the hose. Ask the children to raise their hands if they think they would be able to see the light if they looked through the other end of the hose. Encourage some children to look through the end of the hose. Can they see the light?
Now ask the child who is holding the hose to bend it a little. Shine the torch through the other end of the hose. Ask the children again to raise their hands if they still think they will be able to see the light if they look through the other end of the hose. Encourage some children to look through the end of the hose. Can they see light this time? The children then complete Task 1 on the worksheet.

Ask the children why it is that they can see the light when the vacuum cleaner hose is straight but not when it is bent. Explain that light always travels in a straight line.
That is why you cannot see the beam of light when the hose is bent.
Explain that when beams of light meet an object or a person, a shadow is formed. This is because the object or person gets in the way of the light. The light cannot pass through. Behind the object or the person there is no direct light, so you see a shadow.

Tip. Perform this activity early in the morning and late in the afternoon so you can see a clear difference in the shadows.

The children investigate what a shadow is, how it is formed, and whether a shadow changes during the day.

Drawing shadows 15 min.

Then take the children outside to the playground. Organise the children into pairs. Give each pair a stick of pavement chalk and explain that one child will draw and the other needs to stand still. Ask all the children who will be standing still to face in the same direction. The other children use the pavement chalk to draw around the shadows of their classmates. They should also draw around the feet of the children who are standing still. This will help them to remember where they were standing when they come back in a couple of hours. Draw the children's attention to the direction of the sunlight. Does this match the position of the shadow?

Shadow in the classroom 15 min.

Return to the classroom with the children and ask this question: 'What made your shadow?' The rays of light from the Sun were blocked by the children's bodies. So there was no direct sunlight behind the children. You could see a dark shadow. Explain that you cannot have a shadow without a source of light. Encourage the children to name some sources of light. Discuss briefly the difference between natural light sources (such as the Sun) and artificial light sources (such as electric lights).
Explain that they are now going to look at how the shadow of the block changes if you shine a torch on it from different directions. Give each pair a torch and a block. Ask one child from each pair to shine the torch on the block. Give the children a few minutes to observe what happens to the shadow if you shine the torch at the block from different directions, from directly above, diagonally etc.
Hand out the worksheets to the pairs of children. The drawing in Task 2 shows three ways of shining the torch on the block. Encourage the children to do this and draw the shadow that is formed each time.

When everyone is finished, discuss the completed worksheets. Ask questions such as: Does the shadow change its position if you shine the light from a different direction? Does the shadow get longer or shorter if you shine the light from a different direction?

Has the shadow changed? 10 minutes

Ask the children if they think the Sun has changed position while they have been indoors. Will the shadow be the same? Write their predictions on the board.
After sufficient time has elapsed between activities, return to the playground with the children in pairs. One child stands in the same position as before whilst the other draws with chalk around the shadow. Ask this question: 'Is the new shadow different? Is it longer or shorter than the first time? Is it in the same place?'

The Earth moves! 15 minutes

The children complete Task 3 on the worksheet in the classroom. Discuss the differences between the children's shadows. Was this what they expected? Ask why it is that the shadows have changed.
What happened to the Sun?
Explain that the Earth rotates on its axis. This is why you see the Sun in a different position each time in the playground. Demonstrate this using a ball (the Earth) and a torch (the Sun). Mark the ball with a sticker and say that this represents the place where they live. Turn the ball slowly round while shining the torch on it from the same direction. Show the children that the sticker constantly changes position relative to the Sun. This is why you see the Sun in a different position each time. Because the light always travels in a straight line and the Sun shines from a different position, the shadows look different every time, just as they discovered with the block.

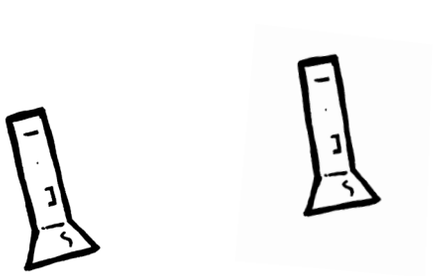
Where is the shadow?

