Destructive Forces – Year 4

Weathering is the natural force that wears down objects by the elements (temperature, wind, water, gravity) in the environment. The term is sometimes used interchangeably with erosion, however the two processes are distinct and should not be considered as one. Erosion is the process of transporting weathered material, and weathering is the actual wearing down of that material. Weathering is an important factor in landslides; heavily weathered landscapes are much more likely to be eroded. This wearing down of objects can be either mechanical or chemical. Erosion, always involves deposition: the deposit of the weathered sediment in a new location. Sediment is constantly being worn down by some type of weathering, carried away by an agent of erosion and deposited in a different place.

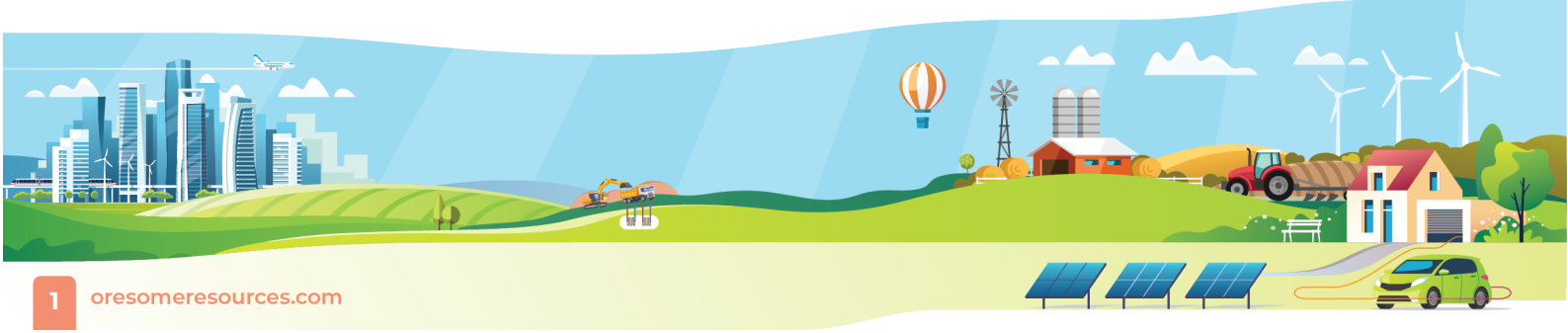
This resource has been produced to align to the content descriptions of the Australian Curriculum: Science for Year 4 students. It incorporates the 5Es instructional model to scaffold the learning of science. This resource suggests a sequence of lessons aligned to the 5Es (Engage, Explore, Explain, Elaborate and Evaluate). For each lesson in the sequence, the resource provides: a set of lesson-specific content descriptions; step-by-step guidance and support for classroom activities which develop the student's understanding of the content; and a set of learning outcomes anticipated for the lesson. When considered together, the lessons' outcomes represent unit outcomes that align the standards of achievement defined in the Australian Curriculum: Science.

Students will explore the differences between weathering and erosion before making an in-depth study of erosion. Erosion in the local environment is investigated. Students create models of water erosion with the teachers' guidance. Through a guided inquiry activity, students design and create a wind erosion model. The culminating activity is the proposal of a remedial land care program to combat erosion of faming soils.

Resource Overview

This resource has been designed to align to the content descriptions of the Australian Curriculum for Year 4, with a particular focus upon Science. The resource includes the following elements, presented approximately in the order of appearance through this document:

- The Australian Curriculum: Science content descriptions which are directly relevant to the theme of 'Destructive Forces' have been identified, and re-phrased to match the theme. These re-phrased content descriptions form the basis of this unit, and are referred to as the unit-level content descriptions.
- Based upon the unit-level content descriptions, a set of unit outcomes is defined. These outcomes have been phrased using similar language and expectations as defined in the



Achievement Standard for Year 4 found in the Australian Curriculum: Science. These outcomes include not only those related directly science, but also those related to literacy and numeracy (i.e., how language and maths is used to 'do' science).

- The phases of the 5Es instructional model1 have been used to sequence the lessons proposed in this unit. For each phase, one or more lessons are used to address the instructional aims of each phase. A unit planner is provided which summarises the correspondence between the phases of the 5Es instructional model, the sequence of lessons, the lesson-level content descriptions, and the assessment of learning outcomes.
- Provision of suitable teacher notes, including links to external resources, which may be used to guide the teacher's development and application of classroom activities. For each lesson:
  - One or more unit-level content descriptions are selected and refined with further detail to form the basis of the lesson, and are referred to as the lesson-level content descriptions.
  - A set of lesson outcomes is defined which complement the lesson-level content descriptions and which support the evaluation of the unit outcomes.
  - Elaboration of the content matter covered in the lesson.
  - A preparation list of those resources and activities that should be readied prior to the lesson.
  - Proposition of a step-by-step activity sequence for the lesson (including suitable explanations of the science involved in the activities), and where appropriate the splitting of lessons into two or more sessions.
  - The integration of tasks which support diagnostic, formative or summative assessment, such that suitable evidence is generated by which to evaluate the achievement of the lesson's outcomes, and ultimately the unit's outcomes.
  - Provision of classroom resources used in the suggested activity sequences (including summaries of useful websites, black line masters, wall charts etc). A summary of the 5Es instructional model and its particular adaptation as the basis for this unit of work.
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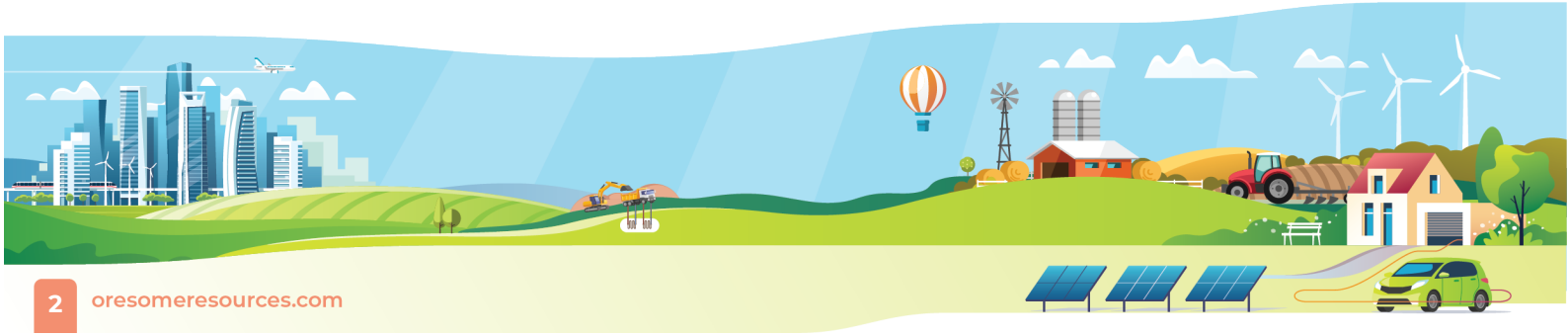
Unit-level Content Descriptions

