Planting Science

real research for engaged education

CREATED BY THE ARC CENTRE OF EXCELLENCE FOR TRANSLATIONAL PHOTOSYNTHESIS

Planting Science

Year 2

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Year 2: Small change, big difference

Unit at a glance

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Plants grow, change and have offspring, but it can be hard to see it in action. This unit shows the unique ability plants have to change to suit the environment in which they're planted.

Science Snapshot
Meet Min Chen. Min discovered a type of chlorophyll that grows under very low light.

1 Planting the seed

Students observe photosynthesis bubbling in water, and plant some seeds, with some placed on a window sill, and others inside a cupboard to see what happens next

2 Growth and change

Students observe the growth in their different test plants. They've both grown, but the one in the cupboard is white!!

Science snapshot
Meet Viv Rolland. Viv investigates the tiniest parts of the leaf using light and a microscope.

3 Lights, colour, action

Place the white plants on the window sill. Does anything change?

Science snapshot
Meet Emma Mace. She finds variation in plants to try and grow more food for the world.

4 Planticulate!!!

Students play a modified version of Articulate, describing the different words in plant science to each other to cement the literacy learning

5 Grow food from scraps

Students grow food from scraps, making sure they place scraps in places with the best chance for growth

6 Sustainability

Students have seen food can be regrown, but why would you? See how much waste comes from one classroom at one meal and see what a difference a small change can make

Optional inclusions and notes

There's an air in there
Air investigation: does air really exist? How can you tell? Investigate with these exciting experiments

Curriculum links & learning outcomes
Teacher information included in a table at the end of this document

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Plants grow, change and have offspring, but it can be hard to see it in action. This unit shows the unique ability plants have to change to suit the environment in which they're planted.

About this unit

Plant science can be hard to show to students within a short amount of time, especially showing that plants move, grow, change and adapt. But it is what makes plants unique to animals, including humans. Indeed, plants aren't able to get up and move if their environment is uncomfortable or not ideal to their growth. Instead they must change to suit their environment.

This unit includes practical, easy, short experiments to enthuse students with the real scientific method, and matches them to the real research that's happening in science to spark their curiosity.

About the program

These teacher resources have been prepared by the ARC Centre of Excellence for Translational Photosynthesis. The Centre is working on maximising photosynthesis inside the leaf, to translate it into higher crop yields for farmers. It's hoped that this will secure food supplies for future generations. The lessons are designed to link the research of the Centre with the Australian Curriculum, creating a direct connection between the students, the research and the scientists.

The lesson plans focus on students achieving science inquiry outcomes by using a modified version of the scientific method. Students will create real tests, create their own hypotheses, test and measure the outcome of their inquiry based experiment.

To work the scientific method accurately, students need to be able to measure and show their results. Including data collection and display in the classroom naturally leads to maths in context activities, which represents what happens in real research.

Structure

The lessons have been modelled on the '5 E's' method for teaching and learning, created by Bybee *et al*, and popularised by Primary Connections. A number of optional inclusions have been incorporated into the program to supplement class learning where required. This may be to achieve deeper learning on a particular outcome, or to familiarise students on a concept or technique before they run their actual experiment.

Science Snapshots provide an important connection to the science. They describe a real research project or technique, and introduce the reader to a scientist working in the field.

Extra information has been included on the trickiest experiments, to troubleshoot if an unexpected outcome occurs. Of course, in science, many experiments end up with an unexpected result, so if this happens, you'll be in good company!

Budget

Lessons have been designed to maximise educational outcomes, while keeping the cost manageable for tight budgets. The cost of materials to deliver each unit is designed to average out at around $20 per lesson for the whole class. All items used are commonly available at supermarkets, home maintenance stores (like Bunnings), health food shops or on eBay.

Copyright Information

About

Year 2 Small change, big difference

Planting the seed

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This lesson sparks curiosity and wonder by showing bubbles of photosynthesis. Students will start their own planting seeds experiment.

This lesson comes in two parts: observing photosynthesis, and creating an experiment where they'll see plants change colour over a few days growth.

Part 1: Observable bubbles of photosynthesis

Teacher information

As plants photosynthesise, the oxygen generally isn't visible as it comes out. Placing a photosynthesising leaf in a liquid solution that includes dishwashing liquid (to make it easier for the air to come out) and sodium bicarbonate (to give the plant a carbon source in lieu of carbon dioxide), both gives the plant the carbon source it needs to photosynthesise, and also allows the investigator to see the oxygen, as air bubbles, as the float out of the leaf.

