ESS444: Development of science learning and teaching unit

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PART B: STATES OF MATTER UNIT

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Rationale

This 'States of matter' unit of work has been created for a year 8 junior science class. This unit is to be completed over a 4-week period in which students will one 50-minute class and one 100-minute class a week. This will amount to 8 classes in total. Our world is made up of matter and therefore it is important for students to understand this and create an appreciation for science in their everyday lives. Everyday students encounter a variety of different matter in different states and by learning this topic students will be able to identify with this as will understand the various processes. Learning about the nature of matter and its various changes is also vital in regards to other sciences such as biology, which looks at how organisms, cells and ecosystems work (Cherif, Adams and Cannon 1997, p. 428). Students will learn that all matter is made up of tiny particles, which is an important link in learning about elements, molecule and atoms (Cherif, Adams and Cannon 1997, p. 428). This unit involves a variety of different activities in order to accommodate different learners. It involves the use of class activities such as role-play, representations and problem solving, while also including individual activities such as questions, worksheets and online activities. Students will also have the chance to work in collaboration with other students in group activities and practical experiments. Power point presentations should be used to reinforce the units' content, generate class discussion and also incorporate the use of diagrams to aid visual learners. There is a lot of content within the topic of matter and therefore not everything can be covered. The content looks at matter and what it's made up of, the particle model, changing states of matter, weather and the process of evaporation. There will be a number of assessment tasks throughout the unit that require students to apply their knowledge, use different skills and resources and undertake study techniques, which students will continue to use throughout their schooling.

Links to the Australian Curriculum

This year 8 chemical science unit on the 'States of matter' addresses the three interrelated learning strands, Science Understanding, Science as a Human Endeavour and Science Inquiry Skills that are within the Australian Curriculum of science (ACARA 2013). In Science Understanding year 8 students will learn how "The properties of different states of matter can be explained in terms of the motion and arrangement of particles" (ACARAR 2013). This involves exploring the overarching idea of the particle model; why it is needed, the arrangement of particles in the states of matter and how they respond to energy and temperature changes (ACARA 2013). Science as a Human Endeavour will have students learning all about the weather. Students will "discover how people's understanding of the nature of matter has changed over time" and how this has resulted in new developments in technology in regards to meteorology (ACARA

2013). Science Inquiry Skills will be used throughout the unit, but mostly evident throughout the practical investigations. Through the range of experiments students will "identify questions and problems" and "make predictions based on scientific knowledge" (ACARA 2013). Students will also "process and analyse data information" by drawing up "tables and graphs to represent relationships and trends in data" in order to "draw conclusions" (ACARA 2013). Finally, students will "reflect on the method" used to investigate scientific problems, "evaluate data" and "suggest improvements".

The E5 instructional model

Engage: Throughout each lesson in the unit, there is a range of teaching strategies used and learning strategies that students will undertake. These will not only engage them but also allow them to express what they already know about the concept of matter and link these pre-existing ideas to the new concepts and ideas that are produced through these strategies (Goodrum and Druhan 2012, p. 71). For example, the first lesson uses the teaching strategy of brainstorming in order for students to express what they already know about the concept of matter. This allows them to express any prior knowledge they have and hear the views of their peers. This brainstorm is then followed up with various activities that may help reinforce their pre-existing ideas of matter or link their views to new ideas introduce (Goodrum and Druhan 2012, p. 71).

Explore: There are a variety of hands on learning activities that students will undertake throughout the unit that allows them to explore various problems (Goodrum and Druhan 2012, p. 72). These activities, among others include the use of role-play, practical experiments, group activities and online activities. When looking at the processes undertaken in the changing states of matter, role-play is used in order to provide students with a visual and physical representation of the structure and particles of matter. By undertaking the processes physically, students are able to breakdown these processes, discuss them with others as well as the teacher and explore how this phenomena relates to the particle model of matter.

