Material World Unit

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| **Stage 3** | **Timing: 8 weeks/ 1 hour per week** |
| **Knowledge and Understanding Outcomes** | **Skills Outcomes** |
| ST3-12MW – identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversibleST3-13MW – describes how the properties of materials determine their use for specific purposes | ST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanationsST3-5WT – 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 |
| **Content – Key Ideas** | **Values and Attitudes Outcomes** |
| >Solids, liquids and gases have different observable properties and behave in different ways.>Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting.>The properties of materials determine their use for specific purposes. | ST3-1VA – shows interest in and enthusiasm for science and technology, responding to their curiosity, questions and perceived needs, wants and opportunitiesST3-2VA – demonstrates a willingness to engage responsibly with local, national and global issues relevant to their lives, and to shaping sustainable futuresST3-3VA – develops informed attitudes about the current and future use and influence of science and technology based on reason |
| **Vocabulary**  | **Learning Support** |
| Solid, liquid, gas, matter, viscosity, density, diffusion, buoyancy, mass, volume, reversible, irreversible, melting, freezing, evaporating, burning, rusting, dissolve | ***Students with learning difficulties******Gifted and talented students***Extension Activities (listed within lessons) |
| **Assessment** | **Learning across the Curriculum** |
| In this unit, assessment incorporates a variety of strategies to support the investigative and hands-on nature of the unit. It includes both formal and informal assessment approaches, and incorporates teacher observations as well as self and peer-assessment.Students are provided with opportunities to demonstrate their learning through a wide variety of activities. These include:* inquiry and design projects
* investigation and problem-solving activities
* spoken and written responses, incorporating drawings, symbols and words
* compare and contrast activities
* presentations and discussion

Formal written assessments have also been included as part of this unit. | Aboriginal and Torres Strait Islander histories and cultures Asia and Australia’s engagement with Asia Sustainability Critical and creative thinking Ethical understanding Information and communication technology ability Intercultural understanding Literacy Numeracy Personal and social capability Civics and citizenship Difference and diversity Work and enterprise  |
| **Quality Teaching Framework** |
| ***Intellectual Quality***Deep KnowledgeDeep UnderstandingProblematic KnowledgeHigher-Order ThinkingMetalanguageSubstantive Communication | ***Quality Learning Environment***Explicit Quality CriteriaEngagementHigh expectationsSocial SupportStudents’ self-regulationStudent direction | ***Significance***Background KnowledgeCultural KnowledgeKnowledge IntegrationInclusivityConnectednessNarrative |

**Lesson 1 – Focus – Mysterious Matter**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-12MW – identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversible | Solids, liquids and gases have different observable properties and behave in different ways.*-observe and compare the differences in the properties and behaviour of solids and liquids, eg shape and ability to flow* | Preparation: Prepare 8 containers with the following substances for the students to observe.Container 1: stones (solid)Container 2: icing sugar (solid)Container 3: play doh (solid)Container 4: elastic bands (solid)Container 5: cooking oil (liquid)Container 6: honey (liquid)Container 7: air (gas)Container 8: psyllium gel (properties of both solid and liquid)* Introduce the containers to the students and explain they will be investigating each container and voting on whether they think each one is a solid, liquid or gas. Distribute the worksheet “Voting Matters” to each of the students. Ask students to write which properties they believe define each state.
* Allow students time to examine each container and vote whether each is a solid, liquid or gas.
* Tally the students’ responses and record in a class science journal (eg. Notebook file, poster, etc)
* Discuss the results and challenges they encountered. Discuss the properties that helped them decide which containers held solids, liquids or gases. Record answers on a class chat board (digital, paper, wall display, etc)
* Optional: Create a class word wall and add any relevant topic words.
* Introduce the “Our questions” section of the chat board. Ask students to record any questions they have about solids, liquids and gases (eg, post it notes, blog, etc)
 | * Containers
* Stones
* Icing sugar
* Play dough
* Elastic bands
* Cooking oil
* Honey