Learning outcomes

Students will be able to:

- see oxygen coming out of a plant photosynthesising.

Materials

- 1/8 teaspoon sodium bicarbonate (baking soda)
- 1 drop dishwashing liquid
- 300ml water
- 2 (or 3) x weeds or leaves per experiment, pulled fresh from the ground, preferably on a sunny day. Weeping willow works well, as does paspalum, and some native grasses.
- Clear container (one per experiment)
- Artificial light source (one per experiment) (see guide on using artificial light sources here)

Instructions

1. Prepare the solution for each trial by mixing:

- 1/8 teaspoon baking soda
- 300ml distilled or cooled, pre-boiled water
- 1 drop dishwashing liquid

The bicarbonate serves as a source of carbon dioxide for photosynthesis. The dishwashing liquid wets the waxy surface of the leaf allowing the oxygen a freer pathway to escape.

This solution can't be made too far in advance, because the sodium bicarbonate will escape as carbon dioxide over time, depleting the plants source of carbon.

2. Place the solution into a glass or clear container.
3. Place the freshly picked weed or leaves into the solution.
4. Place the weed and solution into sunlight, or under a strong indoor light, one that you'd use for hydroponic growth.
5. Watch the bubbles as they float to the surface.

This is what bubbles of oxygen look like as they're forming on a native grass while photosynthesising.

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Part 2: Planting seeds experiment

Teacher information

In this plant growth experiment, students will see that the seeds grown in the cupboard, without light, will grow, although they might expect it to.

This is because for the first few days or weeks of a plants life, the seed contains everything it needs for life. That usually allows the plant enough time to grow up through the soil and to the sunlight it needs to survive.

If grown without light, leaves won't produce chlorophyll. Chlorophyll molecules are the molecules that absorb light for photosynthesis. Leaves don't absorb as much green light as blue and red light, so they appear green. The green is reflected back to your eyes, because most leaves don't use the red and blue light for photosynthesis.

The plants grown in the cupboard won't contain chlorophyll, so they'll look white.

Learning outcomes

Students will be able to:

- discuss and predict what will happen in their experiment.
- students will become familiar with the scientific method.

Materials

- grass seeds
- cotton wool
- clear plastic disposable cups to use as test pots
- water

Instructions

Students have seen photosynthesis happening, do they know what goes into, and what comes out of photosynthesis? Plants use energy from the sun to convert carbon dioxide and water into oxygen and sugar.

1. Given what they know about photosynthesis, ask the students what they wonder about the seeds and plants. Explain that the class will be growing some plants in a cupboard and some on a window sill. One question might be:

- I wonder if the plants in the cupboard will grow

2. Next, explain that as scientists their job is to have a guess at what's going to happen next. This will be their hypothesis. It should start with 'I think that...'. From what's above, they should sounds something like:

3. I think the plants will grow in the cupboard and on the window sill

4. Next, they'll need to describe or write out their steps, which is their method, including the things that stay the same, and the one thing that's different between their test pots.

- In our test, we placed grass seeds into small cups with 3 x cotton balls each. We kept the cotton balls wet but not soaking and the seeds sprouted on the third day. The grass had grown enough to show an obvious colour change in five days.

5. Discuss with the class how they will measure their results. They can do this by a yes/no, (i.e. yes it's growing, or no it's not), or by measuring the growth with a ruler or another method that the class comes up with

6. Next the students will plant their test pots, putting a few seeds in containers with cotton wool and some water.

7. Don't forget to keep watering the plants every day or two.

Seeds planted, ready to grow.

For the word wall

Carbon dioxide, Oxygen, Photosynthesis

Science Snapshot
Min Chen

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Did you know that plants absorb different amounts of different colours of the light spectrum? Min Chen investigates.

Meet Min Chen.

Ever since Min was a child she's been curious about the world around her. She says her work looks hard, but in fact it's been easy because at every step of the way, she's followed her childhood dream.

Min says her lab is an extension of her kitchen - somewhere she can explore and fulfil her curiosity and it's where she feels most relaxed and happy.

