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Scorching swings and slides • Lesson 1 •

**Lesson 1**

**Launch**

**Year 3**

What happens to playground equipment when it’s hot?

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# Lesson overview

Students are introduced to the core concept being explored—heat—through the context of playground equipment on a sunny day.

## Learning Goals

Students will:

* demonstrate curiosity and ask questions about the impact of heat on their bodies and objects around them.
* identify heat sources.
* identify that heat can change the temperature of their bodies and objects around them.

Students will represent their understanding as they:

* participate in and contribute to discussions, using talk to share information, experiences and ideas about heat.
* contribute to the creation and organisation of ideas in an ideas map.

## Assessment advice

In the Launch phase, assessment is diagnostic.

Take note of:

* What, if anything, have students identified as sources of heat?
	+ For example, sun, people, surfaces after they’ve been heated by the sun.
* Have they shown differing levels of heat?
	+ For example, something in direct sun being very hot, and something in shade being less hot.
* What vocabulary have they used?
* Have they used arrows to show heat transfer?
	+ Take note of any students who have for Lesson 2.

## List of materials

**Whole class**

* Class science journal (hard-copy or digital)
* Materials to create a word-wall
* **Thermal images Resource sheet**

**Each student**

* Individual science journal (digital or hard-copy)

NOTE: If you have decided to ask students to build prototypes/models during the Act phase, you might like to ask them to begin collecting materials for this purpose. Materials should be re-used and recyclable. Examples include boxes (tissue, cereal, shoe, etc.) and other cardboard products, foil and trays made of foil, bottle tops and jar lids, skewers paddle pop sticks, etc.

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Experience and empathise | 10 minutes | Whole class |
| Elicit | 15 minutes | Whole class |
| Anchor and Connect | 15 minutes | Whole class, Individual |
| Question | 15 minutes | Whole class |

# Launch

## Experience and empathise • Recall playground experiences

Students role-play or imagine a time they used the playground when it was a hot day or a cold day. The role-play could be a static/statue play or a time limited role-play.

Encourage students to consider all aspects of their playground experience, including the equipment used, weather conditions etc.

Tap into students’ role-plays to determine what is happening in each scene.

**Potential discussion prompts**

* *What equipment are you ‘using’ in the playground?*
* *What is the weather like in your scene?*
* *What is the playground equipment made of?*

Repeat activity as required/preferred.

## Elicit • Prior knowledge about playgrounds and heat

Discuss students' experiences of playing on a playground on a hot day, eliciting their prior knowledge and ideas about the materials found in playgrounds, how the heat affects them and the surfaces and equipment around them, the potential dangers of this, and what they might do to stay safe.

**Potential discussion prompts**

* *What is it like playing at an outdoor playground on a hot day?*
* *Where does the heat come from? (the heat source)*
* *What happens to your body when you play outside on a hot day?*
* *What happens to the play equipment?*
	+ If required, draw out the idea that the equipment often gets very hot—too hot to touch and play on.
* *Why might this happen?*
* *What are the potential dangers of playing on a hot day?*
* *What safety precautions do you take when playing on a hot day?*

Record students’

 ideas and prior knowledge on a mind map in the class science journal. Use the categories suggested in the work sample below, as they will be referred to in subsequent lessons. Add further categories as appropriate.

**Optional:** Discuss what a science journal is, and how and why scientists keep them.

## Anchor and Connect• Viewing thermal images

Introduce the context of the unit: learning about heat, the effect it has on a playground and its equipment, and how playgrounds might be designed to stop them getting too hot. At the end of the sequence, students will use this learning to make recommendations about effective playground design.

Look at a photograph of a playground featuring play equipment. Discuss what might happen to the temperature of the surfaces and objects on a hot, sunny day.

**Potential discussion prompts**

* *Which surfaces/objects do you think will get the hottest on a sunny day?*
* *Which surfaces/objects are likely to be cooler?*
* *Why do you think that?*
* *What might happen to the water in a bottle if you left it on the side of the play area?*

Show and discuss the thermal images of playgrounds on sunny days in **Thermal images Resource sheet.**

**Potential discussion prompts**

* *What do the colours on the image mean in terms of how hot each object/area is?*
* *Why do you think they are hot?*
* *Why are some areas/objects not as hot as others?*

In their individual science journals, students represent what they think about the movement of heat during a hot, sunny day on a playground. Students might use pictures, symbols, words and colours to show where the heat is coming from, and where it is moving to.

**Optional:** Share and discuss student representations as a class, making notes on a page titled ‘Our current ideas’ or similar on a page in the class science journal.

## Question • Asking questions about heat

Students generate any questions they have about heat, its impact on objects (particularly those found in playgrounds), how we might measure how hot things are, and how we might stop objects from getting too hot.

Record all student questions to refer back to during the course of the unit.

Group together similar questions and ask students which ones they think would be important to answer first.

**Reflect on the lesson**

You might:

* begin a class word wall related to heat. This can also be done throughout the lesson, and referred back to it during this reflection, re-defining terms as appropriate.
	+ At this stage, the word wall should only include words that students have offered themselves during the lesson. The word wall is added to in subsequent lessons. Thus, new vocabulary is introduced in context.

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Scorching swings and slides • Lesson 2 • What’s hot?

**lesson 2**

**inquirE**

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# Lesson overview

Students participate in hands-on experiences to identify and categorise sources of heat.

## Key learning goals

Students will:

* identify heat sources.
* categorise objects as being a source of heat themselves, or as being warmed by something else.
* use data tables to identify relationships and patterns between objects that release heat (heat sources).

Students will represent their understanding as they:

* contribute to the joint construction of data tables.
* use oral, written and visual language to record and discuss their observations of heat sources.
* engage in discussion to compare ideas about heat sources.

## Assessment advice

In this lesson, assessment is formative.

Feedback might focus on:

* Have students correctly identified objects that release heat (heat sources), and those that do not?
* Are students reasoning and making justifications based on the evidence they have collected?
* Can students identify similarities between objects that release heat?