The following table identifies, for each of the three strands of the Australian Curriculum: Science, the Year 4 content descriptions that are directly relevant to this unit. Additionally, each of the identified content descriptions has been re-phrased in the context of the theme 'Destructive Forces' and so together constitute the unit-level content descriptions that are the basis for learning in this unit.



Destructive Forces - Year 4

Science Inquiry Skills

Questioning and predicting

- With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge.

Planning and conducting

- Suggest ways to plan and conduct investigations to find answers to questions
- Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate.

Processing and analysing data and information

- Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends Compare results with predictions, suggesting possible reasons for findings.

Communicating

- Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports.

In some cases weathering and erosion can be easily observed and remediated. However, prevention is a better option. By modelling and small scale exploration, inferences regarding cause and effect of erosion can lead to responsible farming and mining.

Science as Human Endeavor

Nature and development of science

- Science involves making predictions and describing patterns and relationships.

Use and influence of science

- Science knowledge helps people to understand the effect of their actions.

The phenomenon of weathering and erosion is observable in our immediate environment and is often the result of human activity.

By being aware of the link between human activity and erosion, plans to reduce the effects of erosion can be devised – leading to responsible uses of the land.

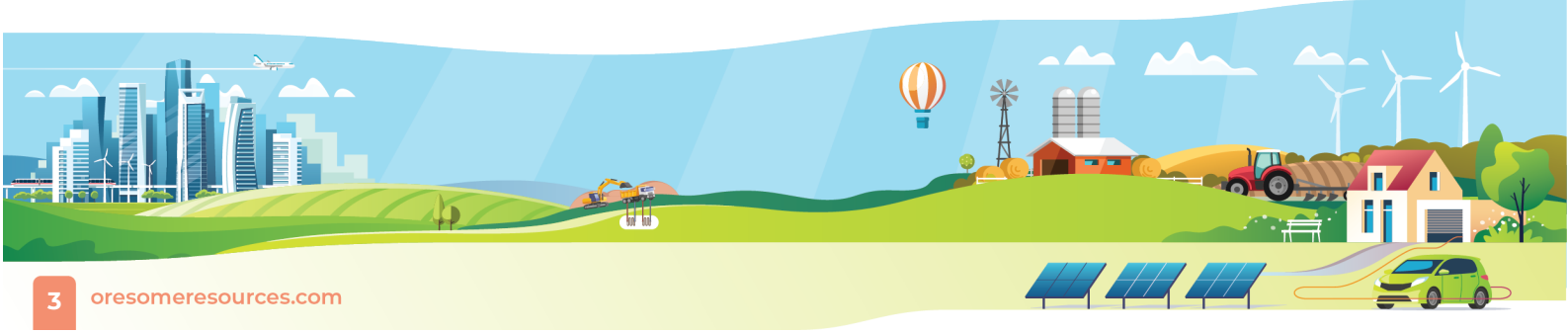
Science Understanding

Earth and spaces sciences

- Earth's surface changes over time as a result of natural processes and human activity.

Erosion and weathering are terms used in relation to the changing earth's surface.

Physical and chemical weathering's, accompanied by erosion shape the landscape and creates soil.



Unit Outcomes

Based upon the Achievement Standard statements for year four found in the Science, English and Mathematics Australian National Curricula, the following science, literacy and numeracy outcomes for this unit have been defined.

Science Outcomes

Students demonstrate a basic understanding of the properties of weathering and erosion (including water and wind) by designing and constructing simple erosion modelling investigations.

Students predict what might happen when variables are changed.

Students conduct investigations using equipment in a way that improves the accuracy of their measurements and observations.

Students describe patterns in their results, report on their findings and reflect on the methods that they have used.

Literacy Outcomes

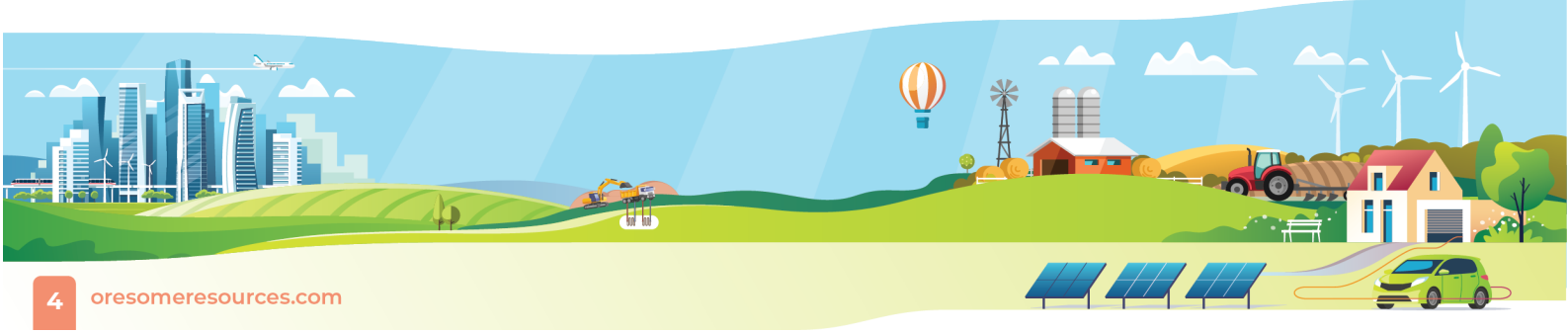
Students select specific scientific vocabulary to express and develop ideas relating to erosion.