A bit about Min's research

In 2010 Min's curiosity led her to investigate a group of large, ancient structures called stromatolites in Shark Bay, Western Australia. What she discovered there, no one had ever seen before. Min found a new type of chlorophyll. Chlorophyll is the pigment that absorbs light energy that's then used in the process of photosyntheisis.

It's called chlorophyll f and it can photosynthesise under very low light conditions, like inside stromatolites.

Different leaves absorb different amounts of the different colours of hte light spectrum. When you think of the colours of the rainbow, most leaves absorb the red light and the blue light the best. The green light energy then reflects back to your eyes, and that's why leaves are green.

The chlorophyll Min discovered, the chlorophyll f, can absorb light we can't even see - the far red light energy on the spectrum of light.

Min and her team are working to modify photosynthesis in food crops to work similarly to the chlorophyll f, so it can absorb more light and grow more food.

More about Min

What got you into science? Curiosity. I am interested in knowing how, why and what from surroundings since I was a girl. Such curiosities result into my passion about sciences.

What do you enjoy most about research? Something are new. Every morning you have new hopes for new results, some unexpected results and new challenges.

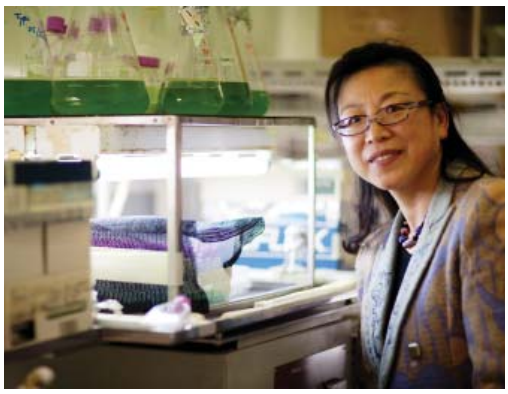
What do you see as challenges for your field of research? New concepts, new questions, and potential new directions in the research.

Who are your science heros? During my high school, I had two favourite subjects, Physics and Biology because of my teachers. I learned how to assembly my first radio from my physics teacher (such knowledge is still useful for me to develop LED light set-up for cyanobacteria/plant culture facilities. Knowledge across disciplines are important for opening your mind and constructing your creative thoughts

I was pleased to have opportunities meeting with many great scientists in photosynthesis research, Talking with them, you can learn more than reading a book (also a quick way to get frontier knowledge in the field). such as Prof Jan Anderson, Prof Hugo Scheer, Prof Robert Blankenship, Prof Jim Barber, Petra Fromme, and others.

What else do you have underway? I enjoy cooking, knitting and sewing if I have time. I also like travel (just wandering around "unknown" cities) for learning different cultures.

It is said " you can do your experiments if you know how to cook".



Min Chen in her lab.

Photo credit: University of Sydney

Stromatolites at Shark Bay, Western Australia.

Year 2 Small change, big difference

Growth and change

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Students have already planted the seeds for their change and growth experiment. In this lesson students will discuss their results and start a new experiment.

Teacher information

Students will see that the seeds have grown in the cupboard. This is because for the first few days or weeks of a plants life, the seed contains everything it needs for life. That usually allows the plant enough time to grow up through the soil and to the sunlight it needs to survive. If grown without light, leaves won't produce chlorophyll. Chlorophyll molecules are the molecules that absorb light for photosynthesis. They don't absorb as much green light as blue and red light, so they appear green. The plants grown in the cupboard won't contain chlorophyll, so they'll look white.

Learning Outcomes

Students will be able to:

- understand what they've observed.
- work through the scientific method.

Materials

- experiment from previous lesson
- test pots from previous lesson

Instructions

1. Students will have made some anecdotal observations while watering their test pots.
2. Ask the students what they've seen, and what they think happened.
3. Were their guesses correct?
4. Explain that it doesn't matter whether their guess is correct or not. In science it's all about getting a result (any result!) and rejecting a hypothesis is just as valuable as accepting a hypothesis.
5. Next place all the test pots to grow on the window sill.
6. What do they think will happen next?

These pots contain grass seeds. The pot on the left germinated by a window. The pot on the right germinated in a cupboard. Notice the difference in colour.

For the word wall

Scientific method

Variable

Constant

Hypothesis

Research

Science Snapshot
Vivien Rolland

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Leaves absorb different kinds of light for photosynthesis, but did you know leaves can also make light bend?

Meet Vivien Rolland.