## List of materials

**Whole class**

* Class science journal (hard-copy or digital)
* Demonstration copy of **What's hot Resource sheet** (or create your own)
* Candle and a means to light it
* Hot water bottle, and warm water to fill it

**Safety notes**

**Candles:** Extreme caution must be taken when using lit candles in a classroom. Consider setting up an exclusion zone to ensure students do not come too close to the lit candle. Under no circumstances should students touch the flame of the candle. The heat of the candle will be most noticeable above the flame rather than beside the flame. Special care should be taken above the flame.

**Hot water:** Any hot water used in a classroom should be at or below 43°C. Any hot water bottle/heat pack etc. should never be opened or pierced with a sharp object. They should always be covered with a layer of insulating material and should never be placed directly onto the body—particularly with children, who may have a reduced sensation to heat.

**Each student**

**Year 3**

* Individual science journal (hard-copy or digital)
* **What's hot Resource sheet** (or create their own)

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Re-orient | 5 minutes | Whole class |
| Question | 5 minutes | Whole class |
| Investigate | 15 minutes | Whole class |
| Investigate | 15 minutes | Collaborative teams |
| Integrate | 10 minutes | Whole class |

# Inquire

## Re-orient

Recall the previous lesson, focusing on the discussion of the source of the heat on a sunny day, and the objects students named that get warm/hot in the sun.

If not already done so in Lesson 1, remind students that they will be learning about heat, how it moves, and its impact on playgrounds and their equipment, and how we can stop them from getting too hot. Brainstorm a list of student questions on this.

## Question • What objects are hot?

Refer back to the list of student questions about playgrounds and heat. Draw on a student question (if one has been asked) as a jumping off point for the following investigation about objects that release heat. For example, *What things are hot?*

If students haven’t asked a question like this themselves, add it to the list of class questions and discuss how answering this question will be the centre of today’s investigation.

## Investigate • Asking questions about heat

Using one or both of the demonstrations described below, explore how some objects, such as a candle, can ‘make their own heat’, whilst others, such as a hot water bottle, only feel warm when they are heated by another source.

Discuss how to safely identify if objects are warm or hot to the touch: by moving your hand slowly towards the object, your hand can be quickly withdrawn as soon as you feel it becoming hot.

Model how to record information during the investigation using the **What's hot Resource sheet** that students will use later in the lesson.



**Demonstration 1: A candle**

Allow students to touch, observe and discuss an unlit candle.

* *Did you expect it to be hot? Why/Why not?*
* *What does it need in order to be hot? Why?*

Light the candle and determine how hot it is, and if it is a source of heat.

* *Where is the heat coming from? The candle or the flame?*
	+ The heat is coming from the flame/burning wax.
* *How do you know?*

We can see it burning. The base of the candle is not hot.

**Demonstration 2: A hot water bottle**

Allow students to touch, observe and discuss the empty hot water bottle.

* *What is this and what it is used for?*
* *What does it need in order to be hot? Why?*

Fill the hot water bottle with warm water and close it tightly.

Allow students to feel it again and discuss what has changed.

* *Is the hot water bottle the source of the heat, or is it heated by something else?*
	+ The hot water bottle is heated by something else.
* *How do you know?*

The hot water is heating the bottle. The water was heated before it was poured into the bottle.

Students draw a diagram to represent where the heat was moving from and to in the demonstrations. Organise a gallery walk so that students can discuss the features in the diagrams that best demonstrate heat transfer, and draw their attention to the diagrams that have used arrows.

Discuss why arrows are a clear way of showing the movement of heat: they show clearly where the heat is coming from, the direction it’s moving in, and what objects it might be heating.

**Potential discussion prompts**

* *Which diagrams showed the movement of heat the most clearly?*
* *Why do you think that?*
* *Why do you think arrows can be helpful to show the movement of heat?*
* *What other movements could we represent with arrows?*
* *What about different sized arrows? Long ones vs short ones, or thick ones vs thin ones—what might they represent?*

## Investigate • Recording data on what’s hot

Students work in collaborative learning teams to list objects that might release heat, recording the information on their **What's hot Resource sheet**.
They then feel these objects and decide if they feel ‘normal’ (i.e. are not releasing heat), warm or hot. Encourage them to explore the classroom and the school grounds. They might also list items at home and add the results of their investigation to the data table at a later stage.

Care should be taken when touching objects to avoid burns. You might also like to ask students to note what part of an object felt warm, or if it felt the same temperature all over. For example, a laptop screen may feel slightly warm to the touch, but underneath closer to the battery may feel warmer.

## Integrate • Sources of heat

Each team shares the name of an object they have examined that released heat and whether they think it is a heat source, providing a reason for their thinking. As each team shares their object, it is added to the appropriate column of a modified T-chart in the class science journal. Check to see if other teams agree and why or why not.

**Potential discussion prompts**

* *What other heat sources can you think of?*
* *What might you say about the objects that make their own heat? What is similar about them? Different?*
* *What might you say about the objects that are heated by something else? What is similar about them? Different?*

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| **Heat source** | **Not a heat source** | **How do we know?** |
| Hairdryer |  | The hairdryer only gets hot when you turn it on. There are metal bits inside that get hot when it’s turned on. |
|  | Playground surface | The playground doesn’t have any way of making heat by itself—there’s no motor or heater. It is not plugged in. It gets its heat from the sun. On a cloudy day it is not hot.  |

**Sample student responses**

**Reflect on the lesson**

You might:

* review the list of questions in the class science journal. Determine which questions have been answered during the session and add any new questions that have arisen.
* reflect on how this learning is relevant to learning about the impact of heat on a playground.
	+ *What are the sources of heat in a playground?*
	+ *Do these things make their own heat, or are they heated by something else?*
	+ *What role does the sun play as a source of heat in a playground?*
* add to the class word wall of vocabulary related to heat.
* re-examine the intended learning goals for the lesson and consider how they were achieved.
* discuss how students were thinking and working like scientists during the lesson. Focus on how they collaborated to investigate sources of heat, how they recorded their data in tables, and how this made it easier for them to find patterns.