Explain: After exploring ideas and concepts through hands on activities, scientific terms and explanations are provided by the teacher in order to further develop students' knowledge (Goodrum and Druhan 2012, p. 72). In regards to the states of matter role-play previously mentioned, the teacher adding in scientific concepts such as melting or boiling can extend this activity. This means that students are able to relate the processes that they have just learnt to scientific phenomena and therefore further develops the ideas of the particle model.

Elaborate: Elaboration "involves students applying what they have learnt to new situations" (Goodrum and Druhan 2012, p. 72). Throughout the unit, students have the opportunity to apply the concepts that they have learnt through various activities and assessment pieces. One area of assessment looks at students undertaking various practical experiments. These investigations allow student's to make predictions based on what they already know and allows them to discuss the results by applying the concepts they have learnt. Therefore this allows students to draw evidence-based conclusions.

Evaluate: Evaluation involves "students evaluating what they have learned" as well as assessing what students have learned (Goodrum and Druhan 2012, p. 72). Throughout this unit students can evaluate what they have learned through assessment items and discussion. Through discussion and questioning, students have the chance evaluate what they know and what concepts they may need further development with. Through practical experiments students have the chance to reflect on the concepts they have learnt in order to apply them to predictions, observations and conclusions. Other assessment items such as the particle model assessment and the 'states of matter' unit test also allows students to apply what they have learnt. A teacher's feedback from the assessment items are vital to a students learning as it allows them to evaluate where their learning currently stands and what they need to do in order to improve and further develop their knowledge.

Key concepts

1. Objects are made of substances and there is a huge variety.
2. Matter consists of objects that take up space and has mass.
3. Substances can exist as a solid, liquid or gas.
4. Substances have a range of physical properties such as colour, density, electrical conductivity, hardness and flexibility.
5. Equal volumes of different substances usually have different masses.
6. All matter is composed of tiny little invisible particles.
7. There is nothing in the space between the particles of matter.
8. There are forces (bonds) holding the particles in a solid and liquid together.
9. Most substances can exist as a solid, liquid or gas, depending on temperature.
10. The temperature of the substance is related to the average kinetic energy of the particles that make up the substance.
11. Particles don't disappear or get created- the arrangements change.
12. The particles that make up a substance do not share properties with the substance made up.
13. A substance undergoing a change of state is undergoing a physical change
14. In a physical change, the number of particles a substance is made of and the number of particles remain unchanged.

(Hubber, P, 2013b pp. 1-2)

'States of matter' lesson sequence

Week no.	Lesson no.	Key concepts/ process skills	Activities	Assessment	Teaching strategies
1	**1** **50 min**	**1-3** **What is matter?** - Students will compare substances - Students will classify substances into solids, liquids and gases. - Communicating with others (Holt, Rinehart and Winston 2013)	- Introduction to the topic: using the power point presentation to introduce and discuss the concepts that will be covered in the unit - Mind map discussion: what is matter? Then referring to power point slides on matter - How can we group matter? - Individual online activity **(Appendix 1-4)**	**Formative assessment:** Questioning and discussion	**Interactive online activity** **Mind map:** problem solving **Power point slides:** use of diagrams and information **Co-operative learning:** group activity **Questioning**
	2 **100 min**	**1-5** **Properties of matter** **-**Communicating - Organising and classifying substances - Hypothesising and predicting - Observing - Inferring - Contrasting	- Recap last lesson through questions about matter - The line- up activity - Investigation 6.1: comparing solids, liquids and gases - Discuss results with the class - Students will write notes about solids liquids and gases relating to power point slides - Discuss measuring matter	**Summative assessment:** - Investigation 6.1 practical report: 10% of total grade - Investigation 6.2 practical report: 10% of total grade **Formative assessment:** Feedback from practical	**Questioning** **Line-up activity:** problem solving and evaluating **Practical experiments:** group work **Power point:** diagrams and unit content