Students write clear, well-structured sentences and paragraphs and use punctuation to provide structure and meaning in their writing.

Students, individually and in groups, present electronic reports of scientific findings from investigative activities.

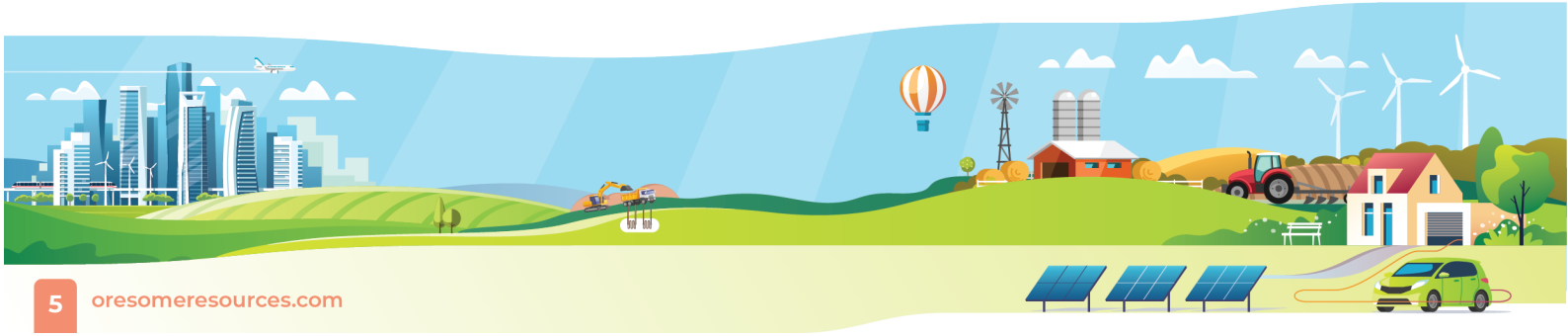
Numeracy Outcomes

Accurate measurements are made and students tabulate and graph primary data.



Unit Planner

Phase	Lesson	Lesson-level Content Descriptions	Assessment of Lesson Outcomes
Engage	**Lesson 1** *Weathering and Erosion*	Weathering and erosion are different forces Weathering processes are either physical or chemical, and occur over time	Students may able to: - Describe differences between weathering and erosion - Follow instructional text - Create a recount of key ideas
Explore	**Lesson 2** *Erosion & Deposition in Local Environment*	Awareness of local environment Identifying and explaining examples of erosion Accurate recording of scientific data is essential	Students may able to: - Accurately record measurement data - Pose solutions to erosion problems
Explain	**Lesson 3** *Modelling Small Scale Water Erosion* Lesson 4 *Sedimentation*	Modelling of processes allows the identification and manipulation of variables Accurate recording of scientific data is essential Vegetation reduces erosion Soil in run off impacts on water quality Accurate recording of scientific data is essential	Students may able to: - Accurately record measurement data - Follow procedural instructions Students may able to: - Accurately record measurement data - Follow procedural instructions
Elaborate	**Lesson 5** *ICT lesson – poster creation for water erosion management*	Ability to use ICT Identifying and explaining examples of erosion Accurate recording and interpretation of scientific data is essential	Students may able to: - Explain erosion examples - Create informative poster presentation



	Lesson 6 *Guided Inquiry – Wind Erosion*	Explain wind erosion and consider safety obligations Design an investigation to model wind erosion Accurate recording of scientific data is essential	Students may able to: - Accurately record measurement data - Design own investigation - Explain safety issues
	Lesson 7 *Modelling Small Scale Wind Erosion*	Awareness of local environment Identifying and explaining examples of wind erosion Accurate recording of scientific data is essential	Students may able to: - Accurately record measurement data - Conduct open inquiry - Explain modelling
	Lesson 8 *Remedial Program for Mining and Farming Soil*	Land stewardship is essential to protect our farming resources Amount of viable farming soils is small Commonalities between farming and mining Interpreting scientific data	Students may able to: - Link erosion between different contexts - Accurately record measurement data
	Lesson 9 *The Meaning of our Mountain*	Compare and look for declining measurement trends Choose appropriate type of graph to represent time based data Construct written explanation	Students may able to: - Compare data - Represent data accurately - Interpret data - Describe trends and provide explanations

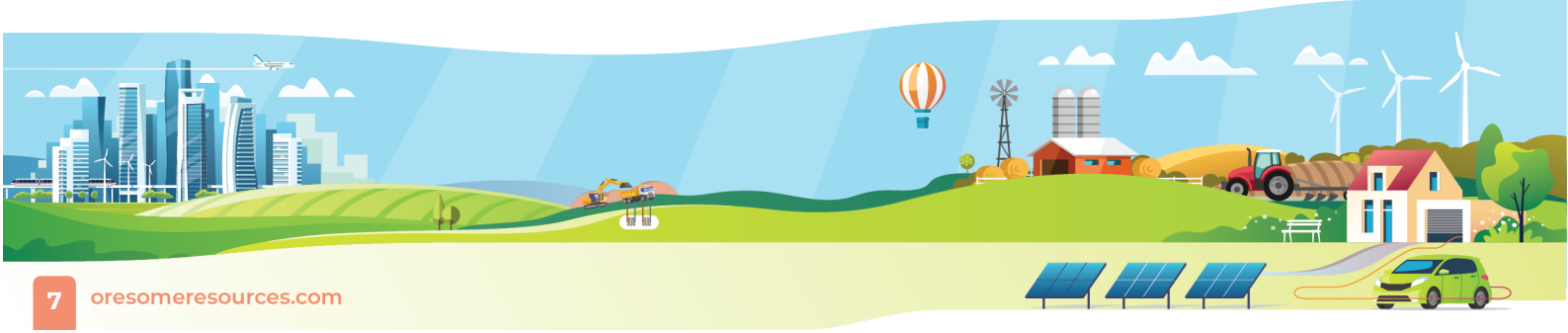
Teachers Notes

Weathering is the natural force that wears down objects by the elements (temperature, wind, water, gravity) in the environment. The term is often used interchangeably with erosion; however the two processes are distinct and should not be considered as one. Erosion is the process of transporting weathered material, and weathering is the actual wearing down of that material. Weathering is an important factor in landslides; heavily weathered landscapes are much more likely to be eroded. This wearing down of objects can be either mechanical or chemical. Erosion, always involves deposition: the deposit of the weathered sediment in a new location. Sediment is constantly being worn down by some type of weathering, carried away by an agent of erosion and deposited in a different place.

