### Year 3 Material World Unit - Planning Page
(Changing States)

#### Outcomes & Content ([Syllabus Page 68](#))

| Working Scientifically ST2-1WS-S | ➔ Questions, plans and conducts scientific investigations, collects and summarises data and communicates using scientific representations  
◆ Questioning & predicting  
◆ Planning and conducting investigations |
| Design & Production ST2-2DP-T | ➔ Selects and uses materials, tools and equipment to develop solutions for a need or opportunity  
◆ Researching and planning  
◆ Producing and implementing |
| Material World (Science) ST2-6MW-S | ➔ Describes how adding or removing heat causes a change in state  
◆ Identify solids, liquids and gases as states of matter  
◆ Recognise that a change of state can be caused by adding or removing heat  
◆ Describe examples of changes of state in everyday life  
◆ Predict and observe the effects of adding or removing heat on a variety of solids/liquids |
| Material World (Technology) ST2-7MW-T | ➔ Investigates the stability of natural and processed material for a range of purposes  
◆ Investigate how the properties of natural and processed materials influence their suitability and use in products, services and/or environments, for example:  
  ● Elasticity  
  ● thermal conductivity  
◆ develop a design solution for an identified need or opportunity, using a variety of tools and materials that considers factors such as sustainability and time  
◆ identify the roles of people working in science and technology occupations |

#### Inquiry Questions (Syllabus)

- How do materials change when heated and cooled?  
- How do you decide upon which material to use for a particular purpose?

#### Thinking Skills (page 35)

- Scientific Thinking, Computational Thinking, Systems Thinking, Design Thinking

#### Cross Curriculum Priorities & General Capabilities (page 38)

- Critical and creative thinking, Literacy, Numeracy, Personal and social capability (SEL)

#### Possible Learning Experiences
How do materials change when heated and cooled?

- Examine a variety of objects that show the different states of matter, e.g. rock, water, honey, balloon filled with air, sand, leaf etc.
  - Small groups work to identify some of the more obvious properties of the different objects, e.g. hard, soft, light, heavy, runny.
  - Groups categorise the objects and explain reasons for categorising this way.
  - Groups share thinking with the class → record class’ categories exploring similarities and differences → display
  - Identify different objects as solids, liquids and gases
    - **English Link**: examine a range of informative texts about states of matter

- Pose the question: 'What does it mean to heat or cool something?'
  - Investigate what happens to water when it is placed in the freezer and is boiled.
    - **Equipment**: ice cube tray, clear kettle, water, iPad, freezer
    - Make predictions about what will happen
    - Record observations over a period of time, e.g. every 15 secs observe clear kettle and take pictures
    - Use labelled diagrams to build a clearer picture of the process occurring
    - Build an explanation about why the water froze or boiled using evidence from the investigation to support explanations.
  - Investigate what happens to the temperature of water when ice cubes are added or boiling water is added.
    - **Equipment**: thermometers, 2x clear containers, ice cubes, boiling/hot water, food colouring (optional), water, iPad
    - Add a couple of drops of food colouring (optional) to each of the containers with water. Add ice cubes to one container & boiling/hot water to the other. Measure & record the temperature at set intervals for both containers. Record any observations they notice as the experiment occurs.
    - **Maths Link**: graph the temperature data and use questions to analyse the data, e.g. Use a variation of the thinking routine See Think Wonder
      - What do you see, observe or notice about the temperature of the water in the ice cube container?
      - What do you see, observe or notice about the temperature of the water in the hot water container?
      - What does it make you think?
      - How do they compare?
      - What questions or puzzles do you still have?
  - Pose the question ’Are all solids and/or liquids affected by adding or removing heat?’
    - **Equipment**: different solids and liquids (e.g. sauce, honey, milk, cheese, bread, chocolate etc.)
    - Investigate what happens to different solids and liquids when heat is added or removed. For example, applying heat to bread using a toaster or boiling or freezing milk etc.
    - Students should be encouraged to:
      - Make predictions about the outcome of each experiment
      - Draw labelled diagrams about their observations
      - Use their observations and understanding to draw conclusions about the inquiry question
      - Pose questions and wonderings that show evidence of deeper thinking

- **Assessment** (ST2-6MW-S, ST2, 1WS-S)
How do you decide upon which material to use for a particular purpose?