**Scorching swings and slides • Lesson 3 •**

**Year 3**

**lesson 3**

**INQUIRE**

How does heat move?

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# Lesson overview

Students participate in hands-on experiences to explore heat moving from one object to another.

## Key learning goals

Students will:

* identify objects that are not a source of heat.
* ask questions and make predictions about the movement of heat.
* investigate to find the answer to questions about the movement of heat.
* explain the movement of heat between an object that does not produce its own heat and a heat source.

Students will represent their understanding as they:

* create labelled diagrams which include arrows to show the movement of heat.
* use questions to agree and disagree with teams’ claims.

## Assessment advice

In this lesson, assessment is formative.

Feedback might focus on:

* Do students’ labelled diagrams include the required features? A [quality matrix](https://primaryconnections.org.au/pedagogical-tools/learning-through-inquiry-tools/providing-formative-feedback) can be used to guide the feedback process.
* Pay particular attention to students who may have demonstrated alternative conceptions in Lesson 1, and any students still demonstrating alternative conceptions.
* Do students use evidence to support their claims? Do they use evidence to respond to questions from other students/teams?
* What do students' labelled diagrams tell you about their developing understanding of the movement of heat? Are arrows accurately showing the direction of the movement of heat?

## List of materials

**Whole class**

* Class science journal (hard-copy or digital)
* Metal spoon
* Wooden spoon
* A heat source such as a wheat heat bag, a hot pack, or a hot water bottle and warm water to fill it
* Demonstration copy of **Spoon temperature investigation Resource sheet** (or create your own)

**Safety notes**

**Hot water:** Any hot water used in a classroom should be at or below 43°C. Any hot water bottle/heat pack etc. should never be opened or pierced with a sharp object. They should always be covered with a layer of insulating material and should never be placed directly onto the body—particularly with children, who may have a reduced sensation to heat.

**Each group**

* 3 metal spoons
* 3 wooden spoons

**Note:** If you are unable to source enough spoons for each group to have 3 of each kind, plan to allow time between the testing of each heat source. By allowing time for the spoons to return to ambient temperature before the next heat source is tested, the test will remain fair and the data valid.

**Each student**

* Individual science journal (hard-copy or digital)
* **Spoon temperature investigation Resource sheet** (or create their own)

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Re-orient | 5 minutes | Whole class |
| Question | 5 minutes | Whole class |
| Investigate | 15 minutes | Whole class |
| Integrate | 10 minutes | Whole class |
| Investigate | 20 minutes | Collaborative teams, Individual |
| Integrate | 15 minutes | Whole class |

# Inquire

## Re-orient

Review the previous lesson, focusing on the list of items that were heated by other sources. Discuss where the heat came from.

**Ask students:** *Do you think that most things around us release heat?*

Use examples of objects in the classroom to build a consensus that whilst many objects/substances might get warm when near a heat source, the heat originates from another source.

## Question • How do objects get warm?

Refer back to the list of student questions recorded in the Launch phase. Draw on a student question (if one has been asked) as a jumping off point for the following investigation about how objects get warmer. For example, *How do most objects/substances get warm?*

If students haven’t asked a question like this themselves, add it to the list of class questions and discuss how answering this question will be the centre of today’s investigation.

## Investigate • Heating metal and wood

Examine and discuss the metal and wooden spoons that will be used in today’s investigation.

Determine through questioning and discussion why the results of an investigation into these spoons will be relevant to playgrounds/playground equipment: because metal and wood are often used to make playground equipment. Refer to the mind map created in Lesson 1 where students identified the materials found in playgrounds.

**Potential discussion prompts**

* *What is a spoon typically used for?*
* *What different types of spoons are there?*
* *What materials might they be made of?*
* *What materials are* these *spoons made of?*
* *Why would investigating spoons made out of these materials be helpful for our learning about the impact of heat in a playground?*
* *Is a spoon a source of heat?*
* *What do you think about the temperature of the metal spoon? What about the temperature of the wooden spoon? Why do you think that?*
* *How might you explain why the spoons feel like they are different temperatures?*
* *How might we change the temperature of the spoons?*

Examine and discuss a heat source such as a hot water bottle, wheat heat bag or hot pack.

**Potential discussion prompts**

* *What is a heat pack/hot water bottle typically used for?*
* *What are they made of?*
* *Where do they get their heat?*
* *How quickly do they lose their heat after warming?*

Model completing the Predict and Reason sections of the Predict, Reason, Observe, Explain strategy, to support students to predict what they think will happen to the metal spoon when it is placed on/in the heat source.

**Optional:** Use a radar thermometer to take the temperature of the spoons before being placed on/in the heat source.

Place the spoons on/in the heat source for 1 minute.

**Optional:** Use a radar thermometer to take the temperature of the spoons after they’ve been in contact with the heat source. Don’t reveal the temperature to the students until *after* they have observed the spoon themselves.

Students feel and describe the spoons again: focusing on if the amount of heat released by the spoons has changed, by how much, and how they think that happened.

**Potential discussion prompts**

* *How has the temperature of the spoons changed?*
* *Does one feel hotter than the other? By how much? Why do you think that is?*
* (After revealing the temperature of the spoons, if this was measured) *Is the metal spoon really much hotter than the wooden spoon, even though it feels much hotter? Why do you think that?*

## Integrate • Representing the movement of heat

Create a whole-class labelled diagram showing a spoon on the heat source in the class science journal. Include arrows to show the heat going from the source (base of arrow) to the spoon (arrowhead). Remind students of the diagrams they created in the previous lesson, and how arrows are used to show the direction of heat transfer.

Alternatively, have students create their own labelled diagrams in their science journals.

Work sample of a labelled diagram

Discuss the initial temperature of the metal spoon, and if/why students thought it felt ‘cold’ compared to the wooden spoon. Discuss where they think the heat is moving to and from when they hold something made out of metal, and how they would use arrows in a diagram if they were to represent that.