Viv grew up in France and moved to Vienna to study the tiniest pieces of biology, the molecules. Viv moved to Australia to work at the Australian National University after finishing his doctorate degree, where he later started working with the ARC Centre of Excellence for Translational Photosynthesis.

Since then, Viv's worked on a number of molecular mechanisms in plants and insects. Currently, Viv's working at CSIRO and is still a part of the Centre. Viv uses microscopes and light to investigate how changes in a plant's DNA will affect its cells

A bit about Viv's research

The picture you see is of a single plant cell where the cell wall has been taken away. Viv's taken the cell walls away by putting small sections of leaves into a liquid solution that has enzymes in it that digest away the cell walls. An enzyme is a molecule that will start or speed up a reaction. An example is the enzyme that's found in pineapple. It will break down protein like meat. That's why pineapple is a good meat tenderiser and why your tongue will hurt if you've eaten too much.

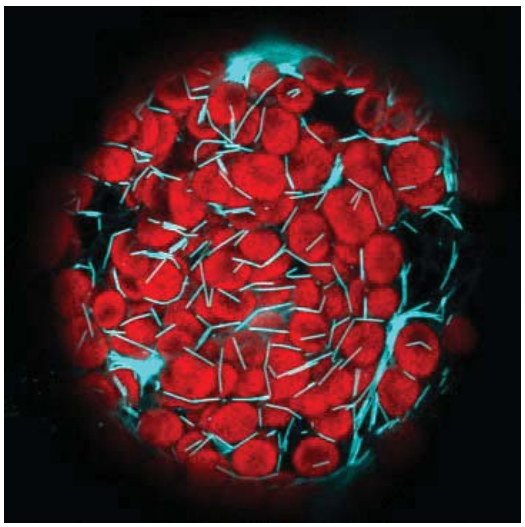
In this image, the red discs are chloroplasts, the subcellular organelles in which photosynthesis takes place. They are naturally fluorescent. Which means that under the right conditions they are able to bend light, so instead of looking green, they fluoresce, or glow, red.

The cyan/blue colour you can see are proteins. A DNA sequence has been added to the cell by microscopic organisms. The added DNA sequence includes a fluorescent marker, so that the added protein can be tracked within the cell using a microscope. The fluorescent marker is what makes them glow. This is done for two reasons.

1. So the researcher knows exactly where the changes in DNA will be acting in the cells, and

2. So that if the changes they want don't go in the right place, they're able to try again until they get exactly what they're after.

In this picture, it shows that the blue proteins haven't made it into the chloroplasts, you can see that they slot in and around the chloroplasts instead.



This is a single leaf cell where the cell wall has been taken away. The red discs you see are chloroplasts. The image hasn't been digitally altered. Each red disc is around 5-10 micrometers wide, which is 0.005-0.010 millimeters.

You can try this yourself!!

Try using a mortar and pestle to extract chlorophyll from a leaf with some nail polish remover (make sure it's got acetone in it). Add a tiny pinch of bicarb soda.

Shine a UV or 'blacklight' on them, the lightbulbs are at Bunnings or online. The previously green solution will appear red!! Just be sure to keep safety first and implement your school's policy if using acetone in the classroom.

Science Snapshot
Vivien Rolland

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Leaves absorb different kinds of light for photosynthesis, but did you know leaves can also make light bend?

More about Viv.

What got you into science?

Asking questions! I have always been curious about the world and could not stop wanting to understand "how things work". And I found that of all sciences, biology was the most fascinating because it relates to us and all the creatures that we see around us, interact with, and totally rely on. From a young age, I was fascinated with observing birds. And from there, I dived right in: how do DNA and other molecules are able to build fully functioning animals, ecosystems, and social structures?

This is Viv, at work and bike riding.

What are your current research interests?

They are quite broad because I am curious about many things. But right now, I am interested in how plant cell walls work. They are essential to so many aspects of life. For example, they are the reason plants can grow up to 100m or that wheat plants can stay up when there is wind, they are what makes your cotton tee-shirts, and without cell walls there would be no wood – think about how this would change your life! If we understand how cell walls work, we can try to improve their properties or even give them new properties – like cotton tee-shirts which don't crease or are water-repellent!

What do you see as challenges for your field of research?