\*Psyllium husks from a health food shop mixed with water to make a gel 10 times the original volume* Journal or workbook
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**Lesson 2 – Focus – Properties of liquids – Go with the flow!**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-12M – identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversibleST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanationsST3-5WT – plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identifies constraints | Solids, liquids and gases have different observable properties and behave in different ways.*-observe and compare the differences in the properties and behaviour of solids and liquids, eg shape and ability to flow* | Preparation: enough of a selection of liquids for each group to have approximately 2 tablespoons of each (eg, lemonade, fruit juice, water, milk, washing up liquid, oil, etc) as well as powdered laundry detergent or similar* Review previous lesson and focus the students’ attention on ideas about liquids.
* Brainstorm as many liquids as possible. Record student responses in the class science journal.
* Ask students to think of words to describe the properties of the liquids. Discuss:
* Are there any liquids that don’t have water in them?
* What are some liquids that are thick and some that are thin?
* Introduce the liquids and detergent to the students. Explain that they will be working collaboratively to explore the substances and decide which are liquids. Discuss what the students can do and look at the help make their decision.
* Allow time for students to conduct the investigation and record their results.
* Discuss the findings as a class. From the findings, define the properties of liquids and record these in science journals.
* Liquids take the shape of their container
* Liquids flow at different rates (viscosity)
* Liquids of the same volume have different weight (density)
* Liquids mix differently in different liquids (diffusion)
* Update the class chat board with what the students have learned. Review the questions and answer any that can be answered. Record these on the chat board.
* Optional: Update the word wall with new vocabulary

Extension activities: Viscosity, Density and DiffusionViscosity: * Viscosity is the rate at which different liquids flow. Students predict the viscosity of a range of liquids from highest to lowest.
* Prepare a measured amount of each liquid into styrofoam cups.
* Students devise a fair test to determine if there predictions were correct.
* Compare the results and draw conclusions.

Density:* Liquids of the same volume have different weight. For example, a litre of water weighs less than a litre of honey.
* Conduct a ‘density tower’ experiment to illustrate this concept:

<http://www.science-sparks.com/2013/08/01/summer-density/>Diffusion* Liquids mix differently in different liquids.
* Students predict whether food dye will diffuse faster in hot or cold water.
* Conduct the following experiment: <http://www.mrsec.psu.edu/education/nano-activities/cells/diffusion_races/index.asp>
* Discuss findings and possible reasons/
 | * Variety of liquids e.g. lemonade, juice, water, milk, dishwashing liquid, oil etc.
* Journal or workbook
* Selection of liquids e.g. sauce, water, dishwashing liquid, oil, honey etc.
* Styrofoam cups
* Glass Jar
* Honey, oil, water, milk, dishwashing liquid, golden syrup
* 2 cups
* hot tap water
* cold tap water
* Food dye (darker colors work best)
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**Lesson 3 – Focus – Properties of Solids – Rock solid**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-12MW – identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversibleST3-5WT – plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identifies constraints | Solids, liquids and gases have different observable properties and behave in different ways.*-observe and compare the differences in the properties and behaviour of solids and liquids, eg shape and ability to flow* | Preparation: Collect a selection of solids such as soap, chalk, play-doh, stone, wood, sponge, jelly snake, elastic band, marbles, flour, rice, laundry powder, etc.* Review the previous lesson using the class journal and chat board. Focus the students’ attention on their ideas about the properties of solids.
* Introduce the solids to the students and the worksheet which will help them investigate. Brainstorm other tests the students might perform. Model how to compare an entry for one of materials.
* Discuss with students what they think the word hard means. Discuss that scientists consider hard to mean how easily a substance is scratched or worn away. Explain that in this investigation the students will use the scientific definition of hard.
* Allow time to complete the investigation and record their results.
* Each group will report back to the class with their findings. Complete an agreed class results table in the class science journal.
* Discuss the investigation, asking questions such as:
* What do different solids have in common?
* What is different about them?
* Are powders solids? How do we know? What properties do they have in common with other solids?
* From these findings, create a definition of solids to record in the science journals.
* Update the class chat board with what the students have learned. Refer to any questions about solids and answer these.
* Optional: Update the word wall with any new vocabulary.