**Potential discussion prompts**

* *What did the temperature of the metal spoon feel like before we warmed it up?*
* *Why do you think it felt cold?*
* *If you kept holding the metal spoon, what would happen?*
* *Where is the heat coming from in that situation?*
* *What would that look like as a diagram? Where would the arrows be pointing?*

## Investigate • Other ways of heating

Students work in collaborative teams to investigate three other ways they might heat metal and wooden spoons. Brainstorm other potential ways of heating the spoons with students, for example: putting it out in the sun, holding it next to a heater, putting it in warm water, putting it on hot sand, holding it over a candle, blowing it with a hairdryer, or putting it close to your skin for body heat.

You might consider having a metal and wooden spoon set aside in the classroom to use as ‘control’ spoons for comparison. Discuss why having a control might be helpful.

Teams will place their spoons in their chosen locations for two minutes, before using their senses to determine if they think each spoon is now warm or hot.

HIGH TECH: Use a digital/radar thermometer to measure the temperature of the spoon before and after.

Model how to accurately use the timing device.

Form teams and allow students time to complete the activity.

Using the **Spoon temperature investigation Resource sheet**, students record their thinking before, during and after the investigation using the Predict, Reason, Observe, Explain (PROE) strategy. Students might include diagrams as part of their observations.

## Integrate • Heat claims

Teams present their findings.

**Potential discussion prompts**

* *Which heat source warmed the spoons the most? Why do you think it did so?*
* *Did the spoon need to touch the heat source? Why do you think that?*
	+ In the example of putting the spoon in the sun, students might think that the spoons were not in contact with the heat source because they were ‘not touching the sun’. However, through questioning, try to draw out the idea that the spoons were in fact ‘touching’ the air and ground surface warmed by the sun, as well as absorbing the sun’s rays—therefore ‘touching’ them as well.
* *How does the heat move to the spoons?*
* *What do you think would happen to the temperature of the spoons if we left it in contact with the heat source for longer than two minutes? Is this the same for every heat source?*
	+ For example, discuss what would happen to ‘hot’ water over time, and if it would continue to heat the spoon, as opposed to the spoon being put in the sun, or warmed with a hairdryer continuously.
* *What might happen to the temperature of the spoons if we put them in the fridge? The freezer? Wrapped them in a blanket?*
* *How did you know that the temperature of the spoon changed?*
* *Will the spoon get hotter than the source? Why or why not?*
* *Will the spoon stay hot? Why/why not?*
* *What will happen to the heat?*
* *How did you decide the temperature of the spoon?*
* *Do you think the way we measured the temperature of the spoon was accurate? Why/why not?*
* *How might we make this as accurate as possible?*
* *How do we accurately measure changes in temperature?*

The audience is encouraged to agree or disagree with the findings, or to question the presenting team using [science question starters](https://primaryconnections.org.au/pedagogical-tools/learning-through-inquiry-tools/facilitating-evidence-based-discussions).

Students add a labelled/annotated diagram to their Explain section of their PROE charts, using arrows to show the movement of heat between the heat source and the object that was heated.

**Reflect on the lesson**

You might:

* review the list of questions in the class science journal. Determine which questions have been answered during the session and add any new questions that have arisen.
* reflect on how this learning will be relevant to the design of the playground/piece of equipment.
	+ *How do most objects get warm?*
		- They come into contact with a heat source—something warmer than them.
	+ *Given what happened to the metal spoon, what is likely to happen to metal objects in a playground on a warm day? And what about wooden objects, given what happened to the wooden spoon?*
	+ *Will the metal objects stay hot? Why/why not?*
	+ *Will the wooden objects stay hot? Why/why not?*
	+ *What will happen to the heat?*
	+ *What does this do to the environment/air temperature of the playground?*
* add to the class word wall.
* re-examine and consider if/how the intended learning goals were achieved.
* discuss how students were thinking and working like scientists during the lesson. Focus on how they asked questions about how to heat a metal/ wooden spoons, made predictions, and then tested these predictions to find answers.
* discuss the importance of sharing and debating evidence.

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**Year 3**

Scorching swings and slides • Lesson 4 •

**lesson 4**

**inquire**

Which ground is best for a playground?

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# Lesson overview

Students plan and conduct an investigation to compare the conductivity of different materials, and determine which type of ground surface might be most suitable for use in a playground.

## Key learning goals

Students will:

* conduct an investigation about the transfer of heat to different surfaces.
* make predictions and claims about what happens to the temperature of different surfaces when warmed by the heat of the sun.
* observe, record and interpret the results of their investigation.
* identify the differences in conductivity of materials.

Students will represent their understanding as they:

* use oral, written and visual language to record and discuss investigation results.
* record data in a table.
* discuss findings and compare results.

## Assessment advice

In this lesson, assessment is formative.

Feedback might focus on:

* the claims students make about the temperature of the ground surfaces. Have groups made similar or different claims? Why might that be?
* if students’ claims are supported by the evidence they have collected.
* how students relate their learning to the context of playground design. What ground surface would they choose and is that choice supported by evidence?

## List of materials

**Whole class**

* Class science journal (hard-copy or digital)
* Demonstration copy of **Ground surface temperature investigation Resource sheet** (or create your own)

**Each group**

* Instruments to measure temperature, for example glass or radar/surface area thermometers (if not possible to source, students can use a ‘hotness scale’ determined by touch)
* Different ground surfaces that are in direct sunlight

**Each student**

* Individual science journal (digital or hard-copy)
* **Ground surface temperature investigation Resource sheet** (or create their own)

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Re-orient | 5 minutes | Whole class |
| Question | 10 minutes | Whole class |
| Investigate | 15 minutes | Collaborative teams, Whole class |
| Integrate | 15 minutes | Whole class |

# Inquire

## Re-orient

Review the previous lesson. Focus on how the heat from the heat source was transferred to the metal spoon, and how the spoon did not remain hot when it was no longer in contact with the heat source.

## Question • What care the different ground surfaces?

Refer back to the section of the mind map created in the Launch phase where students identified the kinds of ground/floor surfaces found in a playground.

