## Why are the characteristics of materials important when designing and producing?

**Science and technology learning sequence 3 material world**

**Learning sequence description**

Students investigate how different properties of materials affect their suitability for products. They will develop their knowledge and understanding of the properties and performance of materials through observation and manipulation. They have the opportunity to design and make an entertaining game.

## Syllabus outcomes and content

**ST3-1WS-S –** plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate solutions

* make and justify predictions about scientific investigations
* compare data with predictions
* communicate ideas, explanations and processes, using scientific representations including multimodal forms

**ST3-2DP-T –** plans and uses materials, tools and equipment to develop solutions for a need or opportunity

* **develop, record and communicate design ideas, decisions and processes using appropriate technical terms**
* **accurately cut, join, bend and measure a range of selected materials to construct the designed solution**

**ST3-7MW-T –** explains how the properties of materials determine their use for a range of purposes

* investigate characteristics and properties of a range of materials and evaluate the impact of their use
* identify and evaluate the functional and structural properties of materials
* design a sustainable product, considering the properties of materials
* select appropriate materials, components, tools, equipment and techniques and apply safe procedures to produce designed solutions

[Science and Technology K-6 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/science/science-and-technology-k-6-new-syllabus) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2017.

## Lesson 1 – investigating materials

Students are learning to:

* describe a range of materials based on their structural properties
* investigate different characteristics and properties of materials
* evaluate how structural properties of a range of materials determine their use.

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Learning experience | Differentiation strategies and/or adjustments | Resources |
| 1.1 | Revisit the concept of materials with students. Pose the question. What is a material? Ensure students distinguish between objects and the material from which the object is made. For example, window (object) – glass (material); door (object) – wood (material).Students demonstrate their prior knowledge of materials by completing a mind-map, ‘materials’ (student workbook). Provide students with topic categories to group their ideas such as, types, properties, source, how they change. Encourage students to create categories of their own. They could conduct research into the topic of materials and/or create digital versions of a mind map. |  | Student workbook – activity 1.1 |
| 1.2 | Revisit observable properties of materials with students. A property of a material represents the distinctive characteristics that can be identified, tested and used to help people select the most suitable material for a particular use. For example, bendy (flexible), stretchy (flexible), stiff (rigid), brittle (breaks easily), durable (doesn’t break easily) smooth, rough, waterproof, absorbent, transparent, opaque, shiny, dull. These properties are known as structural properties of materials.Choose an object and model how to describe it (material, observable properties, other possible uses).Students complete a scavenger hunt to locate ten different objects. Using the objects selected, students identify the material(s) the object is made from and describe the structural properties by completing the table in the student workbook. |  | Student workbook – activity 1.2 |
| 1.3 | After students have completed activity 1.2, ask questions, such as: Could you tell me more about this? What do you mean by that? Could you explain what you did? I wonder what would happen if…?The structural properties of different materials make them suitable for specific purposes and products. For example, glass is transparent and useful for windows, wood is strong, heavy and opaque, it is useful for doors and tables. Ask students to think about why materials are used for a particular purpose and product. For example: Why is aluminium metal used for playground seats? Why isn’t gold used to make pillows?Have students predict what might happen if materials are used for new purposes or consider what our life would be like if plastic had never been invented?Students respond in their student workbook and create two more questions to justify the suitability of materials for a purpose.Discuss how Aboriginal and Torres Strait Islander Peoples use natural and processed materials for a range of purposes. They use natural materials for specific purposes in their daily life such as minerals for painting, wood for tools and plant materials for shelter. They also process natural materials to change the properties to make the material more suited to another purpose such as woven fibres for bags. Knowledge of the natural properties of the various plants in a given place helps with selection of materials needed for a specific purpose, such as in the making of cooking tools and weapons. For example, dense woods are used to construct tools for striking and digging that need to be hard, heavy and durable, whereas tools, such as boomerangs, are constructed from material that is strong but not heavy. |  | Student workbook – activity 1.3 |
| 1.4 | **Opportunity for monitoring student learning**Properties to determine use of materials – practical activityStudents will:* investigate the strength of materials to determine the most suitable for carrying a load over a short distance.
* choose 5-6 different materials to test (for example, paper, cardboard, foil) to test
* collect and analyse data about strength of each material using agreed upon variables
* draw conclusions from the data to justify the material best suited carrying a load a short distance.

**What to look for*** communicates prediction of the most suitable (strongest) material
* compares data from repeated tests against original prediction
* describes investigation using technical language
* justifies conclusion using evidence from data collected data.
 |  | Student workbook – activity 1.4 |

## Lesson 2 – using materials for a purpose

Students are learning to:

* identify the properties which make materials suitable for their design choice
* design a game used for entertainment
* understand the role of testing and use of sustainable (recycled) materials as part of the design process
* select and effectively manipulate materials for a specific purpose and use safe work practices.