Extension: Density and Buoyancy* Discuss why some solid objects float and others do not. Accept all student answers at this point and record in class science journal.
* Using the “Surfing Scientist – Will it Float?” Lesson plan, ask students to predict, test and record which solids will float and which will not. After each, discuss what reasons would explain why an object may float or sink. Record these on the chat board.
* Present to the students a ball of plasticine. Ask the students to predict if it will float or sink. Place the plasticine in water to test.
* Ask the students if they can think of a way to may plasticine float? Working in small group, students will be given a portion of plasticine that they can shape to make it float. Once groups have determined their design, they will test it with and without a load of weight (eg, marbles)
* Optional: Students will video and annotate the design and investigation process. This will be presented to the class.
* Reform as a class and discuss the results.
 | * Magnifying glass
* Variety of solids
* Variety of materials e.g. marble, polystyrene cup, pencil, playdoh
* Large containers filled with water
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**Lesson 4 – Focus – Properties of Gases – What a gas!**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-12MW – identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversibleST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanations | Solids, liquids and gases have different observable properties and behave in different ways.*-demonstrate that air has mass and takes up space, eg an inflated basketball, bubbles, balloons and beaten egg white* | * Review the previous lesson using the class science journal and chat board. Focus students’ attention on their ideas about gases.
* Brainstorm examples of gases that the students might know. Show the students an inflated balloon. Discuss what is in the balloon and a combination of several gases including nitrogen, oxygen and carbon dioxide make up air.
* Explain that we will be conducting investigations to discover some of the properties of gases.
* Introduce a transparent cup to the students and ask if there is anything in the cup. Turn it upside down and repeat the question.
* Pose the question: Do gases have volume? Accept all student responses at this point.
* Introduce the worksheet “Tissues in a cup”. Read through the instructions and model if necessary. Explain to students that they need to complete an annotated drawing of what happened.
* Reform as a class and discuss what happened. Record the results in the class science journal, concluding whether or not gases have volume.
* Pose the question: Do gases have mass? Accept all student answers at this point.
* Provide each group of students with 2 balloons and a wire coat hanger. Ask them to blow up one of the balloons and peg it on one end of the coat hanger, then peg the empty balloon on the other end. Discuss their findings. What does this reveal about the mass of gases.
* From these findings, create a definition of gases to record in the science journals.
* Update the class chat board with what the students have learned. Refer to any questions about gases and answer these.
* Watch the clip from BBC Bitesize “Gases in daily life”: <http://www.bbc.co.uk/education/clips/zxgvr82>.
* Optional: Update the word wall with any new vocabulary.

Extension: Do different gases have different masses?* View and discuss the video, adding key information to the chat board and science journals.

**ASSESSMENT:** Complete MW Written Assessment 1 (Solids, Liquids, Gases). | * Balloons
* Clear plastic cups
* Tissues
* Wire coat hangers
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**Lesson 5 – Focus – Mostly melting**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-12MW - identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversibleST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanationsST3-5WT – plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identifies constraints  | Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting*-observe and describe some readily observable reversible changes that materials can undergo**-make and test predictions about the effect of temperature on the state of some substances, eg adding and removing heat from water**-classify some observable changes that materials undergo as reversible or irreversible* | * Present the class with an ice cube and ask the students to predict what will happen to the ice cube if it sits in the classroom. Why will this happen?
* Ask the students to suggest ways we could make the ice cube melt faster. Working in groups of three, students test three ways to make the ice cube melt faster. They will observe, measure and record their results using the worksheet.
* Compare the ice cube will the melted water. Are these the same object? Discuss the similarities and differences.
* Explain that scientists believe that all substances are made of particles. When objects are solid, the particles are packed together and wobble in a fixed position. When they are a liquid, they have more energy and the particles can move more freely. As they gain more heat energy, particles move more energetically.
* Explain to the students that they are going to role play being particles of water. Explain that they are low in energy and so are not moving much and are all packed together. Ask the students to stand close to each other, not moving from the spot. Discuss what name could be given to the students now, such as ice cube or solid.
* Explain that you will “add heat energy” to students by tapping them on the shoulder. Ask students that have become heated particles to sway backwards and forwards more energetically and to start moving slowly near the other students while staying close. Walk around the group of students, adding heat to the students at the outside first. When all students are moving slowly together, discuss what name could be give to the students as a whole, such as water or liquid.
* Optional: Use a rope on the ground to mark out the shape of a bowl.
* Optional: Ask the students to begin to move faster and spread out more. Discuss what name could be given to the students now, such as water vapour or gas.
* Introduce a tray filled with marbles or small beads. Discuss what the marbles represent (particles of water). Give a tray to each group and ask them to arrange the marbles to represent a block of ice. Ask teams to give reasons for their representation. Ask teams to range the marbles to represent a puddle of water and give reasons for their representation.
* Students take photographs of their models, then annotate their model with an explanation of their model and what it represents. This could be written or spoken, digital or print. Add these to the class chat board.
* Discuss with the students how we could change the water back to an ice cube. Can all things that we have changed using heat be changed back to their original form? Consider items such as an egg, bread and toffees.
* Define the terms “reversible” and “irreversible” changes. Identify examples for each. Add these examples to the class chat board. Students record their definition and examples in their science journals.
* Optional: Update the word wall with the new vocabulary.
 | * Ice cubes
* Marbles, trays
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**Lesson 6 – Focus – Changes everywhere**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-12MW identifies the observable properties of solids, liquids and gases, and that changes made to materials are reversible or irreversibleST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanationsST3-5WT – plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identifies constraints  | Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting*-observe some irreversible changes that common materials undergo to identify that the changes may result in new materials or products, eg rusting iron, burning paper, cooking a cake and making toffee**-classify some observable changes that materials undergo as reversible or reversible* | * Review the previous lesson using the class science journal and chat board. Focus students’ attention on their ideas about reversible and irreversible changes.
* Discuss with the students what they know about dissolving. Record and accept all responses at this stage.
* Explain that they are going to explore whether or not different substances will dissolve. Introduce the students to the substances, such as salt, pepper, sugar, sand, coffee. Invite students to predict which substances will dissolve and which will not.
* Discuss how we ensure that it will be a fair test (eg, equal measure of each substance, equal volume of water, equal temperature of water, etc).
* Students will work in teams to test if each substance will dissolve. Discuss the results as a class.
* Use the BBC Science Clips interactive to explore reversible and irreversible changes made by heating and dissolving. Ask students to predict the outcome before conducting each virtual experiment. <http://www.bbc.co.uk/schools/scienceclips/ages/10_11/rev_irrev_changes.shtml>
* Discuss what changes you might see if one of the variables was changed, eg temperature of the water, volume of water, size and shape of container, etc.
* Optional: Conduct a test to see how the temperature of the water affects how salt dissolves.
* Update the class chat board with what the students have learned.