**Potential discussion prompts**

* *What type of ground/floor surfaces do we find in playgrounds?*
	+ grass, asphalt, wood chips, sand, exposed dirt, soft-fall, astroturf etc.
* *What do you think will happen to these surfaces when they are exposed to the sun (heat source) on a hot, sunny day?*
* *Why do you think this will happen?*
* *Which surface do you think will become the hottest and why?*
* *How can we determine how hot each surface gets?*

By referring back to the student questions asked during the Launch phase, and through questioning and discussion, determine that, in learning about how heat impacts on playgrounds, it would be advantageous to know which of the common ground surfaces found in playgrounds heat up the most in the sun.

## Investigate • Which ground surface gets hottest?

Determine which ground surfaces students can reasonably test in your school environment.

Discuss what would be the best way to gather data to determine which surface is going to be the hottest throughout the day, and how students might record this data: taking a measure of temperature at selected intervals over the course of the day and recording in a data table.

Decide how students will take these measurements:

* NO TECH: Using a hotness scale determined by each group. You will need to discuss how to keep this manner of determining temperature as fair as possible.
* LOW TECH: Use a glass thermometer, placed on the surface for a specific time period before measurements are read.
* HIGH TECH: Use a radar/surface temperature thermometer.

Discuss if it would be fair to measure (for example) the temperature of grass under a tree, as opposed to asphalt that has been in the full sun. Determine that it is most fair/accurate to take temperature measurements of these surfaces in full sun to find out which one gets the hottest in the sun.

The height off the ground can also impact the measured temperature. Discuss how this could be made consistent in their measurements. You might [use a variables grid](/supporting-students-write-questions-investigation) to model the identification of variables, and how selecting one to change whilst leaving the rest the same helps to keep an investigation fair.

In collaborative teams, students select three surfaces for which they will take temperatures at intervals throughout the day. How often these temperatures are taken is dependent on teacher preference, resources available and the needs of the students. However, it is recommended that temperatures are taken at least three times during the day—in the morning, around midday, and in the afternoon.

Students record their data in a data table.

After the final temperature measurements have been taken, allow students time to analyse their results, and encourage them to, as a group, make a claim about which surface heats up the most in the sun, referring to their data as proof.

Teams might complete a sentence stem such as “The ground surface that gets hottest in the sun is… We think this because…”

## Integrate • Surface temperature claims

Teams present their findings, including their claims about which ground surface got the hottest.

**Potential discussion prompts**

* *Which of the ground surfaces you tested reached the highest temperature during the day?*
* *If measurements were taken using a thermometer, what temperature did it reach?*
* *Did anyone else measure the same surface and find the same results? Different result? Why do you think this happened?*
* *Out of all the surfaces that were monitored, which was the hottest? Which stayed the coolest?*
	+ Consider recording and averaging class results and why it would be the most accurate to make claims using the averaged data.
* *What does this mean about the ground surfaces that are included in a playground?*
* *Will the ground stay hot forever after it’s been heated? Why do you think that?*
* *Where does the heat go?*

The class/audience is encouraged to agree or disagree with the findings, or question the presenting team using [science question starters](/facilitating-evidence-based-discussions).

**Reflect on the lesson**

You might:

* review the questions in the class science journal. Determine which questions have been answered during the session and add any new questions that have arisen.
* reflect on how this learning is relevant to learning about the impact of heat on a playground:
	+ *What happens to the temperature of an unshaded ground surface during the course of a hot sunny day?*
	+ *What does that mean for the temperature of a playground? Why would we need to think about that when we design a playground?*
	+ *What could we do to stop the ground from getting so hot?*
* add to the class word wall.
* re-examine the intended learning goals for the lesson and consider how they were achieved.
* discuss how students were thinking and working like scientists during the lesson. Focus on how they asked questions, devised a way to investigate to find an answer, collected data and the used that data to make claims to answer their questions.
* discuss the importance of sharing and debating evidence.

**Scorching swings and slides • Lesson 5 •**

**Year 3**

**lesson 5**

**inquire**

Which playground building material gets the hottest?

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| To read the most recent version of this task, download associated resources, and view embedded professional learning including classroom videos and work samples, visit:[https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-5-which-playground-building-material-gets-hottest](https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-5-which-playground-building-material-gets-hottest?utm_source=docx&utm_medium=lesson5&utm_campaign=SSS)  |

# Lesson overview

Students plan and conduct a further investigation to compare the conductivity of different materials, and determine the suitability of specific materials to playground design.

## Key learning goals

Students will:

* conduct an investigation into the transfer of heat to different materials.
* make predictions and claims about what will happen to the temperature of different materials placed in the sun.
* observe, record and interpret the results of their investigation.
* identify the differences in conductivity of different materials.

Students will represent their understanding as they:

* use oral, written and visual language to record and discuss investigation results.
* record data in a table.
* discuss findings and compare results.

## Assessment advice

Lesson 6 will focus on summative assessment of the skills of science inquiry. By focusing your formative feedback for students on these skills during this lesson, they have an opportunity to further develop them prior to summative assessment.

Feedback might focus on:

* how students have written their question for investigations.
* how closely they follow to fair testing principles.
* supporting students to suggest ways to improve the validity of their results.
* how strongly their evidence supports their claims.

## List of materials

**Whole class**

* Class science journal (hard-copy or digital)
* Demonstration copy of **Hot water investigation planner Resource sheet**
* Demonstration copy of **Variables grid Resource Sheet** (or make your own)

**Each group**

* 3 spoons (or sticks/skewers) of similar size made of different materials, for example plastic, wood and metal.
* You may use only 1 spoon per group if you have difficulty sourcing this many metal/wooden spoons. Simply allow the spoons to return to ambient temperature before placing near the next heat source.
* In previous investigations students tested how metal heated up. In this investigation you might test a metal object again. This time the temperature of the objects will be measured more accurately, and over a longer period of time.
* A timing device for each team
* **Optional**: device for taking photos
* Access to warm water

**Safety note**

Any water used in a classroom should be at or below 43°C.

