 Design and construct a working greenhouse (10 weeks)

Within this unit of work, students will explore sustainability, with a specific focus on growing seeds into seedlings (germination). This will result in students investigating, designing and constructing a greenhouse from recycled materials (including plastic PET bottles) to grow and germinate seeds. Students will investigate the concepts of sustainable design, what plants need to grow, photosynthesis and how the analogy of the microclimate within a greenhouse extends the growing season. This will include the design and construction of a working greenhouse.

Unit overview

Rosemeadow P.S. has a brand new garden on the school grounds with a chicken coup, garden beds and learning spaces. As a class, the students came up with the idea that we needed a place where we could germinate seeds into seedlings in a secure environment with optimal growing conditions. The students came up with the idea of constructing a greenhouse using as many recycled materials as possible.

Driving question

* How can we add to or compliment the new school garden?
* How can we create a microclimate with optimal growing conditions for seed germination?
* How can we design and create a greenhouse best suited for the school environment?

Big ideas

* Research what plants need to thrive.
* Create a microclimate with optimal growing conditions for seed germination so we can transfer seedlings in to the school garden.

Assessment overview

To be completed as unit progresses.

Syllabus references

Outcomes and other syllabus material referenced in this document are from:

* [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
* [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
* [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

| Syllabus outcomes/content | Teaching, learning and assessment |
| --- | --- |
| ST3-10LW – Living WorldLiving things have structural features and adaptations that help them to survive in their environment. (ACSSU043)Students;* research the conditions needed for a particular plant to grow and survive in its environment, eg an indoor plant, plants in deserts, drought-resistant wheat or salt-tolerant plants

The growth and survival of living things are affected by the physical conditions of their environment. (ACSSU094)Students:* make predictions about how changing the physical conditions of the environment impacts on the growth and survival of living things, eg different amounts of light or water on plant growth or the effect of different temperatures on the growth of yeast or bread mould

ST3-4WS - Working ScientificallyStudents plan investigations by:* with guidance, planning appropriate investigation methods to test predictions, answer questions or solve problems including surveys, fieldwork, research and fair tests (ACSIS086,
* ACSIS103, ACSHE081, ACSHE098)
* deciding which variable should be changed and measured in fair tests while keeping everything else the same (ACSIS087,
* ACSIS104)
* collaboratively and individually selecting suitable methods for gathering data and information first-hand and from reliable secondary sources.
 | Sustainability and essential scientific concepts for the design projectWhole-class activity – sustainabilityStudents brainstorm the meaning of sustainability. View the YouTube clip, 'Sustainability easily explained' (Duration 4:01min.). Discuss and identify the key points of sustainability as defined in the clip. Brainstorm why sustainability is important.Whole-class activity – photosynthesisStudents brainstorm the meaning of photosynthesis. Complete a mind map of student responses. View the YouTube clip, 'Photosynthesis - Biology basics for children’ (Duration 4:52min). Discuss and identify the key points of photosynthesis and the importance of plants for human life, eg oxygen production and carbon dioxide removal. Brainstorm photosynthesis and what life forms use this process. Ensure students understand that this occurs with all vegetables, fruits and herbs. Model a basic diagram of photosynthesis ensuring the following are included: energy from sunlight, carbon dioxide and water from air, plants release oxygen into the air, plants make foods from water and sunlight (this can be displayed in the room for future reference).Small-group activityDriving questions:* What happens when wet soil is left in the sun uncovered for the day?
* What happens when wet soil is let covered in the sun all day?

Activity:1. Cut 2 clear bottles in half to create 2 cup like containers.
2. Fill both containers with wet soil.
3. In one of the containers place cotton wool or any absorbent materials on the top and place the top half of the bottle back on top to seal the bottle.
4. Weigh both of the bottles and note down the weights.
5. Place both bottles outside in direct sunlight for the day.
6. In the afternoon students are to revisit the bottles in their STEM groups and note the changes. What has happened to the cotton wool in the sealed bottle?

Discuss with the class:* Why there is condensation inside the sealed bottle?
* The changes occurred to the unsealed bottle?
* Do the bottle weigh the same now as they did in the morning?
* Explain the changes that have just occurred and how students have mimicked a green house.

Whole-class evaluationStudents are to write a hypothesis about the implications they think this would have on plants and their ability to grow. Revisit this hypothesis at the end of the unit.Visible thinking activityPresent students with a variety of images of greenhouses. Students to do a 'See, Think, Wonder' activity using the images as stimulus:* See – what features do they observe in the image?
* Think – why do they think the greenhouse has these features?
* Wonder – are there any questions they would like to answer through investigations or research?