Water is the most important erosional agent, most commonly as running water in streams. Raindrops (especially in dry environments) create splash erosion that moves tiny particles of soil. Water collecting on the surface of the soil collects as it moves towards tiny rivulets and streams and creates sheet erosion. In streams, water is a very powerful eroding agent. The faster water moves in streams the larger objects it can pick up and transport. This is known as critical erosion velocity. Recent Queensland floods are an excellent example of this. Fine sand can be moved by streams flowing very slowly. Streams erode their banks in three different ways: 1) the hydraulic action of the water itself moves the sediments, 2) water acts to corrode sediments by removing ions and dissolving them, and 3) particles in the water strike the bedrock and erode it.

Erosion by wind is known as aeolian (or eolian) erosion (named after Aeolus, the Greek god of winds) and occurs almost always in deserts. Aeolian erosion of sand in the desert is partially responsible for the formation of sand dunes. The power of the wind erodes rock and sand.

Agricultural areas often experience dust storms. In 2009, Brisbane was blanketed by a very dense dust storm which originated “probably from the New South Wales-Queensland border, out further west, Southern Queensland, directly where the dust is coming from. The south-westerly wind is bringing it across" (ABC reporter Fidelis Rego).



Engage

Lesson 1: Weathering and Erosion

Weathering and erosion are often erroneously considered to be the same entity. Introductory activities are presented to highlight the differences between the two. Following these activities, the students will build a "mountain" of soil 50 cm high in an undisturbed but exposed location in the schoolyard. Each lesson, the class will observe the mountain and measure its height and width and note any changes in its surface. These measurements need be tabulated and graphed over time.

In this lesson, students will:

- Conduct a variety of short investigations relating to weathering.
- Conclude that weathering can be either physical or chemical.
- Build a mountain to measure and observe the occurrence of erosion over time.

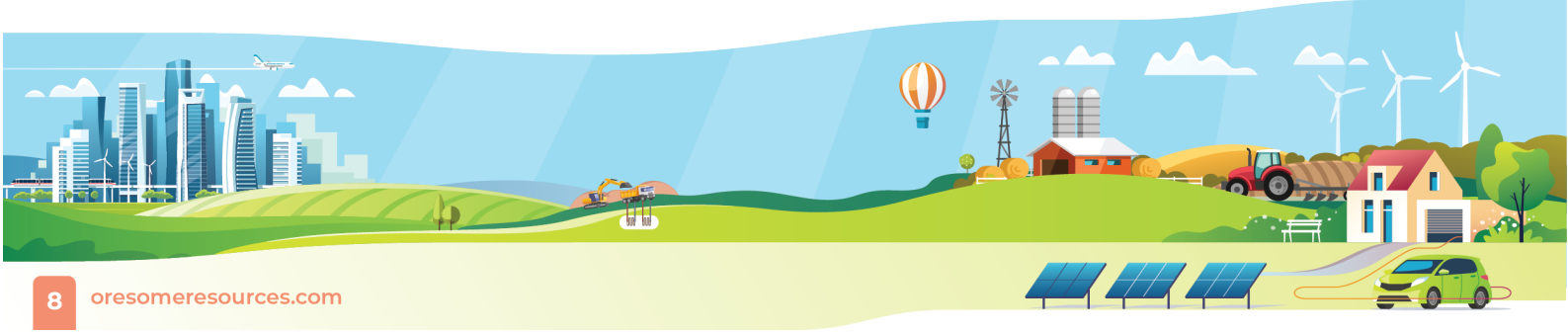
Lesson-level Content Descriptions

- Develop an understanding that weathering and erosion are different.
- Chemical weathering explored via vinegar and carbonate rocks.
- Physical weathering is explored by rocks tumbling on each other.
- A term long activity of documenting weathering is established. Students build a dirt mountain and observe it over time – documenting its changes.

Lesson Outcomes

The assessment focus of this lesson is diagnostic.

The classroom activities provide an opportunity for students to generate evidence with which the teacher can establish the student's current understanding of the concepts which are to be further developed throughout the unit, as well as those other prerequisite understandings that underpin conceptual development. The students may be able to: Describe differences between weathering and erosion Follow instructional text Create a recount of key ideas



Preparation List

For the whole class:

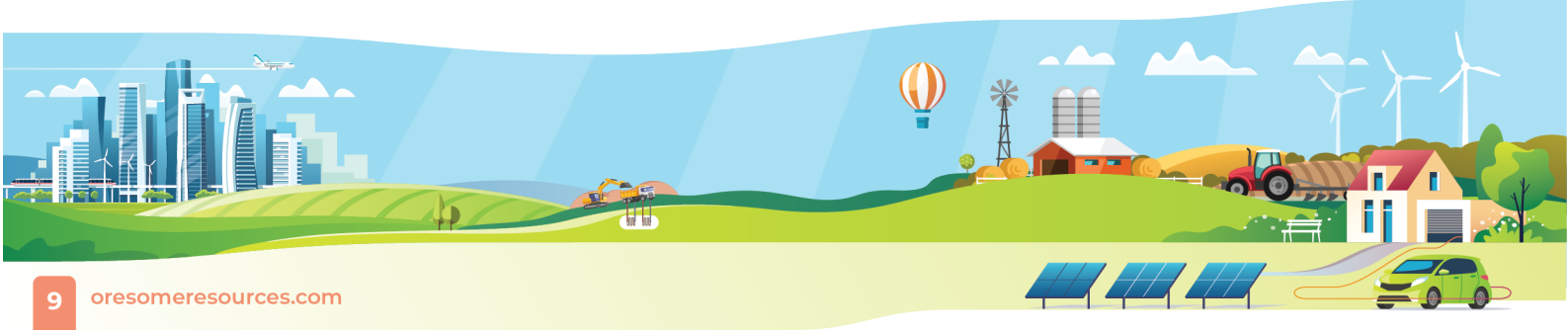
- A pile of garden soil. The teacher will have arranged a class pile for you to use.
- Spade (optional)
- A long piece of rope
- 2 meter rules
- Measuring tape (a 5 meter tape would be ideal)