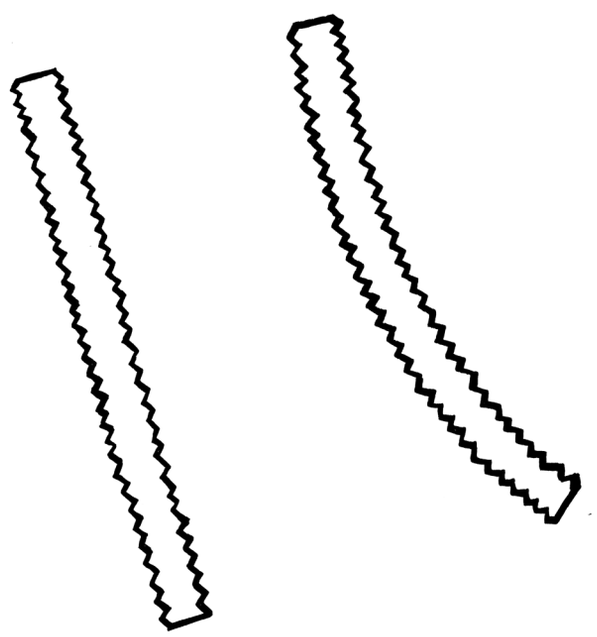
1 Light travels in a straight line

Here you can see two vacuum cleaner hoses.

How does the light travel through them?

Draw this!





draw **HERE** the light travelling through each hose

2 Shadow in the classroom

What do you need?

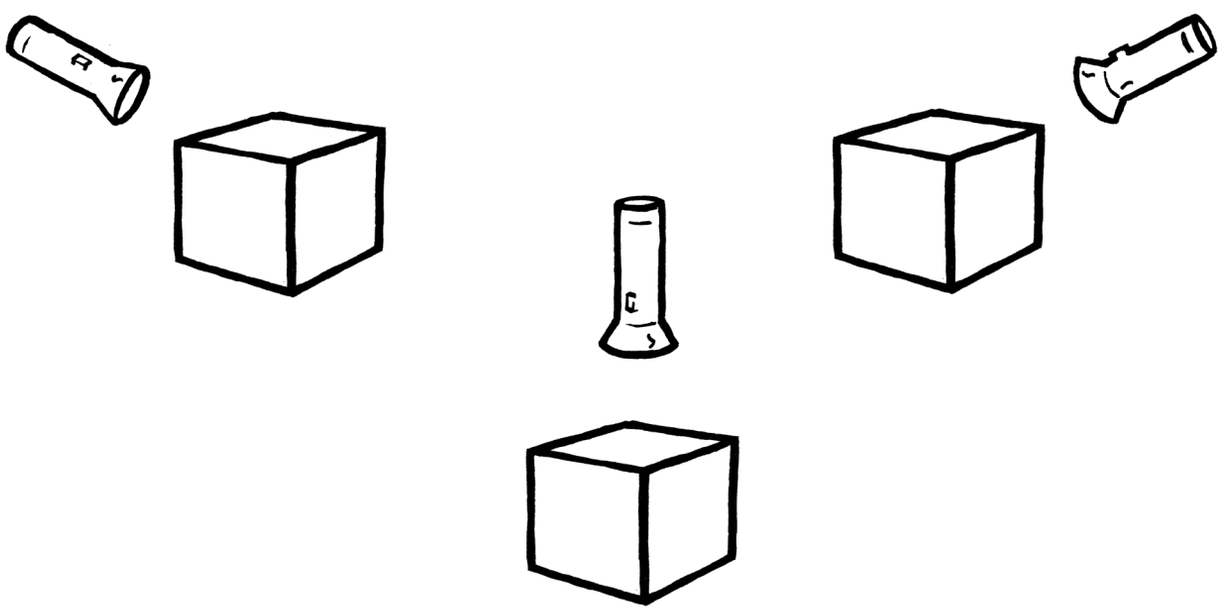
- torch
- pencil

What are you going to do?

1 Look at the drawings.

2 Hold your torch as shown in the drawing.

3 Draw the shadows you can see.



3 The Earth moves!

CIRCLE the correct answer

Circle the correct answer.