Go through student responses and give students the opportunity to express their prior knowledge of greenhouses. This will determine exactly how detailed and what information to give to the students.Introduce the basic concept of greenhouses and what they do.Researching optimal growing conditionsSmall-group activityPose the questions:* What climate in Australia is best for a fast growing plant?
* What are the climatic qualities that support plant growth?
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| **ST3-10LW – Living World** **ST3-5WT – Working Technologically**Students explore and define a task by:* developing a design brief individually and in collaboration with others
* developing design criteria that considers, where relevant, function, aesthetics, social and environmental considerations Students generate and develop ideas by:
* selecting and using techniques for documenting and communicating design ideas to others, eg drawings, plans, flow charts, storyboarding, modelling and presentations, using digital technologies

Students produce solutions by:* using their plans and production sequence

Students evaluate by:* self or peer assessing the final product by using the established design criteria

**MA3-10MG – Area 1*** Calculate the areas of rectangles using familiar metric units (ACMMG109)
* establish the relationship between the lengths, widths and areas of rectangles (including squares)

**MA3-9MG – Length 1*** Choose appropriate units of measurement for length (ACMMG108)
* describe how a length or distance was estimated and measured (Communicating, Problem Solving)
 | Design brief and designTeacher background informationOutline to students that they are to design and build their own greenhouse (as a class) and germinate selected vegetables from seed to seedling.Whole-class discussion* where the seedlings/seeds will be planted
* location - is there an existing vegetable garden or is a new one required
* what needs to be determined before planting (prompt determining perimeter and area)

Pose the following questions:* Is it possible to grow a vegetable in a greenhouse-like environment?
* Can we determine if there is a difference in how the vegetable grows outside in the vegetable patch to in the greenhouse? How?

Review and brainstorm the:* definition of a greenhouse
* functions of a greenhouse
* vital design elements required when designing a greenhouse

Students describe how this is modelled on the process of photosynthesis and make direct comparisons between the two.Design briefA greenhouse needs to be constructed at school. It needs to:* mainly be made of recycled materials
* contain all the vital elements of a greenhouse
* be aesthetically and environmentally appropriate
* be large enough to house the plants when grown

Using the key points from the brainstorm, students develop a design brief for the mini greenhouse. Remind students that seeds will be germinated into seedlings within the mini greenhouses.Small-group activity* Divide students into groups. Specific roles may be given within the group to encourage cooperative learning.
* Referring to the design brief, students research an appropriate and workable design for their greenhouse.

They:* determine which recycled materials are needed to make the greenhouses
* determine how their greenhouse will work
* include a labelled diagram of their greenhouse
* determine how to create the right conditions for the types of plants chosen
* allocate the resources to be brought in by each student
* identify what teacher/school assistance will be needed.

Whole-class evaluationGroups ensure all the requirements specified on the design brief are met. Designs are presented to the teacher and signed off for construction. |
| **ST3-5WT – Working Technologically**Students explore and define a task by:* developing design criteria that considers, where relevant, function, aesthetics, social and environmental considerations

Students generate and develop ideas by:* selecting and using techniques for documenting and communicating design ideas to others, eg drawings, plans, flow charts, storyboarding, modelling and presentations, using digital technologies

Students produce solutions by:* using their plans and production sequence

Students evaluate by:* self or peer assessing the final product by using the established design criteria

ST3-4WS - Working ScientificallyStudents conduct investigations by:* using equipment and materials safely, identifying potential risks (ACSIS088, ACSIS105)
* accurately observing, measuring and recording data, using digital technologies as appropriate
 | Construction of greenhouseWhole-class discussion* Review design brief and design plans from previous lesson.
* Students to bring in the recycled materials they require for their greenhouse, ensuring they have all things necessary to commence construction. (Note teacher/school may assist in recycled materials if students are unable to provide.)

Small-group activity* Referring to the design plan students construct their greenhouses.
* Once the greenhouse is built, students select the right amount of soil for their greenhouse.
* Students water the soil and plant the seeds (ensuring they are adhering to the planting recommendations researched in previous lessons). Note: It is advisable to complete this step of the lesson either outside or in a wet area of the classroom/school.

Whole-class evaluation* Take photos or videos of the steps in the design process and to make notes of students’ ability to work effectively in groups. Students may wish to record the design process using appropriate digital resources.
* Review the established design criteria. Students reflect on how they worked as a group on the project, what went well, what could have been improved.
* Students may also complete a questionnaire / reflection on how they worked as a group.
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| **ST3-10LW – Living World** The growth and survival of living things are affected by the physical conditions of their environment. (ACSSU094)Students:* identify some physical conditions of a local environment, eg temperature, slope, wind speed, amount of light and water
* make predictions about how changing the physical conditions of the environment impacts on the growth and survival of living things, eg different amounts of light or water on plant growth or the effect of different temperatures on the growth of yeast or bread mould
* use gathered data to develop explanations about how changing the physical conditions of the environment affects the growth and survival of living things

ST3-4WS - Working ScientificallyStudents conduct investigations by:* working individually and collaboratively in conducting a range of appropriate investigation methods, including fair tests, to answer questions or solve problems
* using equipment and materials
 | Planting of seeds/seedlingsSmall-group activityStudents observe their greenhouse see Week 3 Lessons 1 and 2.Whole-class discussionReview the findings of previous lessons on perimeter and area of the vegetable garden. Note: depending on time, students can mark out the even area for each group or alternatively the teacher can do this.Small-group activityRefer to note in teacher background information page 1* Students are given seeds / seedlings of their chosen vegetable.
* They refer to the planting specifications recorded in previous lessons to ensure planting is done correctly.

