 Material World

Term 2 and 3 – 10 weeks (2 to 2.5 hours per week)

This unit is designed to widen students’ knowledge about how the materials used to create things can be altered or changed according to various elements. This unit is based on the 5E model.

Purpose/context

In Stage 3, students will redesign a safe and durable play equipment area for students at The Grange Public School. Using their knowledge gained through a variety of experiments and research on the changing states of matter within the environment, the students will investigate suitable materials that could be used in their designs.

Big ideas – design and function is strategic

Students will actively investigate the key factors that influence design. They will gradually build upon this idea throughout the unit through investigating the properties of materials and how they can be altered.

Students will be investigating the differences between solids, liquids and gases. They will develop an understanding of the difference between reversible and irreversible changes that can occur to these solids, liquids and gases. They will look at the properties of material and how these can be altered to suit the purpose of the product. Students will audit the existing outside play equipment area within the school and look at designing a safe, durable area using the knowledge gained throughout the unit.

Driving questions

* What influences design?
* Can we identify the differences and behaviours of gases, solids and liquids?
* How does temperature affect the state of some materials (reversible and irreversible change)?
* Can we design and create safe school play equipment that can be used all year round?

Assessment overview

* Observable participation in discussion, research and group work
* Samples of written scientific explanations and procedures
* Completed design to be assessed against design brief and rubric

Syllabus outcomes/content

Science & Technology

* ST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanations
* ST3-5WT – plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identified constraints
* ST3-12MW – identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible and irreversible
* ST3-14BE – describes systems in built environments and how social and environmental factors influence their design
* ST3-15I – describes how social influences impact on the design and use of information and communication systems

[Science (incorporating Science and Technology K-6) K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/science/science-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2012

Mathematics

* MA3-9MG – selects and uses the appropriate unit and device to measure lengths and distances, calculates perimeters, and converts between units of length
* MA3-10MG – selects and uses the appropriate unit to calculate areas, including areas of squares, rectangles and triangles
* MA3-16MG – measures and constructs angles, and applies angle relationships to find unknown angles
* MA3-17MG – locates and describes position on maps using a grid-reference system
* MA3-18SP – uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables

[Mathematics K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2012

English

* EN3-1A – communicates effectively for a variety of audiences and purposes using increasingly challenging topics, ideas, issues and language forms and features
* EN3-2A – composes, edits and presents well-structured and coherent texts
* EN3-3A – uses an integrated range of skills, strategies and knowledge to read, view and comprehend a wide range of texts in different media and technologies
* EN3-5B – discusses how language is used to achieve a widening range of purposes for a widening range of audiences and contexts
* EN3-6B – uses knowledge of sentence structure, grammar, punctuation and vocabulary to respond to and compose clear and cohesive texts in different media

[English K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/english/english-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2012

Creative Arts

* VAS3.1 – investigates subject matter in an attempt to represent likeness of things in the world

[Creative Arts K-6 Syllabus](http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/creative-arts/creative-arts-k-6-syllabus) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2006.

Lesson 1-3 – engage phase

| Syllabus outcomes | Teaching, learning and assessment  | Resources |
| --- | --- | --- |
| ST3-12MW EN3-1AEN3-2AEN3-5BEN3-6B | * KWL Chart – Can you identify solids, liquids and gases?
	+ Identify what the students already know about solids, liquids and gases. What would they like to investigate in this unit? What questions do students have about solids, liquids and gases?
* What is fair test?
	+ Brainstorm with children their understanding of fair testing. Discuss what a fair test means. Students write the definition of a ‘fair test’ in their SciTech journal.
* Gathering data through using our senses (Habit of Minds).
	+ Discuss with children how we use our senses to be aware of what is happening around us and how we can use these senses to help us identify the changes in state between solids, liquids and gases.
* Title page
* Mini investigations/rotations – complete template of observations.
1. Gas – blowing a pompom into bottle – identifying that air is all around us and has pressure.
	* Using a variety of plastic bottles, students place a small pompom inside the lip of the bottle then using a straw, students try to blow the pompom into the bottle. This is for students to discover that air is all around us and takes up space.
2. Solids – identifying the effects of water on different types of paper.
	* Students use an eyedropper to drop water onto different types of paper to observe the effects the water has on that material (paper needs to be the same size, and same amount of drops of water onto each piece of paper as per fair testing).
3. Liquids – changing cream into butter.
	* Students will observe the effects of how the properties of a liquid can be changed. Use an electric beater to beat cream in a bowl. Alternatively, place cream and a marble into a glass jar. Have students continually shake the jar until cream changes form. Students observe the changes in state of the liquid.
4. Eggs in bottle – students observe how when air is heated it expands and creates pressure.
	* Whole class teacher led investigation and completion of a written scientific procedure. Teacher shows class a glass jar with a hard-boiled egg without the shell inside. Turn the jar upside down and ask students for solutions on how to remove the egg without breaking it.
	* Holding upturned jar over a sink or large container, pour boiling water over the jar. This causes the air inside the jar to heat and expand, thus causing pressure pushing the egg out. Ask students how we get the egg back into the jar? Teacher places the egg in the mouth of the jar ensuring there are no gaps. Place the jar into a dish of boiling water. The air inside jar heats up. In order for the expanded air to escape is pulls (sucks) the egg into the bottle.
	* Students to complete a written scientific procedure for this investigation in their SciTech journals.
 | cardboard, pompoms, empty large plastic bottles, straws, water, water dropper, tissue, newspaper, paper towel, baking paper, cardboard, gift cardcream, beaterrecording template for observationshard-boiled egg (shell removed), glass jar, tongs, saucepan, boiled water, iced waterscaffold for procedure writing |