Did the shadow this morning look different from the shadow this afternoon?

yes / no

Is the second shadow longer than the first? **yes / no**

Is the second shadow in a different position from the first? **yes / no**

Available from:
https://esero.ie/wp-content/uploads/2015/01/52_The-sundial.pdf

The sundial
Use the Sun

52

time
55 minutes, spread across two days

learning outcomes
To:
- know that you can tell the time using a sundial
- tell the time using the Sun
- discover that long ago it was much more difficult to tell the time than it is today

end product
- a small sundial indoors
- a large sundial outdoors

materials needed
- large stones
- scissors
- glue
- a stick around 150 centimetres long
- a large protractor
- a marker pen
- a compass to tell where North is
- optional: extra small stones

Preparation
For the activity **The large sundial** you will need a playing field that is in sunlight most of the day.

What time is it? 5 min.
Ask if any of the children is wearing a watch. Why is it handy to have a watch? Explain that 600 years ago nobody had a watch. Ask how the people back then knew what time it was. Before the mechanical clock was invented, people sometimes used the sun to tell the time. They did this using a sundial.

Have any children ever seen a sundial? Do they know how it works? Explain that a sundial has a stick or pointer that makes a shadow. This is called the gnomon. It is important that in the Northern hemisphere the gnomon always points North, or you will not be able to read the sundial. Explain that the Earth turns on its axis. This means that the position of the Sun with regard to the Earth is always changing. If necessary demonstrate this using a torch and an orange. Explain that the shadow of an object also changes as the Earth rotates. The sundial uses this fact. By looking at the position of the shadow of the gnomon on the sundial, you can tell what time it is.

Tip.
Long ago people also used other devices to tell the time, such as the hourglass. Lesson 50 shows how to make an hourglass and use it to tell the time.

The children make two sundials.

Make a sundial 20 min.

Hand out scissors, glue and the activity sheet. The children complete Task 1 on the worksheet.

Important: to calculate the angle for the gnomon, you need to know the latitude of your town. You can look this up in an atlas or on the internet. For example the latitude of Cork is 52 degrees N, so the angle needed for a sundial in London is 51 degrees. The instructions are on the worksheet. When their sundial is ready they should put it somewhere with the arrow facing South.

The children read the time shown by the sundial. Can they see what time it is? The children complete Task 1 on the worksheet. Discuss the tasks. Come to the conclusion that today we always know exactly what time it is because there are so many clocks around us. Long ago, when there weren't any watches and clocks, it was much more difficult to tell the time. And of course they could not use a sundial at night!

The large sundial at least 30 min.

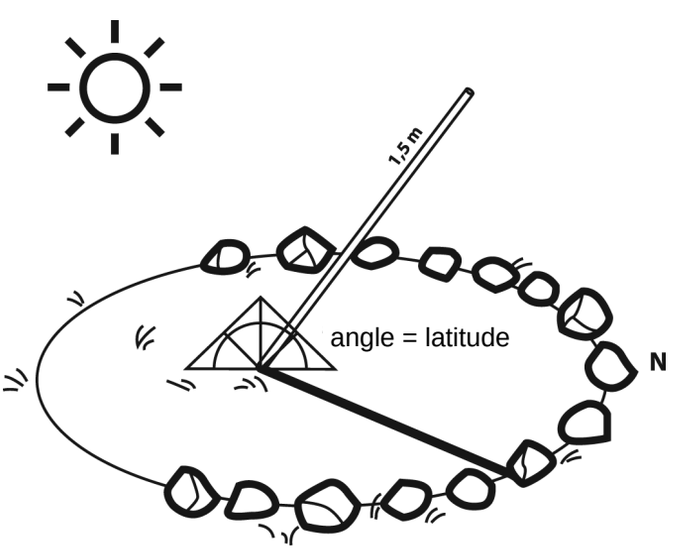
Make a large sundial with the children. Take the children outside to a location where the sun shines most of the day. Mark the direction of North, using a compass if necessary.

Stand the large protractor upright on its long side in the grass. Use it to measure the correct angle to the ground, as described above. Stick the stick firmly in the ground at the chosen angle, facing North. See the picture for how this should be done.

Every hour the children place a large stone on the ground where the shadow of the stick falls. One of the children uses the marker pen to write the number of the hour on the stone. You can use the smaller stones to mark the quarter and half hours.

If you don't want to take the children outside every hour, you can just place two stone markers, one in the morning for example at 9.00) and one in the afternoon (for example at 14.00). Of course your sundial will be less accurate.