Extension: Rusting* Complete the iron filings experiment featured here:

<http://www.education.com/science-fair/article/iron-rusting/>**ASSESSMENT:** Complete MW Assessment 2 (Reversible and Irreversible Changes) | * Salt, pepper, sugar, sand, coffee
* Clear plastic cups
* Water
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**Lesson 7 – Focus – Our material world**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-13MW – describes how the properties of materials determine their use for specific purposesST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanations | The properties of materials determine their use for specific purposes.*-identify the properties of materials used in a familiar product and relate them to its use**-describe how scientific and technological knowledge about the properties of materials can be used to inform decisions about use for their specific purposes* | * Discuss with the students that they will be working in small group to investigate the properties of a variety of materials.
* Each group will select a material at random from out of a hat, such as wood, plastic, metal, paper, wool, cotton, glass. They will photograph many examples of the material being used around the classroom or school. Students will then work with their group to brainstorm why they think that material is suited to that purpose. Groups will share their findings with the class.
* Watch the clip from BBC Bitesize “Materials and their properties”: <http://www.bbc.co.uk/education/clips/z27w2hv> . Discuss the materials in the clip and the ways they were used.
* Use this to create a list of material properties – eg, flexibility, flammability, conductivity etc. In their groups, students will identify, using research where need, the properties of their material.
* Optional: Groups create a riddle about their materials, describing it in as much detail as possible. Share riddles on the class chat board for other students to solve.
 | * Samples of different materials: wood, plastic, metal, paper, wool, cotton, glass.
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**Lesson 8 – Focus – Playground Materials**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-13MW – describes how the properties of materials determine their use for specific purposesST3-4WS – investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanationsST3-5WT – plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identifies constraints  | The properties of materials determine their use for specific purposes*-explore how materials are used in innovative ways for specific purposes, eg the use of soft-fall materials in playgrounds and geotextiles to retain water in landscaping* | * Revise the content of the previous lesson, focussing on the properties of materials and their suitability for different purposes.
* Explain that the class will be investigating materials used in the school playground and specifically, playground equipment.
* Allow the students to observe the school playground equipment, then discuss as a class their findings. What materials did they find? Why do they think this material was chosen? Do they believe this is a good choice? If not, what would be a better choice? How is the school playground similar or different to other playgrounds they are familiar with? Record answers in the class science journal.
* Watch the clip “Playground safety inspections” from BBC Bitesize <http://www.bbc.co.uk/education/clips/z8w8q6f> .
* Review the students’ findings about the school’s playground equipment. Discuss how they could conduct an investigation to test the safety of landing surfaces. For example, drop a tennis ball and record how high it bounces, comparing the playground surface, grass, concrete and dirt.
* Working in small groups, students will conduct the investigation and record their data. Discuss what the students will need to do to ensure their data is accurate. Students will record their investigation in their science journals.
* Watch the following clips on soft-materials.

<http://vimeo.com/78799578><https://www.youtube.com/watch?v=TsVHG3OOFAs><https://www.youtube.com/watch?v=i_QYDmQaMsw>* What are the features of soft-fall that make it suited to this purpose? Do you think it is the best choice of materials for playground equipment areas?
* Students will write a response, justifying their opinion, to which material is best suited to playground areas. This can be in science journals and/ or part of the class chat wall.
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**Research Project – Focus – Fuels**

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| Outcome | Content | Teaching and Learning Activities | Resources | Notes & Register |
| ST3-13MW – describes how the properties of materials determine their use for specific purposes | The properties of materials determine their use for specific purposes*-research the reasons for and the benefits of using solid, liquid and gaseous fuels for heating* | We use fuels in different states for heating – Coal, oil, gasHow is coal/oil/gas formed? Where is it found in Australia? Examples of how each used in Australia? Benefits of each? Disadvantages of these? |  |  |