For each group (pairs):

- 4 small beakers
- 8 limestone or marble chips
- 8 sandstone chips
- Clear water
- Vinegar
- a small number of rocks or brick chips. Softer rocks such as sandstone, shale, or limestone work best
- a large plastic soft drink bottle with lid
- ½ bottle of clear water
- Filter paper or kitchen towels (2 sheets)
- Funnel
- Magnifying glass
- Camera

For each student:

- Paper and pencil (scrap paper is fine)
- Gardening gloves (optional)
- Copies of the 3 worksheets



Activity Sequence

1. Introduce the unit by showing students a PowerPoint slide containing a collage of photographs of weathered and eroded landforms. Use the slide to initiate a discussion of weathering and erosion. Use photographs that may be relevant to students (e.g. farm erosion, mine site erosion or local landslip).

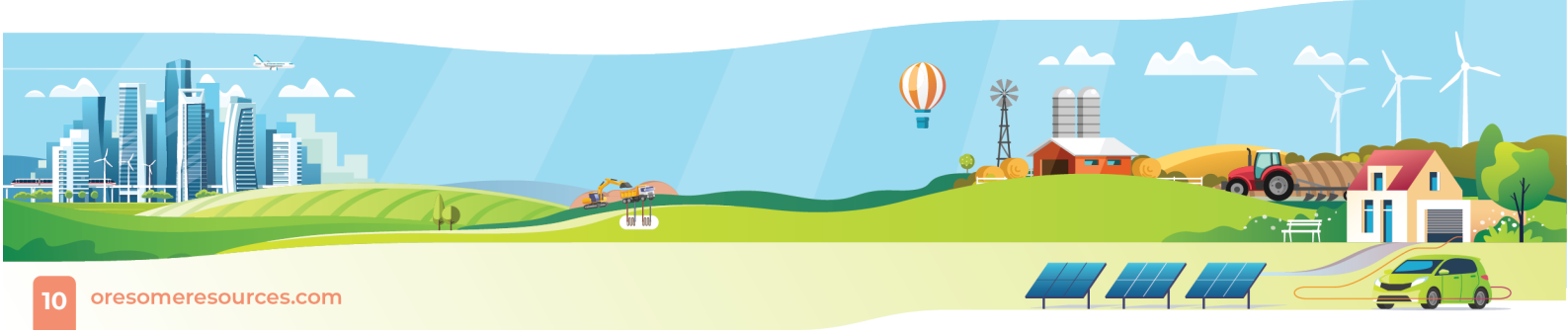
Observe the level of complexity and sophistication of the terminology used to describe the student's prior knowledge of weathering and erosion.

2. Outline work to be covered over next 8 weeks:
   - Looking at the difference between weathering and erosion
   - Building a mountain to measure its erosion
   - Investigating water erosion
   - Designing investigations to investigate wind erosion
   - Propose a remedial plan to prevent farmland erosion

3. **Student Activity 1 - How do Chemicals Weather Rocks?** In this activity, students place a small number of rock chips in water and vinegar. You may notice some bubbles forming in the sample with the vinegar. Ask the students to speculate about what this might mean [The carbonate rocks in vinegar will react to produce carbon dioxide]. If reaction is allowed to continue over time, it is possible to evaporate off the liquids to show the soluble salt weathered from the rock chips.

4. **Student Activity 2 - How do Streams Weather Rocks?** In this activity, students place a number of freshly broken rocks or bricks in a plastic soft drink and shake vigorously. The more it is shaken, the better the results. The shaking can be done in conjunction with Student Activity 3 below. When out in the school grounds building a mountain, students can roll the container, use it as a soccer ball to kick it around etc. Complete this activity back in the classroom using a magnifying glass to look at contents of plastic container.

5. **Student Activity 3 – Build a mountain.** Build a "mountain" of soil 50 cm high in an undisturbed location in the schoolyard. Observe the mountain once a week for the school term. Have students measure its height and width and note any changes to its surface. These measurements should be tabulated and graphed over time. A large class graph could be created and added to each week. After observing the mountain for the extended period of time (8 weeks), ask students to suggest what forces might have caused changes in your mountain. How long do they think the mountain would remain



if you left it there?

6. Lesson is concluded with students writing a recount of the main ideas in each of the activities they did. This recount may be a simple sentence per activity (e.g. acid on some rocks eats them away. Water and rocks bashing together breaks the rocks into smaller pieces. We measured our 'mountain' before it started to weather.

   Observe the level of sophistication of the sentence structure used in the recount

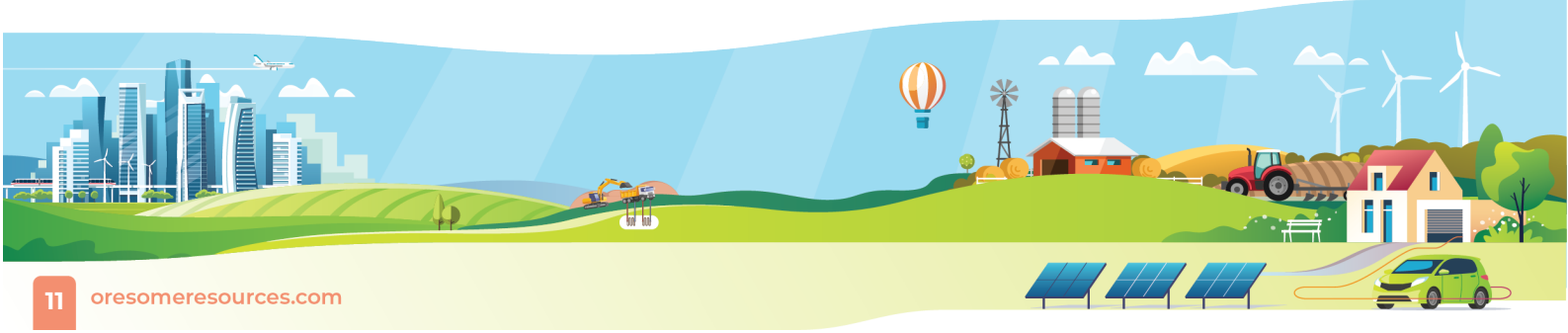
Student Activity 1 – How do chemicals weather rocks?