To finish the sundial, the rest of the day after school-time needs to be divided using the stones. In the example shown here, five hours have passed and so the time in between needs to be divided into five. Encourage the children to write the numbers of the hours on the stones and place them in the correct position. The next day, take the children outside to see if they can read what time it is. How accurate is their sundial?



Good to know.

When the Sun is due South and the shadow is pointing to the North, it is noon. That means it is exactly 12 o'clock in solar time. Solar time is not always exactly the same as the time shown on your watch. That is because the time we use today is not based on the sun's actual position in the sky.

The sundial

You are going to make a sundial.

1 Make a sundial

What do you need?

• scissors

What do you need to do?

1. Cut out the square on the cut-out sheet.
2. Cut the gnomon at the correct angle for where you live.
3. Fold the gnomon on the dotted lines.
4. Fold the dotted line upwards on the dial base.
5. Paste the lettered tabs A, B, C and D onto the dial base.
6. Place the sundial on the ground with the arrow pointing South.

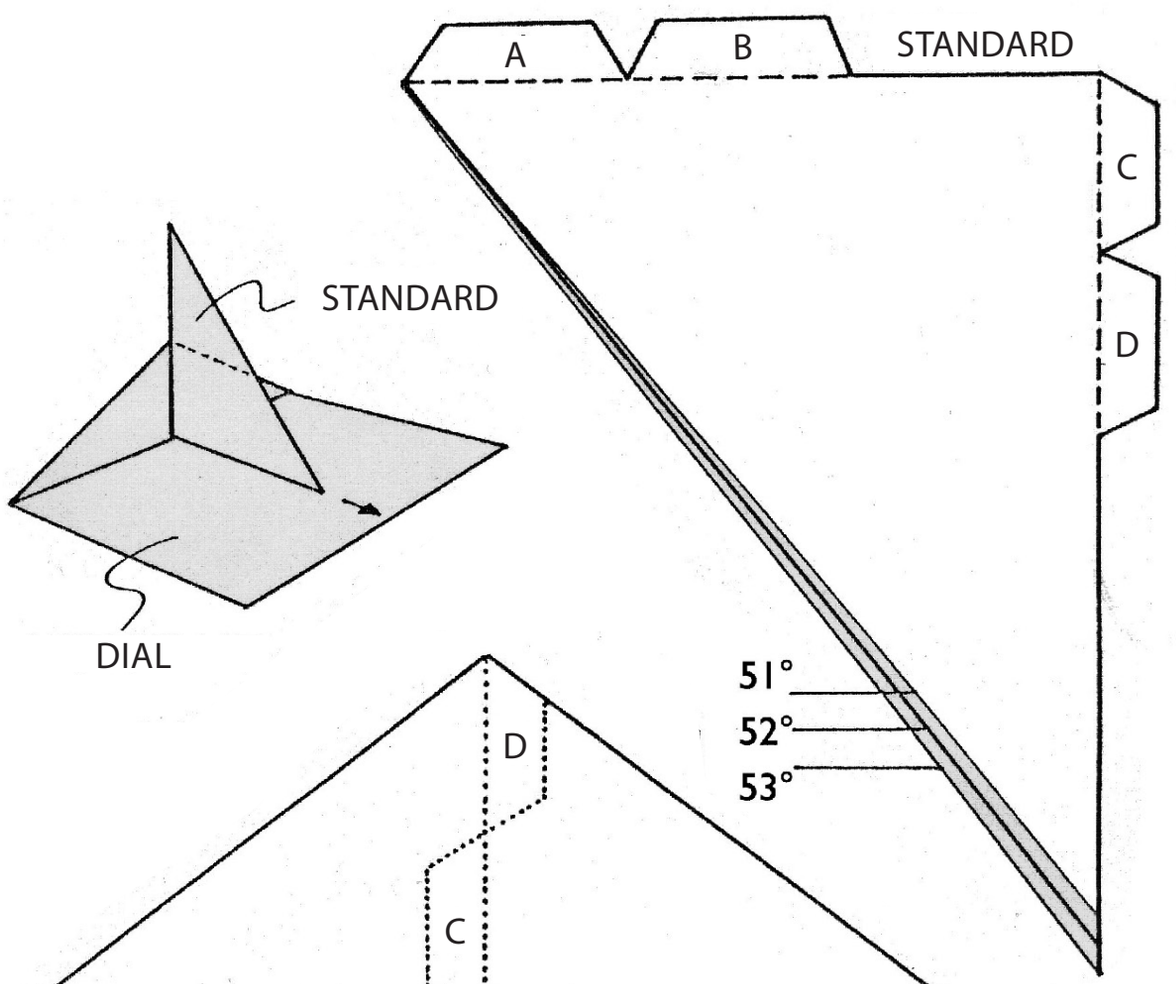
a What time does your sundial show?