- Discuss and identify the difference between an *object* and the *material* of which it is made.
  - For example, a boat is an object which can be made from a range of materials such as wood, fiberglass, aluminium — this ABC Education clip could be used to spark discussion [link](http://abcspla.sh/m/1662238)

- Introduce the concept of *physical properties* of materials by showing the students a ball of wool. Let them pass this around and as they explore the wool, ask the students to tell you something they observe about the wool.
  - Explain to the students that an observation is something they can find out about the material using their senses, e.g., what does the material feel like, look like, sound like or smell like?
  - Record student observations about the wool. Answers may include: blue, furry, strong, stiff—not elastic, bendy, soft, scratchy, long, thin.
    - Explain that observations like these about the material are called properties. (Physical properties are those properties of a material that can be measured or observed without changing the nature of the material.)

- Small groups of 3 to 4 students explore the materials and discuss the physical properties of each object.
  - Equipment: plastic sandwich bag containing small samples each of wool, pipe cleaner, curling ribbon, string, cotton thread, pop stick, rubber band, balloon.
  - Groups record the colour, strength, elasticity, shape, texture and flexibility of each object sample. Representing their observations in their own way.

- **Investigation 1: Selecting Materials for a Purpose**
  - Watch the first 1 min of *Looney Tunes: Coyote Falls* [link](https://youtu.be/ly3dP352Iso)
    - Discuss as a class what properties does a bungee cord need? Why?
      - Examples may include strength, elasticity, flexibility
  - Re-examine the properties matrix/table they created previously. Ask: Which material or combinations of these materials would have these properties?
  - Ask the students to colour in the squares on the properties matrix/table that relate to the selected bungee cord properties.
  - Examine the matrix/table, ask the students to select the materials that they would use to build a bungee cord.
  - Ask the students to draw and label what their bungee cord might look like.

- **Investigation 2: Engineering Challenge** — *Assessment* (ST2-7MW-T, ST2-2DP-T, ST2, 1WS-S)
  - Equipment (per group): 2x zip lock bags, 2x wire bin bag ties, 1x egg, iPad
  - Equipment (per class): large bulldog clip (launch pad), tape measure, masking tape, marbles or other weights, quantities of the sample materials used in previous investigation
  - **CHALLENGE:**
    - The students’ challenge is to design a bungee jump so that an egg stops within 5 cm of the floor when dropped from a height of 1.5 m. The egg should not hit the ground and break.
- Note to teachers: You can adjust this height to work with what you have available in the classroom to use as the launch pad for the eggs. For example, you may decide to launch from the teachers' desk, clamping the cord to the edge of the desk with a bulldog clip. In this case, the distance would be a lot shorter than 1.5 m.
- Engineering Design challenge recording sheet

- Explain the task to students. If the egg stops too far above the floor, the bungee jump attraction won’t be exciting enough. Of course, if the egg hits the floor, the jump fails the safety test. Explain that they will get to build and test their bungee cord before the final class challenge.
- Show the students the launch pad (bulldog clip) you will be using for the class challenge and demonstrate how you will launch the egg.
- As a class, discuss how they will measure how close each egg gets to the floor.
  - Note to teachers: Students may come up with ideas such as having observers at eye level, testing more than once, having a string at 5 cm above the floor for the egg to touch, holding a tape measure next to the jump, filming on iPads or phones and watching back in slow motion. This discussion will help the students think about how they are going to gather their own data from their test runs and use it to redesign their cord if needed.
- Explain that each group needs to measure a height of 1.5 m to practice their jumps from. Before each jump, they should line up their egg and attached cord with this mark before launching.
- Ask students to complete the Ask, Imagine and Plan sections of the student worksheet Engineering design, in collaboration with their group members.
  - Ask a question
  - Imagine a possible solution
  - Plan out a design and draw your ideas
- Have the students collect the materials that they have selected to design their bungee cord.
  - Suggest to students that they may like to make a ‘test egg’ to practice with and save their raw egg for the class challenge. Allow the students to work out how they will construct this ‘test egg’. They may decide to use the weights and electric scales to keep the weight of their egg and the test egg the same. Use questioning to guide students into thinking about fair testing.
- Allow time for the students to create and test their bungee cord. They will need time to test their designs, evaluate and improve and retest etc. (engineering design process).
- Ask students to complete the Create section of the student worksheet Engineering design, in collaboration with their group members. Groups use iPad devices to take photographs during the engineering design process.
  - Create and construct a working model
- Class challenge: To conclude the investigation, gather all the groups together and test each design from the launch pad. Use Slow-motion video to record to film their bungee egg jump.
• Test the model
  ■ Evaluate each design constructively. Ask the students:
    • What worked well with this design?
    • What could you change to improve this design?
  ■ Students can use this feedback to complete the Improve sections of the student worksheet Engineering design, in collaboration with their group members.
    • Improve and try to revise the model