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Learning experience | Differentiation strategies and/or adjustments | Resources |
| 2.1 | Some materials can be recycled through waste management systems such as cardboard, glass, paper, metal cans and some plastics. Some materials cannot be recycled using the recycling bin. For example, some plastics and packaging materials such as Gladwrap and Styrofoam.Discuss examples of materials that can be recycled through waste management systems? Why can’t some materials be put in the recycling bin? Identify examples of objects that might be able to be recycled around home or school.Pose the question. What is upcycling?Students brainstorm and draw ideas in their student workbook.Students could gain further information about waste and recycling facts in Australia from a website link if they have a device.Pose these questions to students. Why do you think it is important to recycle materials? What might happen if materials aren’t recycled? Students record responses in the student workbook.Brainstorm with students new ways to use recycled materials or upcycle products for new purposes. Students sketch their ideas in the student workbook. |  | Student workbook – activity 2.1[10 waste and recycling facts, Australia](https://www.ankbudgetbins.com.au/10-recycling-facts-in-australia/)[website] |
| 2.2 | Identify and defineDiscuss common games with students. For example, ten pin bowling, arcade games, mazes, throw the ball, ring toss. Using what students know about games, brainstorm possible extensions to existing games, or the development of a new game, to entertain a kindergarten student or younger sibling. This will assist in the ‘identify and define’ step of the design and production process. Students identify an idea for the game they will design and clearly define the need they will meet with this game. Students prepare interview questions and conduct an interview with a student in kindergarten or younger sibling. This interview will help to clearly define the need for the game and identify the likes and dislikes of the child. This information will inform the design process. For example, What games do you like to play? Do you have a favourite game? Why do you like playing it? Is there a favourite character or game piece you like? Is the game easy or hard to play? Do you like games that have a dice or games you play on your own? |  | Student workbook – activity 2.2 |
| 2.3 | Research and planStudents research additional information to inform the planning of their game design. Students develop a labelled, annotated scaled drawing to describe how their game will work. They list the materials needed to develop the game and possible recycled materials that could be used to create it. They plan a sequence of steps needed to produce their game. |  | Student workbook – activity 2.3 |
| 2.4 | Produce and implementStudents explore and select appropriate tools and recycled materials for the task. They could refer to the investigation from the previous lesson to inform their choice of materials. Students investigate flexible materials, such as cardboard, and how they can be manipulated by joining, scoring, folding and layering. Students draw or take photos of ways to attach pieces of cardboard and add to the student workbook. Students accurately cut and measure the materials for their small-scale sample model (prototype). Students consider sustainability of materials and aesthetic features of their final product.Students draw, or take photos, of their sample (prototype) design in their student workbook. Showcase the prototypes in the classroom to allow peers to provide feedback. |  | Student workbook – activity 2.4Recycled cardboard |
| 2.6 | **Opportunity for monitoring student learning**Design and produce a game – Practical activityStudents develop a design idea for a game to entertain a kindergarten student or younger sibling. They produce a labelled, annotated, scaled drawing, collect suitable materials, build and test a sample small-scale model (prototype) of their game.**What to look for*** incorporates needs and preferences of target audience into design
* labels and annotates, scaled drawing of game design
* identifies recycled materials.
* develops small-scale model (prototype).
* considers sustainability of materials and aesthetic features of the game.
* reflects on the design process and the success of their game.
 |  |  |

## Lesson 3 – optional

Students are learning to:

* design a game used for entertainment
* understand the role of testing and use of sustainable (recycled) materials as part of the design process
* select and effectively manipulate materials for a specific purpose and use safe work practices.

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Learning experience | Differentiation strategies and/or adjustments | Resources |
| 3.1 | Test and evaluateStudents develop the whole game, test and refine it as a result of feedback, and play their game with a kindergarten student or younger sibling.Students communicate and evaluate their design choices, justify their selection of materials and the suitability of their game in entertaining their audience.A classroom games day could be held where students showcase their games and present to the class.Use of question stems: Which materials did you chose and why? How does your game work? What did other people think of your game? Did they have fun playing it? What would you do differently if you could make another game? Could you use other materials to make your game last longer? What would they be? Could you adjust this game to create another new game? Was your game suitable for your audience? |  | Student workbook – activity 3.1Variety of recycled materials to create their game. |
| 3.2 | Students complete a written reflection using the student workbook with question stems such as, I really enjoyed...; I learned a lot about...; I could improve ...; I’m still wondering about ... |  | Student workbook – activity 3.1 |
| 3.3 | **Opportunity for monitoring student learning**Design and produce a game – Practical activityStudents develop a design idea for a game to entertain a kindergarten child or younger sibling. They produce the final product, receive feedback from the player, family members and peers and present their game to the class.**What to look for*** modifies existing or creates new game.
* selects suitable materials
* presents ideas using technical language
* evaluates and justifies design solution
* incorporates feedback to improve design.
 |  |  |

**Reflection and evaluation**

These simple questions may help you reflect on your students’ learning and plan for next steps.

What worked well and why?

What didn’t work and why?

What might I do differently next time?

What are the next steps for student learning based on the evidence gathered?