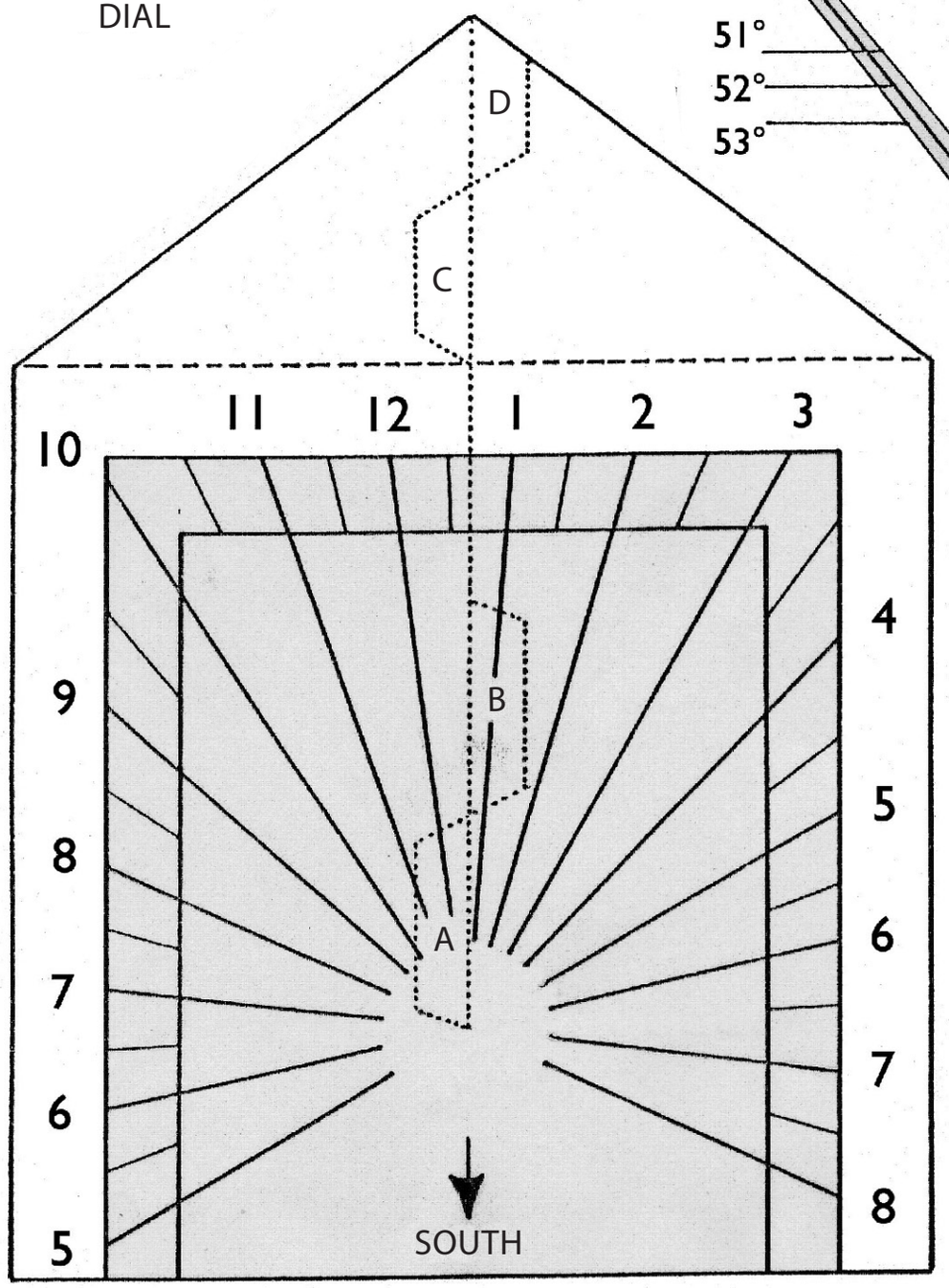
_____ o'clock

b What time does your watch show?