Understanding the learning behind this investigation:
Students will have different outcomes depending on the material or combination of materials they choose to make their bungee cord.
Science concepts:

-
The idea of the target.
Technologies:

-
Have the

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St
Enginnering:

- Most students will be able to complete their studies...
Mathematics skills:

- ...
- Measuring the weight of the fruit.
• Discussion prompts:
  ○ What properties of your materials made them useful for a bungee cord?
  ○ Were some materials more suited than others? Why?
  ○ Can you think of other materials (other than those provided) that may be suitable for use as a bungee cord?
  ○ Was your egg bungee jump successful?
  ○ What would you change to make it better?
○ What would happen if the length of the bungee cord were changed?
○ What would happen if more weight were added to the test egg?
○ What would happen if the bungee cord were only made out of string?
○ How do you think bungee-jump developers test the length of a bungee cord for a human bungee jump?

**ALTERNATIVE**

- **Investigation - Squarosaurus Plane**
  ○ Identify the properties of a piece of paper and discuss why it is commonly used to make paper planes. For example, it is lightweight, easy to fold, smooth
  ○ Follow instructions to make a squarosaurus paper plane [http://abcspla.sh/m/2238616](http://abcspla.sh/m/2238616)
    - Tips for making great paper planes may be useful for students [http://abcspla.sh/m/2238554](http://abcspla.sh/m/2238554)
  ○ **Exploring materials:** Small groups of 3 to 4 students explore a range of materials and discuss the physical properties of each object.
    - Equipment: plastic sandwich bag containing small samples each of paper, cardboard, aluminium foil, cling wrap, newspaper, baking paper, tissue paper, paper towel, wrapping paper, butcher's paper.
    - Groups record the colour, strength, elasticity, shape, texture and flexibility of each object sample. Representing their observations in their own way.
    - Groups choose 4 different materials they think will help the plane fly the longest distance
  ○ **Experimenting with materials:** Groups experiment with the materials and design of their squarosaurus planes with the aim of having the longest flying plane.
    - Groups ask, imagine and design as part of the engineering design process - drawing labelled diagrams of each of the four planes.
    - Groups create and test their designs, having the opportunity to make adjustments.
    - Whole class paper plane challenge.
  - Measure and record the length each plane flies. Students could record flight using slow-motion on an iPad.
  - Compare the length of flight with the properties of materials used for each plane.
  - Discussion prompts:
    - What properties of your materials made them useful for a plane?
    - Were some materials more suited than others? Why?
    - Can you think of other materials (other than those provided) that may be suitable for use as a plane?
    - Was any one of your four planes successful?
    - What would you change to make it better?
    - What would happen if different materials were combined to make a plane?
    - How do you think different designs and materials impact the length a plane can fly?

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**Information for the Teacher**

It is important to distinguish between an **object** and the **material** of which it is made. For
example, a wheel is an object that can be made of the materials rubber, and steel. The properties of rubber that make it useful are its durability and elasticity. The property of steel is its strength and rigidity. Combining these two materials produces an object with a specific purpose, which utilises the properties of the materials of which it is made.

Many students might be unaware that the properties of a material determine how useful it is for particular purposes. For instance, they might just accept that rubber is commonly used in car tyres without considering the properties that make it a suitable material for this purpose, including flexibility and durability.

Students frequently have unconnected knowledge of the properties of the materials. The materials students use every day have been chosen by others (based on the properties of those materials), so students seldom have a need to identify and appreciate the specific properties of those materials, for example, the waterproof nature of cling wrap or the transparency of glass. The range of physical properties, and the terms used to describe them, may be unfamiliar to students. For example: absorbency, strength, flexibility, elasticity, malleability, transparency, viscosity, porosity, density, opacity, hardness and brittleness. As students describe the materials they are investigating, it is important to introduce the scientific terms that classify their observations, e.g., 'it’s bendy'—flexibility, 'it’s furry'—texture.

**Resource Links:**