In this activity you will need to use the following equipment:

- 4 small beakers
- 8 limestone or marble chips
- 8 sandstone chips
- Clear water
- Vinegar
- Paper and pencil (scrap paper is fine)

Once you have the equipment, do the following:

1. Place 4 chips of limestone into each of two beakers
2. Place 4 chips of sandstone into each of the other two beakers
3. Label each beaker with the rock type – write the name of the rock on the scrap of paper and put paper under beaker so it won't blow away
4. Gently pour vinegar into one limestone beaker and one sandstone beaker. Only pour in enough to cover the chips. Add 'vinegar' to the label of these beakers



You may notice some bubbles forming in the beaker with the vinegar. What do you think this might mean? Draw a diagram of what you are observing.

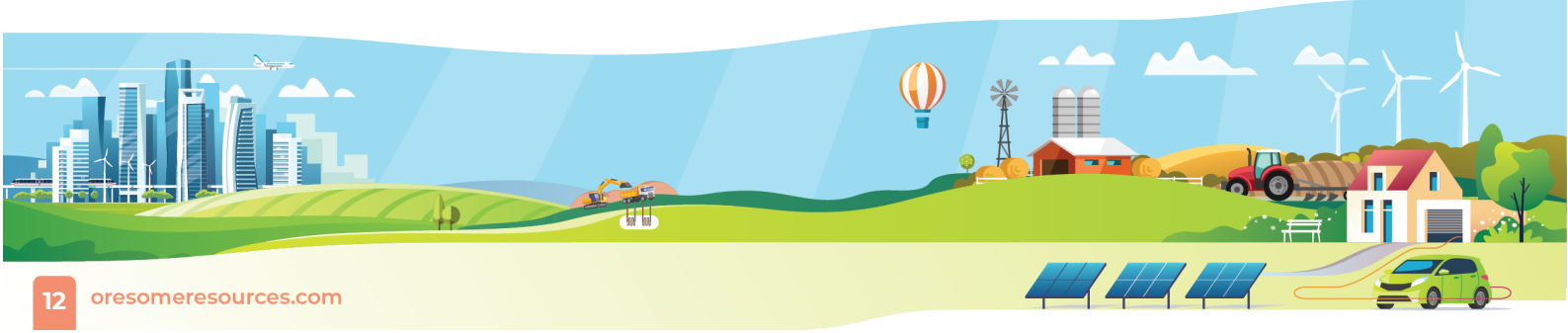
5. Gently pour water into the other two beakers. Only pour in enough to cover the chips. Add ‘water’ to the label of these beakers.

6. Allow the jars to stand overnight. Your teacher might take the beakers back to the classroom so you can do step 7 tomorrow.

7. The next day, pour out the liquid from each jar into separate bowls. Label the bowls "water" and "vinegar". Allow the water in the bowls to evaporate.

8. Compare the amount of solid material remaining in the bowls.

One of the bowls has more solid material in it than the other bowl. Which bowl is this, and what do you think the solid material is? Draw a diagram of your bowls.



Student Activity 2- How do streams weather rocks?

In this activity you will need the following equipment:

- a small number of rocks or brick chips. Softer rocks such as sandstone, shale, or limestone work best
- a large plastic soft drink bottle with lid
- ½ bottle of clear water
- Filter paper or kitchen towels (2 sheets)
- Funnel
- Magnifying glass
- Camera (optional – to take before and after photos of rocks)

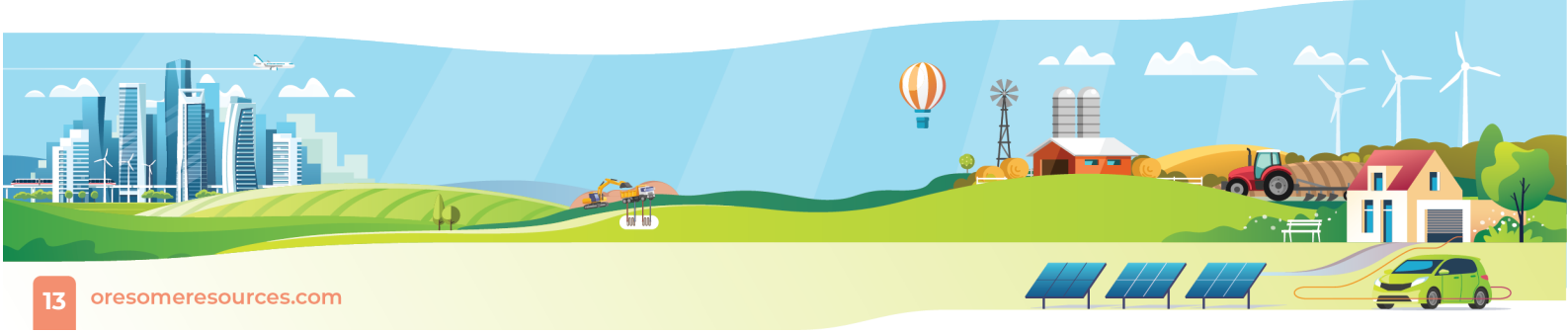
Once you have the equipment, do the following:

1. Place some of the rocks or brick chips into the plastic bottle. Make sure the rocks or chips are freshly broken – they should have sharp edges not smooth rounded edges. If you need to break the rocks or bricks, wrap loosely in a rag, and break with hammer.

2. Fill the bottle about halfway with clear water. Put aside some other pieces of the broken rock. Close the lid of the bottle and shake it 1,000 times. Pass the bottle round the class and have your friends take turns to shake it.

3. Take your bottle outside with you if you are going to build a mountain. You can shake it during the mountain activity or kick it around if your teacher says you can.