Lesson 4-5 – explore (research)

| Syllabus outcomes | Teaching, learning and assessment  | Resources |
| --- | --- | --- |
| ST3-4WSST3-14BEEN3-2AEN3-3AEN3-5BEN3-6B | * What are a solids, liquids and gases?
	+ Students use technology to research the scientific properties of a solid, liquid and gas. Record in SciTech journals.
* What are reversible and irreversible changes in matter (class discussion)?
* Class investigations (teacher directed).
1. Burning paper (irreversible) – demonstrate and discuss how when paper is burnt it turns to ash and cannot be returned to its former state.
2. Burning a candle (reversible) – demonstrate and discuss how when you burn a candle the wax turns into a liquid. However, it can be molded back into its original form.
* How does heat and cold affect metal?
	+ Student research how heat and cold affect metal and record findings in science journals.
	+ Watch heat and ball investigation (<https://www.youtube.com/watch?v=GgrnhHMqZDY>) and have students write a scientific explanation as to why it worked.
 | XOscandle, paper, lighterYouTube video on the effects of heat on metal – <https://www.youtube.com/watch?v=GgrnhHMqZDY>  |

Lesson 6-9 – explain

| Syllabus outcomes | Teaching, learning and assessment  | Resources |
| --- | --- | --- |
| ST3-4WSST3-14BEMA3-9MGMA3-18SPEN3-1AEN3-3A | 1. Have a class discussion of what students know about the properties of steel. Where do we see it? What types of thing do we use it for? Do you think this is a good product to use for children’s toys? Why/Why not? How do you think environmental elements may affect steel products?
2. Steel wool rust investigation – explain that the class will be observing the effects of different products on steel wool over a period of time.
	* Using 3 jars – fill one with water, one with water with salt added and one with water that has had either vinegar or bleach added to it.
	* Place a piece of steel wool into each jar.
	* Have students predict what effects they think the solutions will have on the steel wool, if any. Examine the changes to the steel wool over time in different solutions (Record observations daily on class chart).
	* Investigating different surface materials. Discuss soft and hard surfaces and how they should suit the purpose they are designed for (eg. hard tar = road, grass = sports field)
3. Maths – look at different ways to collect and display data. Provide students with opportunities to make and deliver surveys. Investigate the best way to display data collected eg. different types of graphs.
4. Egg drop investigation – explain to students that they are going to simulate a child’s skull falling onto different surfaces. Using hard boiled eggs, discuss how a child’s skull is fragile and the purpose of it is to protect the brain (similar to a shell around an egg).
	* Observe a hard-boiled egg being dropped on different surfaces (eg. soft-fall, basketball court, dried leaves in the garden) from a height of 1 meter (fair testing). Allow students to decide the best way to record results (eg. graph) and discuss the damage, if any, the drop had on the egg. Pose question to students – how would engineers use this knowledge when designing areas that people use – different purposes? Have student’s record thoughts in SciTech journals. Discuss as a class.
5. Real world engineering solutions – identify purposes for different solid materials and how they are modified for purpose (hard plastics, metal, wood eg. cars, bridges, packaging, and furniture). In pairs or small groups, have students brainstorm as many materials and their uses as they can within 5 mins. Share with class.
	* Investigate play equipment designs and the materials that designers use.
	* What safety standards are required in Australia for children’s play equipment?
 | 3 glass jars, water, salt, vinegar, bleach, steel wool, chart1 meter ruler, 2 dozen hard-boiled eggssurfaces – soft-fall, basketball court, dried leaves in gardenYouTube video on how cooling systems in cars work – <https://www.youtube.com/watch?v=V7inC4lOpGs> XOs |