**Each student**

* Individual Science journal
* **Hot water investigation planner** **Resource Sheet**

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Re-orient | 5 minutes | Whole class |
| Question | 5 minutes | Whole class |
| Investigate | 15 minutes | Whole class |
| Investigate  | 20 minutes | Collaborative teams |
| Integrate | 15 minutes | Whole class |

# Inquire

## Re-orient

Review the previous lesson. Focus on which ground surface/s was identified as getting the warmest during a sunny day, and why students think that.

## Question • Considering playground materials

Refer back to the section of the mind map created in the Launch phase where students identified the materials that are found in a playground.

**Potential discussion prompts:**

* *What materials are the equipment in an outdoor playground usually made of?*
* *Why do you think they use these materials?*
* *During our previous investigation about how heat moves, we found that metal will heat up when placed in the sun, but what about other materials we find in a playground?*
* *Do you think these materials will get warm, or hot when placed in the sun? Why?*
* *How can we determine how hot each material gets?*

By referring back to the student questions asked during the Launch phase, and through questioning and discussion, determine that it would be advantageous to know which common playground materials heat up the most when they come into contact with a heat source.

## Investigate Planning to test heat conductivity

Plan a fair test investigation to find out what happens to different materials when they are put in contact with a heat source*.* In the previous investigation the sun was used as a heat source. Discuss alternative heat sources that might be used for the investigation, safely and cheaply.

Explain that the class will use warm water as their heat source. Discuss.

**Potential discussion prompts**

* *When does water become hot? Why do you think that?*
* *Does it always stay hot? Why do you think that happens?*

Students will test how well different materials transfer/conduct heat. They will use three spoons (or sticks/skewers) made of different materials: wood, plastic and metal. Refer back to the mind map from the Launch phase and the materials students identified as being commonly present in a playground. Support students to make the connection between the materials commonly found in a playground, and the materials the spoons are made of.

Using a demonstration variables grid, begin with the broad question ‘*What things might affect how much a spoon heats up in hot water?*’ Identify that the thing to be changed in the investigation is the type of material, and place that in the centre of the grid. Brainstorm other variables in the surrounding columns/rows. Sections can be added or removed as required. Some example answers might be: how long the spoon is in the water, the temperature of the water, how much of the spoon is in the water, the volume of water, what the spoon is made from.

Discuss ways to keep the investigation fair.

**Potential discussion prompts**

* *What if we put one spoon in a cup with a little bit of water and one spoon in a cup with a lot of water?*
* *What if we put one spoon in very hot water and one in warm water?*

Discuss how students might collect, record and represent their data:

* NO TECH: Using a hotness scale determined by each group. You will need to discuss how to keep this manner of determining temperature as fair as possible.
* LOW TECH: Use a glass thermometer, placed on the surface for a specific time period before measurements are read.
* HIGH TECH: Use a radar/surface temperature thermometer.

**Potential discussion prompts**

* *How might we measure the temperatures of each object?*
* *How will we record these temperatures? How often should we record them?*
* *When might we measure the temperature of the objects?*
* *Is it important to take a measurement of their temperature before we put them in the hot water? Why do you think that?*
	+ Yes, so we can more easily tell if they have heated up, and how much they have heated up over time.

## Investigate Investigating conductivity

In collaborative learning teams, and using the investigation planner, students plan, conduct and record the findings of a fair test investigation to answer the question: *What happens to the temperature of the spoon* (or stick) *when we change what it is made from?*

The level of modelling/scaffolding you provide students on how to complete their investigation planner will depend on their level of experience in conducting fair tests in this manner.

Students represent their data as it is being collected.

After the final temperature measurements have been taken, allow students time to analyse their results, and encourage them to, as a group, make a claim about which material heats up the most when in contact with heat source, referring to their data as proof.

Teams might complete a sentence stem such as “……… warms up the most when in contact with a heat source (the warm water)… We think this because…”

Individual students might also represent the transfer of heat from the water to the objects by drawing a labelled diagram in their science journals.

## Integrate • Which shape is the strongest?

Teams share and discuss the findings of their investigations. Guide the students through the process.

**Potential discussion prompts:**

* *What happened to the temperature of the materials when they were in contact with the hot water? Why?*
* *Were there any differences between the materials? For example, was there a difference in how hot they became? Why?*

The audience is encouraged to agree or disagree with the findings, or question the presenting team using [science question starters.](https://primaryconnections.org.au/pedagogical-tools/learning-through-inquiry-tools/facilitating-evidence-based-discussions)

**Optional:** You might like to introduce students to the [QCER framework](https://primaryconnections.org.au/pedagogical-tools/learning-through-inquiry-tools/facilitating-evidence-based-discussions) to support this form of science argumentation.

After class discussion, allow students time to complete/add to this section of their investigation planner.

Discuss and identify which object had the greatest change in temperature, and which object changed its temperature the fastest.

**Potential discussion prompts:**

* *Are the objects that had the greatest change in temperature and the objects that changed their temperature the fastest made from the same material?*
* *Discuss the type of material the object/objects are made from.*
* *Are these materials good conductors of heat? Do they allow heat to transfer easily and quickly?*
* *Which would be the best conductor?*
	+ The metal spoon, because it becomes the hottest the most quickly, and cools down more quickly too.
* *Can you give an example of where and why we use metal in real life because we want it to conduct heat effectively?*
* *Do you think the same ideas would apply in a playground? Do we want our playground equipment to conduct heat easily and effectively? Why? Why not?*

**Reflect on the lesson**

You might:

* review the list of questions in the class science journal. Determine which questions have been answered during the session and add any new questions that have arisen.
* add to the class word wall.
* re-examine the intended learning goals for the lesson and consider how they were achieved.
* evaluate the importance of fair-testing principles and how they are an essential element for reliable scientific discovery, including discussing how future investigations may be improved.



**Year 3**

Scorching swings and slides • Lesson 6 •

**lesson 6**

**inquire**

How effective is shade at reducing heat?