The biggest challenges I have in mind are not specific to my field. One of them is that research takes time because we are constantly pushing the envelope of knowledge, but we live in an age of immediate results. Sometimes it is hard to reconcile both, especially with funding pressure. Another challenge is to keep increasing diversity in science. Science is not done by long-bearded mad scientists, mixing chemicals in their basement – nor is it as depicted in TV shows! In truth, it is done by ordinary people, and because science entirely relies on new ideas, the scientific community needs to be more representative of the general population. This means that we need more women, and more people from varied cultural backgrounds.

What do you enjoy most about research?

Definitely the fact that I get to look at things that no one else has ever looked at before! There is no thrill greater than working on a difficult problem, cracking it and knowing that you are the first to do so.

Who are your science heros?

Interestingly, I do not have science heros. To me, scientists are not heros, they are just like you and me.

What else do you have underway?

I love riding my mountain bike and my road bike with friends, I keep bees and I love birdwatching!

Year 2 Small change, big difference

Lights, colour, action!!

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Students have placed their white plants on the window sill to continue growing. What do they see?

Teacher information

The leaves that were grown in the cupboard were white, because they hadn't yet produced chlorophyll. When placed on the window sill with plenty of light, chlorophyll were produced by the plants. This is an example of plants changing according to the physical characteristics of their environment.

The change from white to green leaves happens quickly. The second photo below changed from white to green in only one day (i.e. it was taken out of hte cupboard in the morning, and by the afternoon the leaves were green).

Learning Outcomes

Students will be able to:

- understand what they've observed.
- work through the scientific method.

Materials

- experiment from previous lesson
- test pots from previous lesson

Instructions

1. Students will have made some anecdotal observations while watering their test pots.
2. Ask the students what they've seen, and what they think happened.
3. Were their guesses correct?
4. Explain that it doesn't matter whether their guess is correct or not. In science it's all about getting a result (any result!) and rejecting a hypothesis is just as valuable as accepting a hypothesis.
5. Did they think the leaves would change colour?

Explain that plants aren't like animals (including humans), they can't move to make sure their environment gives them what they need.

Plants have to change to survive in their environment because they can't move. This is an example of plants changing according to their environment.

These are the grass seed pots, five days after planting. The pot on the right was grown inside a cupboard.

These are the same pots after both being placed by a sunny window for one day.

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Planticulate!!

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Students will play an intereactive describing game to cement their literacy learning and to have fun with plant words.

Teacher information

The game 'Articulate for kids' has been adapted for use in this unit. Students pick up a card and try to explain the word, without saying the actual word to their opponent, so the other person can guess what the word is. Each player has 1-2 minutes on the timer to guess, depending on where the students are at in their learning.

Learning outcomes

Students will be able to:

- describe the words associated with plants and photosynthesis
- practice social and literacy skills.

Teachers will be able to:

- evaluate classroom learning.

Materials

- printed cards
- timer

Instructions

1. Print off the vocabulary cards and cut them up for class (one set per group of 4)
2. In pairs, one person:
3. Takes a card from the top of the stack, while...
4. ...The other person starts the timer.
5. Set the timer to 1 minute for confident explainers, or 2 minutes for students who are still learning
6. Describe the word on the card, but you CAN'T spell the word, say the word or any part of it, you can't say 'rhymes with' or 'sounds like'
7. You CAN describe the word, act or mime the word
8. If the word is too hard, you can choose to PASS the card and take another one. You can PASS no more than TWO cards per turn.
9. At the end of the timer, it's your opponents turn. The pair with the most correct guesses at the end of the lesson wins.

Printed Planticulate cards!

Year 2 Small change, big difference

Grow food from scraps

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Students have been learning a lot about science and plants, but why is this all important? And can they uses their learning and apply it to grow more food from scraps?

Teacher information

Researchers at the ARC Centre of Excellence for Translational Photosynthesis are working hard to solve the global challenge of ensuring food security for the worlds increasing population.

They're tackling to problem in a range of ways, and one way is by looking at natural variation in plants.

Students will decide the best place to grow their food, and how much water to give it, in order to be able to grow the most food they can.

This lesson can either be a test of knowledge learnt in the previous experiment or as an investigation to supplement or extend student learning about plant science.

In winter, putting plants by the window sill might be too much of a temperature difference for little growing plants. Try an artificial light (information on what kind of lights to get is here).

Learning outcomes

Students will be able to:

- grow food from scraps.
- to apply students learning to real scientific context.