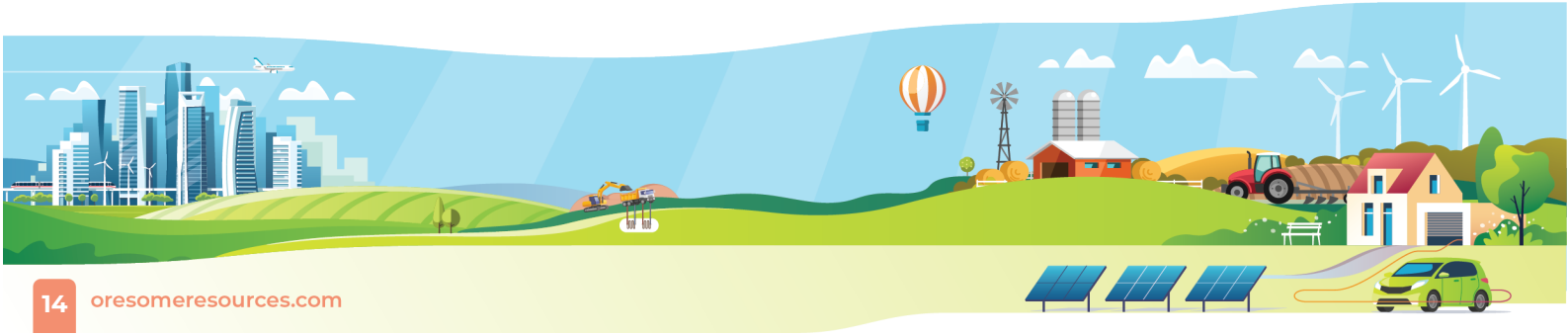
4. After you have shaken the bottle as much as you can, pour all the rocks and water into a funnel lined with paper towels. Remove the rocks and look for changes in the rocks appearance compared with the rocks that were not shaken. Describe these changes.



Describe the changes in the rocks before and after shaking. You may want to use a magnifying glass. Draw a diagram of your rocks.

What do you see in the filter paper? Draw a diagram of your filter paper and sand grains

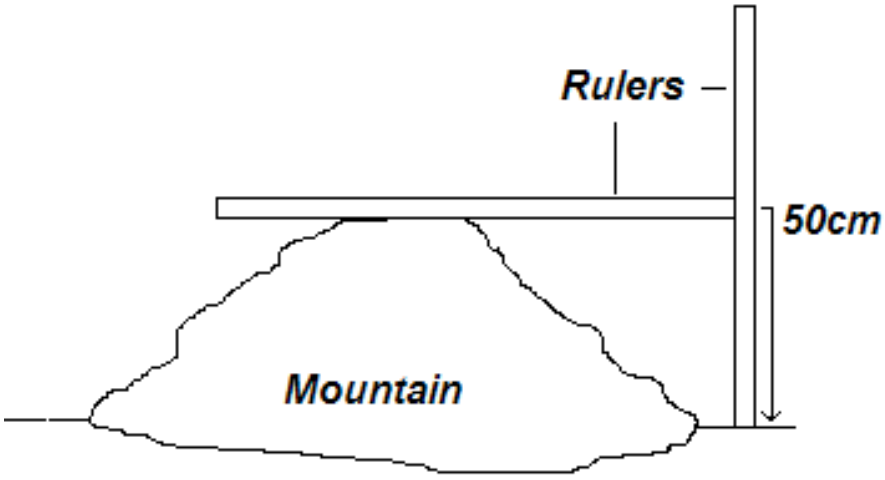
What might happen to rocks in a creek or river? Draw a PROCESS diagram of what you think might be happening. (A process diagram is a picture which has arrows and words explaining the picture. The arrows might show water moving and making the rocks tumble along in the water).



Student Activity 3 – Build a mountain

In this activity you will need to use the following equipment:

- A pile of garden soil. The teacher will have arranged a class pile for you to use.
- Spade (optional)
- Gardening gloves (optional)
- A long piece of rope
- 2 meter rules
- Measuring tape (a 5 meter tape would be ideal)
- Camera (optional – to take weekly photo of mountain)



Once you have the equipment, do the following:

1. With your classmates, build a mountain out of your soil. Discuss with your teacher how best to do this. As you start to build the mountain, make sure you firmly pat down the sides of the mountain.

2. Build up your mountain so it is about 50 cm tall.

3. You may like to place a rock or a stick on top of your mountain when it is finished.

4. With the help of your classmates, use the rope and then the tape measure to measure the base of your mountain.

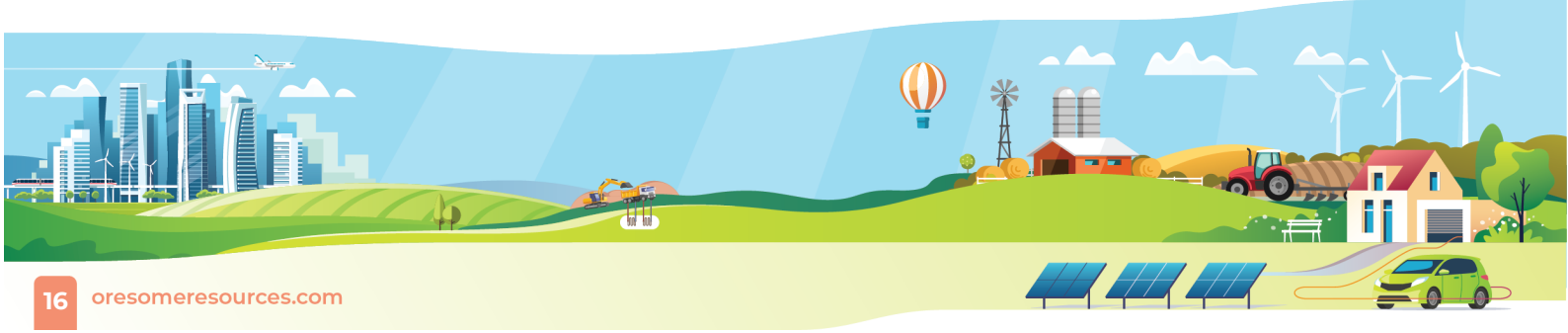
Draw a diagram and describe how you measured the base of your mountain.

What was the base measurement for the mountain?

5. With the help of your classmates, use the 2 meter rules to measure the height of your mountain.

Draw a diagram and describe how you measured the height of your mountain.