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| To read the most recent version of this task, download associated resources, and view embedded professional learning including classroom videos and work samples, visit: [https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-6-how-effective-shade-reducing-heat-transfer](https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-6-how-effective-shade-reducing-heat-transfer?utm_source=docx&utm_medium=lesson6&utm_campaign=SSS)  |

# Lesson overview

Students plan and conduct an investigation to find out if putting an object in the shade impacts the transfer of heat.

## Key learning goals

Students will:

* conduct an investigation into how heat transfer might be slowed or stopped
* make predictions and claims about what will happen to the temperature of different materials that have been shaded from direct contact with a heat source
* observe, record and interpret the results of their investigation.

Students will represent their understanding as they:

* use oral, written and visual language to record and discuss investigation results
* record data in a table
* discuss findings and compare results.

## Assessment advice

In this lesson, assessment is summative.

Students working at the achievement standard (science inquiry) should have:

* posed an investigable question.
* collected and represented data that answers their investigable question.
* undertaken measures to ensure the measurement of the temperature of the objects is as accurate and reliable as possible.
* considered factors that made their investigation fair.
* made a claim (drawn a conclusion) based on their evidence.

Refer to the Australian Curriculum content links on the [Our design decisions tab](https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-6-how-effective-shade-reducing-heat-transfer?utm_source=docx&utm_medium=lesson6&utm_campaign=SSS) for further information.

## Resources

**Whole class**

* Class science journal (hard-copy or digital)
* Demonstration copy of **Investigation planner Resource sheet** (or create your own)
* Demonstration copy of **Variables grid Resource sheet** (or create your own)
* Sunny day

**NOTE:** This investigation relies on being enacted on a sunny day. However, the investigation can be modified if conditions and context don’t enable this.

**Each group**

* Resources required will depend upon the investigation planned by the team, but should be easily sourced from classroom materials.

**Per student**

* Individual science journal (hard-copy or digital)
* **Investigation planner Resource sheet** (or create their own)

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Re-orient | 5 minutes | Whole class |
| Question | 10 minutes | Whole class |
| Investigate | 15 minutes | Collaborative teams, Whole class |
| Investigate | 20 minutes | Collaborative teams, Whole class |
| Integrate | 15 minutes | Whole class |

# Inquire

## Re-orient

Review previous lessons. Focus on how playground equipment and surfaces can warm up significantly on a hot sunny day.

## Question • Why do we seek shade in the heat?

Discuss how and why people seek out shade on a hot sunny day.

**Potential discussion prompts**

* *Why do people like to sit in the shade on a hot sunny day?*
* *What different types of shade are there?*
	+ Trees, shade sails, tents/cabanas, gazebos, patios, awnings, hats, umbrellas etc.
* *Where do you usually find these types of shade?*
* *What do you think is the best (most effective) type of shade?*

By referring back to the student questions asked during the Launch phase, and through questioning and discussion, determine that it would be advantageous to know which type of shade would be most effective to use on a playground.

## Investigate • Do we need shade?

Plan an investigation to find out: *What difference does shade make to how hot an object gets on a sunny day?*

The investigation should allow students to collect temperature data of two identical objects: one object placed in the shade and one placed in the sun. Depending on the experience of your students you might plan the investigation together or you might allow students the freedom to plan the investigation in collaborative teams.

Plan/discuss how students might collect, record and represent their data. Support students to use a variables grid and an investigation planner.

Your school context and layout will impact how you conduct this investigation. You might:

* measure how quickly two ice cubes or chocolate buttons melt when placed in the sun or shade, for comparison of the heat.
* measure the temperature of a ground surface such as asphalt or exposed dirt, in both sun and shade.
* modify the investigation to measure the temperature of different objects that have been placed under the same shading, to determine which heats up less.

It also provides teachers with an opportunity to assess students’ skills in Science Inquiry.

## Investigate • Does shade affect heat transfer?

In collaborative learning teams, students plan, conduct and record the findings of their investigation.

After the final temperature measurements have been taken, allow students time to analyse their results. Encourage them to make a claim as a group about how shade affects the temperature of an object, referring to their data as proof.

Teams might complete a sentence stem such as “The shade causes the material to… We think this because…”

Individual students might also represent the transfer of heat from the sun to the objects by drawing a labelled diagram in their science journals.

## Integrate • What claims can we make about shade?

Discuss the effect the shade had on the transfer of heat and the change in the temperature of the object/ground covering investigated.

Through discussion and questioning, guide students to make generalisations about the impact of shade on heat transfer.

**Potential discussion prompts**

* Do things in the shade get as hot as things in the direct sun?
* Why do you think that is?
* Where does the heat go if it can’t reach the object as easily?
* What other examples of ‘blocking’ out heat can you think of?

Discuss the implications of these findings on playground design.

**Reflect on the lesson**

You might:

* review the list of questions in the class science journal. Determine which questions have been answered during the session and add any new questions that have arisen.
* add to the class word wall.
* re-examine the intended learning goals for the lesson and consider how they were achieved.
* evaluate the importance of fair-testing principles and how they are an essential element for reliable scientific discovery.

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Scorching swings and slides • Lesson 7 • Designing a playground for the heat

**lesson 7**

**ACT**

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| To read the most recent version of this task, download associated resources, and view embedded professional learning including classroom videos and work samples, visit:[https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-7-designing-playground-heat](https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-7-designing-playground-heat?utm_source=docx&utm_medium=lesson7&utm_campaign=SSS)  |

# Lesson overview

Students apply their learning by designing a playground or piece of playground equipment with the aim of reducing heat transfer.

## Key learning goals

Students will:

* use design thinking processes to design a playground or piece of playground equipment that minimises the transfer of heat.

Students will represent their understanding as they:

* contribute to a class discussion about potential solutions that stops/slows the heating up of playground equipment on a sunny day.
* create annotated diagrams of their playground/piece of playground equipment that show/explain where heat transfer is occurring, and how it will be slowed/stopped.
* communicate their design thinking and choices in a manner appropriate for a specific audience.

## Assessment advice

In the Act phase, assessment is summative.