_____ o'clock

c Why is it handy to have a watch?


A
B
STANDARD
C
D
STANDARD
DIAL
51°
52°
53°


D
C
11
12
1
2
3
10
9
8
7
6
5
4
5
6
7
8
B
A
SOUTH

DIAL

DPSM/ESERO

Framework for Inquiry - Promoting Inclusion

SPECIAL EDUCATION SUPPORT SERVICE
building on ability

When planning science activities for students with Special Educational Needs (SEN), a number of issues need to be considered. Careful planning for inclusion using the framework for inquiry should aim to engage students in science with real purpose. Potential areas of difficulty are identified below along with suggested strategies. This list is not exhaustive, further strategies are available in the Guidelines for Teachers of Students with General Learning Disabilities (NCCA, 2007).

ENGAGE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Delayed language development/poor vocabulary/concepts	• Teach the language of science demonstrating meaning and/or using visual aids (material, property, strong, weak, textured, dimpled, absorbent, force, gravity). • Have the student demonstrate scientific phenomena, for example gravity —using 'give me, show me, make me,' as much as possible. • Assist the student in expressing ideas through scaffolding, verbalising a demonstration, modelling. • Use outdoor play to develop concepts.

INVESTIGATE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Fear of failure/poor self-esteem/fear of taking risks	• Model the speculation of a range of answers/ideas. • Repeat and record suggestions from the students and refer back to them.
Understanding Time and Chronology	• Practice recording the passing of time, establish classroom routines that draw the students' attention to the measurement of time. • Teach and practice the language of time.
Fine/Gross Motor Difficulties	• Allow time to practice handling new equipment. • Allow additional time for drawing diagrams, making models etc. • Give students the option to explain work orally or in another format.
Short Term Memory	• Provide the student with visual clues/symbols which can be used to remind him/her of various stages of the investigation.

TAKE THE NEXT STEP

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Developing Ideas	• Keep ideas as simple as possible, use visuals as a reminder of earlier ideas. • Discuss ideas with the whole group. • Repeat and record suggestions from students and refer back to them. • Encourage work in small group and in pairs.
Communicating Ideas	• Ask students to describe observations verbally or nonverbally using an increasing vocabulary. • Display findings from investigations; sing, do drawings or take pictures. • Use ICT: simple written or word-processed accounts taking photographs, making video recordings of an investigation.

REFLECTION

- Did I take into account the individual learning needs of my students with SEN? What differentiation strategies worked well?
- Did I ensure that the lesson content was clear and that the materials used were appropriate?
- Was I aware of the pace at which students worked and the physical effort required?
- Are there cross curriculum opportunities here?
- Are the students moving on with their skills? Did the students enjoy the activity?

More strategies, resources and support available at **www.sess.ie**

Discover Primary Science and Maths
www.primaryscience.ie

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Ireland esero

Curriculum Links

English / Irish

- Read Aloud: There are many picture books available on the concept of the Sun for example:
  - ❖ Sun (Whatever the Weather) by Carol Thompson.
  - ❖ Sunny Day (Usborne Picture Books) By Anna Milbourne (Author), Elena Temporin (Illustrator).
  - ❖ What Makes a Shadow? (Let's-Read-and-Find-Out Science 1) by Clyde Robert Bulla (Author), June Otani (Illustrator).
  - ❖ The Sun Is My Favorite Star by Frank Asch.
- As a whole group ask them for ideas for a story entitled 'Me and My Shadow.' Ensure to incorporate the following words: Sun, Day, Night, Cloudy, Sunny, Summer and Winter. The children can draw pictures showing the different stages of the story including the Sun in their pictures.

Arts Education - Drama

- Show video clips of shadow theaters from YouTube.
- Develop the ability to co-operate and communicate in helping to design: Shadow Theatre and a drama about the Sun, Moon and Stars.

Arts Education - Visual Arts

- Make shadow puppets (discuss lines, shape, form and tone)
- Use crayons/paint in yellow, orange and red to create pictures of the Sun.

SESE History

- The story of Icarus and his flight to the Sun (is this possible?)