Lesson 10-16 – elaborate (design)

| Syllabus outcomes | Teaching, learning and assessment  | Resources |
| --- | --- | --- |
| ST3-4WSST3-5WTST3-14BEST3-15IVAS3.1 EN3-1AMA3-9MG MA3-10MG MA3-16MG MA3-17MG | * Explain to students they will be using their existing knowledge and the knowledge they have gained throughout this unit to become ‘Design Engineers’. They have been hired to produce a scaled drawing and 3D model of a new and updated durable play equipment area for the students of The Grange Public School. Completed designs must include a breakdown of the costing of materials that will be required to complete their designs.
* Place students into groups (3-5 students per group). Teacher to outline the rules for group work, focusing on the importance of working collaboratively. Show and discuss with students the design brief and marking criteria. Direct students to the Kids Safe website (to be used by groups when considering design). This website outlines: the Australian Safety Standards for children’s playgrounds, potential hazards and points to consider when designing a playground.
* Groups will audit existing playground focusing on safety, durability and design features. Students make notes in SciTech journal on what needs to be updated, fixed or replaced. Allow opportunities for students to survey other students/teachers of the school to explore what the whole school community like and dislike about the existing play equipment.
* Teacher to encourage designs to include modifications so that, the play area can be used all year round (e.g. water cooling system, retractable shelter). Ensure students have access to internet technology, graph paper and a group scrap book. Students are responsible for keeping detailed notes of ideas, designs and websites. Student can also use Google Docs to communicate and share ideas with group members.

Concepts to be covered in maths lessons during this time* Measurement:
	+ length – measuring height and distance of existing equipment
	+ area – students will measure designated play space to determine the area. they will use this information to determine how much the ground cover they will require
	+ volume: depending on the selected ground cover material (eg. soft fall) students will use; concepts of volume will be explored.
	+ perimeter: students will measure the perimeter of the playground to add to the aesthetics of their designs eg edging, fencing.
* scaled drawing:
	+ in preparation for the final design, students will explore a variety of maps to understand what drawing to scale means. students will practice by drawing their classroom to scale on grid paper.
* position:
	+ students need to understand compass directions, positions and locations on a map.
* angles:
	+ student will measure the angles of different pieces of equipment eg. slides
	+ as groups complete scaled drawing have them replicate their design onto drawing app before beginning their 3d models. encourage student to provide as much detail as possible.
 | paperpencilstape measuresdesign brief and marking rubricinternet access for researchgraph paperscrap bookspapervarious equipment for modelsdrawing app |

Lessons 17-18 – evaluate (presenting and reflecting)

| Syllabus outcomes |  Teaching, learning and assessment  | Resources |
| --- | --- | --- |
| EN3-1A | * present designs: students present designs to audience (class, teacher and principal) describing their innovative play equipment design and addressing how their design meets the set design brief.
	+ encourage students to think of creative ways, including the use digital technology (eg. Prezi, Power Point, One Note) to present final designs.
* reflection – can these designs be used all year round? What modifications have been made? Are the materials used in the design durable? Has a costing of design been provided?
 | Designs |

Culminating event, activity, or product

Students will be producing a scaled, labelled drawing and a 3D model of a children’s playground designed specifically for The Grange Public School. Parents and school executive staff will be invited to attend presentations. After presentations, drawings and models will be on display in the parliament room for other classes to view. As the school currently has money set aside for an upgrade of this play area, student ideas will possibly be incorporated into a real world product.

Evaluation

Evaluation strategies

Observation of participation and engagement.

* Pre and post assessment of content
* Driving Question- display wall, added to regularly as students conduct investigations
* Can students provide a comprehensive account of the factors that influence design?
* Have students successfully developed a product that demonstrates an understanding of materials, their properties and function?
* Can students apply their knowledge and understanding of strategic design to other tasks?

Student reflection

Students will be provided with opportunities to evaluate their designs and the designs of their peers. They will identify the strengths of their designs and will identify areas for further development eg what would they change to improve their product?

Design brief

Design a safe, durable play equipment area for TGPS.

Background

Students at TGPS enjoy time spent on the play equipment. Unfortunately over the years wear and tear on the equipment has taken its toll. The soft-fall has begun to break down and some equipment needs to be updated.

Task

You and a team of engineers who have been asked by Mrs. Wilson to research and design a safe, durable play equipment area for TGPS. Include modifications so that design can be used all year round (e.g. Water cooling system, retractable shelter).

Design

Your design should include:

* A quote sourced from different companies that clearly breaks down the cost of the upgrade
* A scaled, labelled drawing of the design. A 3D model of your design to support your presentations.
* The modifications you have made should be outline.
* Explain how your play design is durable.

Remember

You will need to sell your design to Mrs. Wilson. Your measurements and costing needs to be correct. You will need to source quotes from business groups with teacher assistance.