Students working at the achievement standard should have:

* demonstrated an understanding that heat can be transferred.
	+ Evidence might include labelled diagrams identifying heat sources, diagrams with arrows showing transfer of heat from a heat source to another object, or descriptions of objects increasing in temperature once they have come into contact with a heat source.
* applied their learning when selecting materials that decrease or slow conductivity of heat.
	+ Evidence should be found in student labelled playground design prototype.

Refer to the Australian Curriculum content links on the [Our design decisions tab](https://primaryconnections.org.au/teaching-sequences/year-3/scorching-swings-and-slides/lesson-6-how-effective-shade-reducing-heat-transfer?utm_source=docx&utm_medium=lesson6&utm_campaign=SSS) for further information.

## List of materials

**Whole class**

* Class science journal (digital or hard-copy)

**Each student**

**Year 3**

* Individual science journal (hard-copy or digital)
* If you have decided to ask students to build prototypes/models, you will need reused and recyclable materials that might be useful. Students may have been collecting them since the beginning of the unit. Examples include boxes (tissue, cereal, shoe, etc.) and other cardboard products, foil and trays made out of foil, bottle tops and jar lids, skewers, paddlepop sticks, etc.

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| **Lesson Routine** | **Estimated time** | **Task type** |
| Re-orient | 10 minutes | Whole class |
| Anchor and Connect | 15 minutes | Whole class |
| Design | 30 minutes +  | Whole class, Individual |
| Communicate | 20 minutes | Collaborative teams, Whole class |

# Act

## Re-orient

Re-examine the data and ideas collected in the class science journal over the course of the teaching sequence.

Discuss what conclusions students have drawn about heat:

* how it is transferred
* how it changes the temperature of objects around it
* how temperature is measured
* how some objects change temperature quicker than others

## Anchor and Connect • why consider heat when designing playgrounds?

Refer back to the images viewed in the Launch phase showing playgrounds, particularly the thermal image.

Students share their own experiences outdoors on a really hot day.

Examine some news articles that provide information about hot playgrounds and share stories of the consequences. Some examples are:

* [Kidsafe NSW *Playground News* newsletter: *How Hot Is Too Hot To Play?*](https://www.kidsafensw.org/imagesDB/wysiwyg/PlaygroundNewsIssue392012EmbeddedFonts_2.pdf)
* [9Honey article: *'Startling' temperature tests reveal danger of hot playgrounds ahead of summer*](https://honey.nine.com.au/parenting/child-safety-playground-burns-warning-ahead-of-summer/31a08e4d-f516-43bc-8f2d-7445c04b1f2a)
* [The Conversation article: *Materials that make heat worse for our kids demand a rethink by designers*](https://theconversation.com/materials-that-make-heat-worse-for-our-kids-demand-a-rethink-by-designers-93274)

**Discuss:** *Now that we understand scientifically how heat is transferred, and how it changes the temperature of objects, why is it important that we use this understanding to design better playground areas?*

## Design • Designing a playground

Using the steps of the design thinking process, students use their understanding of heat transfer and conductivity to design a playground/piece of playground equipment with a focus on reducing heat on a sunny day. You might present students with a design brief to outline what you would like them to do.

### Define

Outline the problem in a simple manner such as:

How can we ... (design a playground) ... so that ... (we can better control the amount of heat transferred to playground equipment/surfaces on a hot day?

**Potential discussion prompts**

* Who are we helping?
* What do they need help with?
* Why do they need help?

### Ideate

Brainstorm ideas related to the design of the playground/piece of equipment.

At this stage, to support creative thinking, every idea offered by students should be recorded in the class science journal. No idea is discounted, as the practicality/possibility of each idea will be considered later.

As students offer ideas, ask probing questions (‘why do you think …’ or ‘how do you know that…’) to draw out the reasoning and evidence behind the idea.

Potential reasons, related to the core concept, that students might include:

* Wood isn’t a good conductor of heat—it takes longer to get as hot as plastic or metal.
* Grass was the ground covering that got least hot in the time.
* Shade helped to slow/prevent the transfer of heat.

Students might also offer other ideas that weren’t specifically tested during the learning sequence. For example, they might suggest installing fans in the playground, or that running cold water over a surface will stop it getting too hot (due to the evaporation removing the heat energy). These ideas are valid and can be added to the board, but it should be noted that these ideas were not specifically tested, and questioning should be used to determine where students may have gotten these ideas from.

Once all ideas are listed, discuss which ones might be easy to include in a design and which ones might not be.

Jointly construct a set of criteria for which the designs will be assessed.

### Prototype

Either independently or in teams, student(s) create a labelled diagram/s of their playground or piece of equipment, including explanations related to why each material was chosen in relation to heat transfer. Alternatively, students might prepare a poster that describes why heat can be so dangerous on a playground, and why careful playground design is important.

**Optional:** Students/teams are provided opportunities to share their ideas and receive peer feedback ([download AITSL's guide for more on peer feedback](https://www.aitsl.edu.au/docs/default-source/feedback/aitsl-peer-feedback-stratedy.pdf)).

**Optional:** Students build a 3D prototype of their design.

## Communicate • Share our designs

### Test and share

Students communicate their playground designs to the chosen audience identified in the previous step. You might consider using the [CROWN tool](https://primaryconnections.org.au/pedagogical-tools/learning-through-inquiry-tools/crown) to support students in this.

Students should be encouraged to prepare questions to ask this audience that tests the possibility of their design, for example questions about cost, space and safety.

### Reflect on this sequence

You might:

* refer back to the list of student questions asked in Lesson 1. Determine which questions have been answered over the course of the learning sequence, what the ‘answers’ to the questions are, and the evidence that supports these claims. Address questions that have not been answered during the learning sequence, discuss why they might not have been addresses and potential investigations that might support students to answer them.
* consider what students have learnt about heat transfer and resulting changes in temperature.
* ask students to represent this learning in words, symbols and pictures.
* discuss why it’s important to have a good understanding of heat transfer: what kinds of jobs would require you to understand this? What about in your everyday life? What tasks that you do around the house involve heat transfer? What activities might be affected?