Materials

- shallots, at least one stem per person or group
- water
- shallow bowls or cups to place the shallots in

Instructions

1. Each pair/small group will need a cut a stem of a shallot to take the green part off.
2. Place the base in 2-3 cm's of water in a shallow bowl or wide based cup
3. For the best results, place the shallots somewhere near sunlight, where it's sheltered from winter cold
4. Change the water every 2-3 days
5. You should see growth in 24 hours.
6. After 3-4 days, measure the growth.

Shallots ready to grow!

Year 2 Small change, big difference

Grow food from scraps

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Students have been learning a lot about science and plants, but why is this all important? And can they uses their learning and apply it to grow more food from scraps?

7. We recommend using shallotsfor this experiment because we've it to be the easiest to re-grow, but other food items that may also work are:

- Celery
- Bok choy
- Avocado seeds
- Lettuce
- Fennel
- Potatoes (we recommend organic as regular store bought potatoes are spray with a growth retardant)

Shallots ready to grow!

Shallots after two days growth.

Shallots after five days growth.

Science Snapshot
Emma Mace

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Did you know that plants grow and photosynthesise differently? Emma Mace investigates.

Meet Emma Mace.

Emma works in a lab and on a farm. The farm Emma works on is different to most farms in Australia. The farm is actually a research facility where researchers can investigate different hypotheses.

Emma Mace.

A bit about Emma's research

One of the ways Emma works is to plant seeds from different plants and see which ones grow the best. Usually, she'll plant slightly different seeds from the same kind of plant. This might be different kinds of wheat, which makes flour for bread, or a crop called sorghum, which can be cooked and eaten like rice or it can be used as food for cows.

She'll plant a number of small gardens, called plots, with these seeds. The plots all get the same amount of water and sunlight. Emma and the other researchers in the team watch the plants very closely with their eyes and also with special equipment to help them measure how well the plant is growing.

The researchers are looking for plants that might produce the most food, or the plants that might survive best in changing weather patterns, like droughts or flooding.

The changes between the different plants is called natural variation. Researchers can use these natural variations that show positive traits on their own, or they might be cross bred with other plants to hopefully create an even more efficient plant.

Emma and the team at the Hermitage Research Facility recently noticed that one species of corn looked a lot greener than the others. They used special equipment to test how well the plants were photosynthesising, and found that the darker corn was able to absorb more light energy, potentially making it better at growing and photosynthesising.

Taking measurements of the different coloured corn.

Year 2 Small change, big difference

Sustainability

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Students have seen that food can be regrown from scraps. Why would anyone want to regrow food from scraps?

Teacher information

It's estimated that around a third of the food that's produced for human consumption is wasted (http://www.fao.org/save-food/resources/keyfindings/en/). That's 1.3 billion tonnes of food globally. Some of that food is destroyed by poor transportation or refrigeration, particularly in developing nations, but some also comes from household wastage and spoilage.

Learning outcomes

Students will be able to:

- compare masses of objects.
- visually see how much waste occurs just in their own classroom.
- gain perspective on food production, waste, and how it relates to their lives.

Materials

- scales
- bucket

Instructions

1. Hold the lesson over lunch.
2. Once students have finished their lunch, ask them to bring their scraps, anything they didn't eat, to front of the room, where it'll be weighed with the whole class's food scraps.
3. Ask students to calculate how much food has been wasted in that one meal
4. Ask them to calculate or estimate the wastage across the school.
5. Ask them to calculate or estimate the wastage across the school, for each of the 3 meals of that day (assuming breakfast and dinner wastage would be similar).
6. For more information, visit http://www.worldfoodclock.com/

Lesson 6

Year 2 Small change, big difference

There's an air in there

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The air involved in photosynthesis can be the most abstract to teach. This lesson uses really exciting experiments to show that air really exists, and that there are different types of air

Teacher information

Air, and the idea that there are different kinds of air, are foundation principles of photosynthesis, but the concept is quite abstract and can be difficult to relay to students. These investigations are designed to show that air exists, that it can be produced, and that different types of air have different properties.

This lesson includes three different experiments that you'll be able to show as displays. They are:

1. Does air weigh anything?
2. Elephants toothpaste
3. Putting fire out with carbon dioxide

Learning outcomes

Students will be able to:

- see that air exists.
- see that liquid can turn into air (quickly!).
- see that air is made up of different types of air, and different types of air have different properties.