Students use the specifications to measure out the recommended width and depth to plant the seeds/seedlings. They water the soil and plant their seeds/seedlings. |
| **ST3-10LW – Living World** The growth and survival of living things are affected by the physical conditions of their environment. (ACSSU094)Students:* identify some physical conditions of a local environment, eg temperature, slope, wind speed, amount of light and water
* make predictions about how changing the physical conditions of the environment impacts on the growth and survival of living things, eg different amounts of light or water on plant growth or the effect of different temperatures on the growth of yeast or bread mould
* use gathered data to develop explanations about how changing the physical conditions of the environment affects the growth and survival of living things

ST3-4WS - Working ScientificallyStudents conduct investigations by:* working individually and collaboratively in conducting a range of appropriate investigation methods, including fair tests, to answer questions or solve problems Students process and analyse data and information by:
* comparing gathered data with predictions, and using as evidence in developing explanations of events and phenomena (ACSIS218, ACSIS221, ACSHE081, ACSHE098)

**MA3-9MG** – Length 2* Connect decimal representations to the metric system (ACMMG135)
* recognise the equivalence of whole-number and decimal representations of measurements of length, eg 165 cm is the same as 1.65 m
* interpret decimal notation for lengths and distances, eg 13.5 cm is 13 centimetres and 5 millimetres

**MA3-7NA** – Fractions and Decimals 1Students:* Compare, order and represent decimals (ACMNA105)
* interpret zero digit(s) at the end of a decimal, eg 0.170 has the same value as 0.17

**MA3-7NA** – Fractions and Decimals 2* Add and subtract decimals, with and without the use of digital technologies, and use estimation and rounding to check the reasonableness of answers (ACMNA128)
* round a number of up to three decimal places to the nearest whole number
* describe situations where the estimation of calculations with decimals may be useful, eg to check the total cost of multiple
 | Monitoring and observing growth of seeds/seedlingsSmall-group activityThis activity should be completed at the beginning of every lesson until the conclusion of the unit.Students observe their greenhouse and:* make sure it is getting enough sunlight
* check the soil’s dampness record the time of day that they are doing the observation
* take a photo of their greenhouse
* record their results.

Whole-class activity* Create a mind map of the criteria that should be observed and measured in the vegetable garden experiment. Ensure students are referring back to initial concepts taught such as sustainability, photosynthesis etc.
* Discuss what would be the best measuring tool to use to measure the growth in height and width of the seedling.

Individual/group/paired activityStudents:* measure a selection of objects similar in size to a seedling, eg pencil, pen, rubber etc
* record the measurement to the nearest whole number
* discuss the role of the zero when measuring, eg 0.170 has the same value as 0.17.

Whole-class activityStudents:* share their results
* discuss the accuracy of measuring to the whole number.

Pose the questions:* Is this an efficient way to measure and record information?
* What problems could occur if we only measured to the whole number?
* What real world examples support this idea? (For example, builders, architects, engineers etc).

Model how to measure an object to two decimal places using a ruler/tape measure, including using ICT tools to assist.Ensure students understand how to use the third decimal place to round the number up. Discuss how this is important and why it would affect accuracy, refer back to experiment and measuring seedlings.Individual/group/paired activityIn grouped pairs students:* re-measure the objects previously measured using a ruler and tape measure
* record to two decimal places
* use the ruler and tape measure for each object and compare measurements.

Whole-class discussionStudents:* discuss the findings
* compare measurements to the whole number with those to the decimal place
* describe situations where estimation of calculations might be useful
* discuss effectiveness of ruler and tape measure in accuracy of measurements.

Optional – support student understanding of seeds and vegetable gardens by exploring the ABC Splash clips:* 'How seeds become plants' Duration 5.19
* 'Vegetable gardens' Duration 5.18

Small-group activityStudents:* measure their seedlings
* record their measurement to two decimal places
* observe their section of the vegetable patch
* record the important observations as identified in part 1 of this lesson.
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Culminating event, activity, or product

Present out constructed and working greenhouse to the school community.

Evaluation

* student group evaluation of design – does it meet the criteria?
* student self-evaluation as team member
* teacher reflection on each step of the unit
* teacher summative evaluation of overall unit