		- Analysing - Evaluating (Holt, Rinehart and Winston 2013)	with the class, via power point - Investigation 6.2: Measuring the volume of an irregular shaped solid - Discuss results from this experiment **(Appendix 5-9)**	reports can let students identify where they are in terms of the learning standards and how they can improve (Hackling 2012, pp. 141-143) Questioning and discussion	**Discussion**
2	3 **Duration: 50min**	**1-4, 6, 7, 8** **The particle model** - Communicating - Classifying - Contrasting - Comparing - Inferring (Holt, Rinehart and Winston 2013)	- Properties of solids, liquids and gases quiz - Online activity: Types of matter: particles - Introduce the particle model: why the model is needed and key ideas of the model: via power point - Discuss particle arrangement in a solid, liquid and gas (power point – diagrams) - Particle model assessment **(Appendix 10-12)**	**Summative assessment:** - Particle model assessment piece: 10% of total grade **Formative assessment:** Standards of performance stated through a rubric which lets students know what they should be aiming for (Hacking 2012, pp. 141-143) Questioning and discussion	**Questioning and discussion** **Interactive online activity** **Power point:** diagrams and content **Particle model assessment:** students choose how they wish to present this
	4 **100min**	**1-4, 6-10** **The particle model and temperature** - Communicating - Hypothesising and predicting	- Recap: particle model, group activity - Looking at temperature through representations - Drawing representations - Online activity: Air pressure:	**Summative assessment:** Investigation 6.6 practical report: 10% of total grade **Formative assessment:** Feedback from practical	**Role-play - representation:** visual **Drawing representations:** aids visual learners

		- Observing - Inferring - Contrasting - Analysing - Evaluating (Holt, Rinehart and Winston 2013)	Particles, volume and temperature (if time) - Investigation 6.6: Expansion of liquids - Discuss the results with the class **(Appendix 13-17)**	reports can let students identify where they are in terms of the learning standards and how they can improve (Hackling 2012, pp. 141-143) Questioning and discussion	**Group collaboration** **Online interactive activity** **Practical experiment:** group work **Discussion and questioning**
3	**5** **50 min**	**3, 6-12** **Changing states of matter** - Communicating - Classifying - Contrasting - Comparing - Inferring (Holt, Rinehart and Winston 2013)	- Changing states of matter discussion: power point with diagram from textbook - States of matter role play - Students fill out worksheet - Students to complete questions from their textbook **(Appendix 18-21)**	**Formative assessment:** Questioning and discussion	**Power point:** diagrams and content **Role-play-representation:** visual learning and involves student working in groups **Worksheet** **Questions and discussion**
	6 **100min**	**3, 6-14** **Changing states of matter and evaporation** Communicating - Hypothesising and predicting	- Changes of state: interactive smart board activity - Experiment: The Great Melt - Discuss the results of the experiment - Experiment: Exploring evaporation -Discuss results with the class	**Summative assessment:** The great melt practical report: 10% of total grade **Formative assessment:** Feedback from practical reports can let students identify where they are in terms of the learning	**Interactive smart board activity:** class collaboration **Practical experiment:** group work **Discussion and questioning**

		- Observing - Inferring - Contrasting - Analysing - Evaluating (Holt, Rinehart and Winston 2013)	- Students will start revision questions for test **(Appendix 22-25)**	standards and how they can improve (Hackling 2012, pp. 141-143) Questioning and discussion	
4	**7** **50 min**	**3, 4, 6-11** **The state of the weather** - Communicating - Comparing - Contrasting - Analysing (Holt, Rinehart and Winston 2013) **REVISION** **1-14**	- Water and the weather: power point - Student will complete questions in their book - What do hydrologists do? **(Appendix 26-28**)	**Formative assessment:** Questioning and discussion	**Power point:** diagrams and content **Discussion and questioning** **Group work:** could assign jobs, take on responsibility
	8 **100 min**	**1-14** **Revision and unit test**	- Revision for test - 'States of matter' unit test **(Appendix 29-30)**	**Summative assessment:** 'States of matter' unit test: 50% of total grade	**Discussion and questioning** **Class revision activities** **Online activities** **'States of matter test'**