Experiment 1: Does air weigh anything?

Materials

- A skewer
- 2 x identical balloons
- String

Instructions

1. Blow up 2 x identical balloons to the same size.
2. Attach the balloons to opposite ends of the skewer (either by poking the skewer through the balloon itself, or by attaching it with tape, string or pegs.
3. Attach the string to the centre of the skewer and then hang it from something.
4. You've made a basic scale
5. Now pop one balloon and see what happens.

Explanation: The full balloon will weigh more than the deflated balloon, because it's full of air, proving that air does have weight.

Video tutorial here: https://www.youtube.com/watch?v=o5LT_wfI98w (Note: Not a Centre created tutorial)

Experiment 2: Elephant's toothpaste

Materials

- Gloves
- Newspaper or plastic cover for the workspace
- Funnel
- 1.25L Soft drink container or similar
- 120 mL of 40-volume/12% hydrogen peroxide
- 1/3 teaspoon of dishwashing liquid
- A package (7gm) of dry yeast
- 4 tablespoons warm (body temperature) water
- Optional: food dye

Instructions

1. Cover the workspace with a cloth
2. With the funnel, put the hydrogen peroxide in the soft drink bottle
3. Add the dishwashing liquid to the hydrogen peroxide and swirl it to mix (add a few drops of food dye here if you choose)
4. Mix the yeast with warm water in a separate container

There's an air in there

The air involved in photosynthesis can be the most abstract to teach. This lesson uses really exciting experiments to show that air really exists, and that there are different types of air

1. Pour the mixed yeast and water into the soft drink container with the funnel
2. Watch as the oxygen-filled foam is created
3. Emphasise that the air bubbles were created by mixing the substances together.
4. Extension or to make this observation into an experiment, try answering the following questions using the scientific method worksheet:
5. Does the amount of yeast change the amount of foam produced?
6. Does the experiment work as well if you add the dry yeast without mixing it with water?
7. Does the size of the bottle affect the amount of foam produced?

Experiment 3: Carbon dioxide putting out fire

Materials

- 2 teaspoons of bi-carb soda
- 1-2 tablespoons of vinegar
- 1 x tea light candle or similar
- Box of matches
- 2 x drinking cups or glasses
- Cloth or paper towel to clean up spills
- 1 x piece of paper or clear acrylic to act as a lid as the CO_2 is being produced

Instructions

1. Put the candle in one of the cups (don't light yet)
2. Put the bi-carb soda in the other cup
3. Have your lid ready
4. Pour the vinegar into the cup with the bi-carb in it
5. Quickly place the lid on top of the cup, so the CO_2 is captured in the cup (CO_2 is heavier than atmospheric air and will stay in the cup naturally, but the lid will help)
6. Light the candle
7. Once the bubbling reaction has stopped in the cup with the vinegar and bi-carb soda, pour the air from the cup only (it will be CO_2) into the other cup with the candle
8. Watch as the candle flame is extinguished by the CO_2
9. Note that the fire couldn't survive in the CO_2, where it could in the regular atmospheric air. Different types of air have different properties.

Safety first

You'll be lighting a candle with a match. Ensure you're following your school's safety policy on the use of matches and candles, it's usually a good idea to have students sit at least a metre from the experiment.

Optional Lesson

Year 2: Small change, big difference

Curriculum outcomes and teacher information

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Type of lesson	Lesson	Short description	Delivery	Science outcomes	Maths Outcomes
Engage	**Planting the seed**	Students see photosynthesis in action and start their own experiment by planting seeds, with one pot growing in a cupboard, and another growing in sunlight.	Observation and experiment	Living things grow, change and have offspring similar to themselves, ACSSU030, Science involves observing, asking questions, describing changes, ACSHE034 Pose and respond to questions, ACSIS037 Participate in guided investigations, ACSIS038 Compare observations others, ACSIS041	
Optional Lesson	**There's an air in there**	This lesson shows that air really exists and there are even different types of air by using exciting experiments.	Observation	Science involves observing, asking questions, describing changes, ACSHE034	Compare masses of objects, ACMMG038
Optional Inclusion	**Science Snapshot**	Min Chen discovered a special type of chlorophyll that grows under very low light.			
Explore	**Growth and change**	Students observe the growth in their different plants. They'll notice that without light, plants will grow for a short time, but they'll look white	Interactive experiment	Living things grow, change and have offspring similar to themselves, ACSSU030 Science involves observing, asking questions, describing changes, ACSHE034 Pose and respond to questions, ACSIS037 Participate in guided investigations, ACSIS038 Compare observations others, ACSIS041	
Explore	**Lights, colour, action!!**	Students observe the changes after they put their white plants on the window sill for a few days.as the leaves won't have produce chlorophyll.	Interactive experiment	Living things grow, change and have offspring similar to themselves, ACSSU030 Science involves observing, asking questions, describing changes, ACSHE034 Pose and respond to questions, ACSIS037 Participate in guided investigations, ACSIS038 Compare observations others, ACSIS041	
Optional Inclusion	**Science Snapshot**	Vivien Rolland inestigates the tiniest parts of leaves using a microscope and light.			

Year 2: Small change, big difference

Curriculum outcomes and teacher information

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Type of lesson	Lesson	Short description	Delivery	Science outcomes	Maths Outcomes
Explain	**Planticulate**	Students practice their new learning, vocabulary and social skills in the fun game of explaining	Interactive language game		
Elaborate	**Grow food from scraps**	Students use their knowledge of how plants grow best to regrow food from scraps.	Interactive experiment	Living things grow, change and have offspring similar to themselves, ACSSU030 Science involves observing, asking questions, describing changes, ACSHE034, Pose and respond to questions, ACSIS037 Participate in guided investigations, ACSIS038 Compare observations others, ACSIS041	
Evaluate	**Sustainability**	Why is all this plant learning important? Because there's not enough food to go around for the increasing population. Students investigate how much food waste there is over one lunchtime to see that small changes can make a big difference.	Interactive experiment	People use science in their daily lives, including when caring for their environment and living things, ACSHE035	Explore the connection between addition and subtraction, ACMNA029, Solve simple addition problems ACMNA030, Recognise multiplication as repeated addition ACMNA031 Compare masses of objects, ACMMG038, Collect, check and classify data, ACMSP049, Create displays of data, ACMSP050
Optional Inclusion	**Science Snapshot**	See how Emma Mace is working to secure food for an increasing population.			

Year 2: Small change, big difference

Materials

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What you will need

Lesson	Materials required
Planting the seed	**Bubbling photosynthesis** • 1/8 teaspoon Sodium bicarbonate (Baking soda) • 1 drop dishwashing liquid • 300ml water • 2 (or 3) x weeds or leaves per experiment, pulled fresh from the ground, preferably on a sunny day. Weeping willow works well, as does paspalum, and some native grasses. • Clear container (one per experiment) • Artificial light source (one per experiment) (see guide on using artificial light sources here) **Planting seeds experiment** • seeds • cotton wool • clear plastic disposable cups to use as test pots • seeds, grass seeds work well • water
Growth and change	• experiment from previous lesson • test pots from previous lesson
Lights, colour, action	• experiment from previous lesson • test pots from previous lesson
Planticulate	• printed cards • timer
Grow food from scraps	• bok choy (one bunch for each student or small group) (other vegetables/fruits could be used as listed at the end of these instructions)** • water • shallow bowls to place the bok choy in • potting mix, if you choose to plant the bok choy after 7-10 days

Materials

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What you will need

Lesson	Materials required
Sustainability	• scales • bucket
There's an air in there	**Does air weigh anything?** • A skewer • 2 x identical balloons • String **Elephants toothpaste** • Shadecloth (to simulate smog) • Aluminium foil to exclude light **Putting a candle out with carbon dioxide** • 2 teaspoons of bi-carb soda • 1-2 tablespoons of vinegar • 1 x tea light candle or similar • Box of matches • 2 x drinking cups or glasses • Cloth or paper towel to clean up spills • 1 x piece of paper or clear acrylic to act as a lid as the CO2 is being produced

Planting Science Scientific Method

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What do you want to know more about?
This is your research question.

I wonder if...

What do you think will happen? Have a guess.
This is your hypothesis.

I think that...

How would you find out the answer to your question?
What steps would you take?

Step 1:

Step 2:

Step 3:

Step 4:

What stays the same?
These will be your constants.

What changes?
This will be your variable. **Only change one thing to make sure you've made a fair test.**

How will you measure your results?

Discuss your results with someone else.
Was your hypothesis correct?