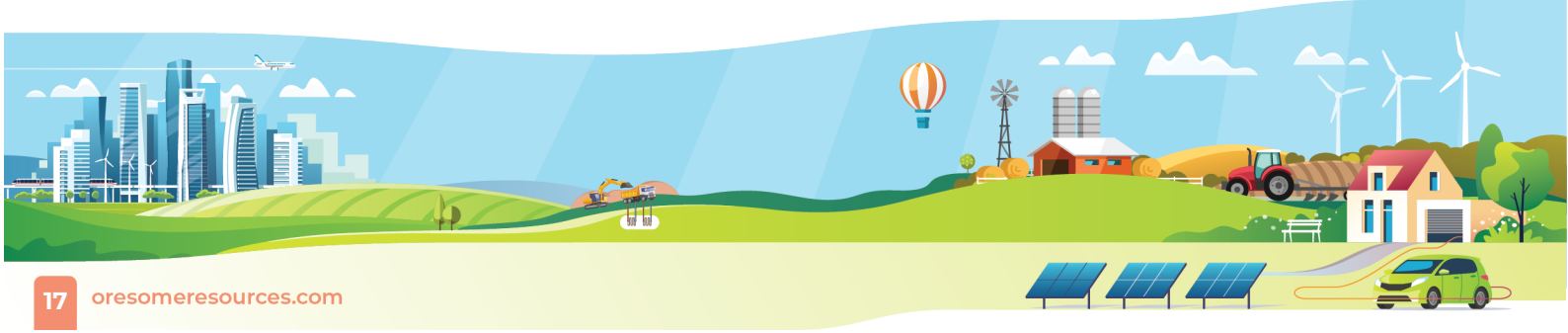
What was the height measurement for the mountain?



6. Below is a data table. Each week your class will visit your mountain and measure its base and height. You might also be taking a photo of the mountain. Fill in all your measurements in the data table.

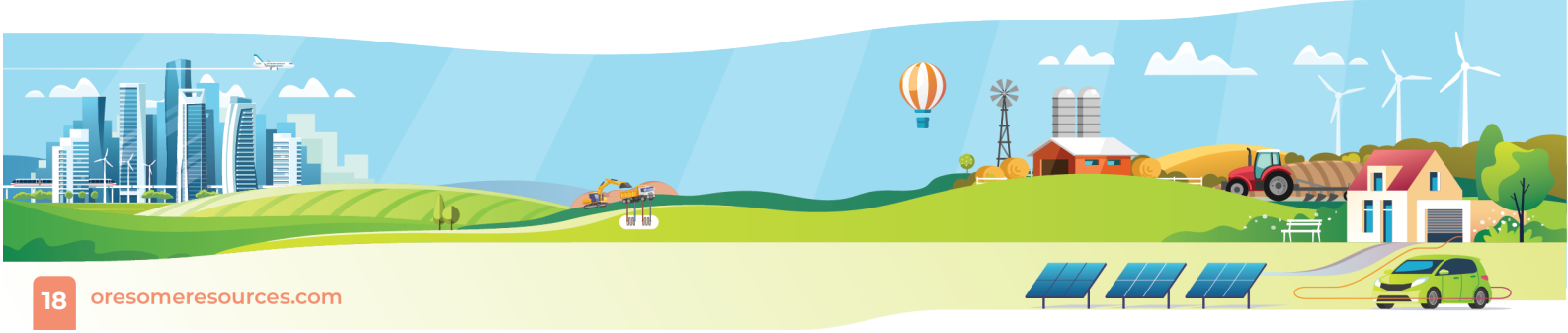
Build a mountain data table.

Week and date	Base measurement (cm)	Height measurement (cm)	Notes about changes to mountain
1			
2			
3			
4			



5			
6			
7			
8			
9			

Each week, record your measurements and notes and add these to the class graph on the wall. In the notes column, you might like to record the weather for the week e.g. it rained on Wednesday and was very windy on Saturday and Sunday.



Lesson 2: Erosion & Deposition in Local Environment

Looking for evidence in school, nearby parklands and local mine (optional).

In this lesson, students will:

1. Explore their school for occurrences of erosion
2. Document the location and nature of the erosion
3. Postulate solutions to erosion problems.

Lesson-level Content Descriptions

- Awareness of local environment
- Identifying and explaining examples of erosion
- Documenting scientific phenomenon.

Lesson Outcomes

The assessment focus of this lesson is formative. Students may be able to:

- Accurately record measurement data
- Pose solutions to erosion problems.

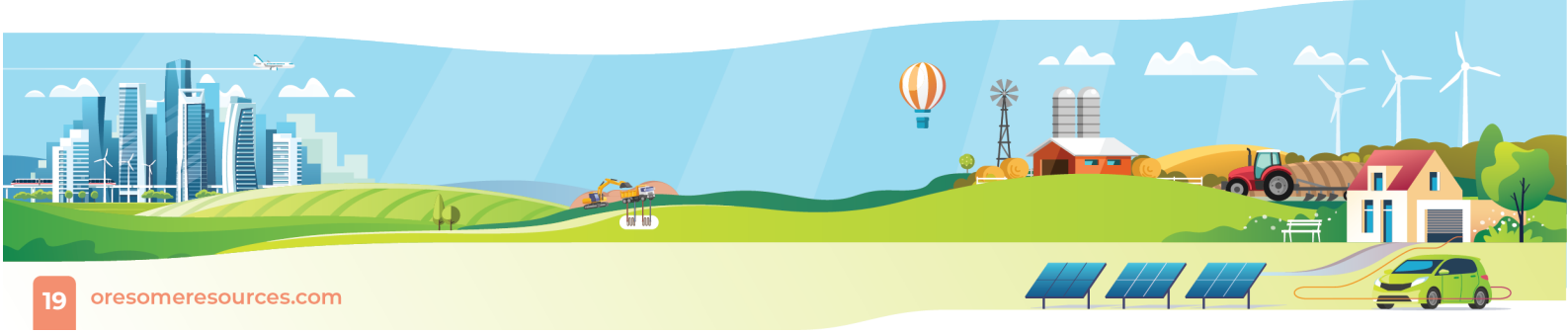
Preparation List

For the whole class:

- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table.

For each group (pairs):

- Digital camera (to record changes in mountain and evidence of weathering and erosion)
- Computer for data storage



For each student:

- Copies of the worksheets.

Activity Sequence

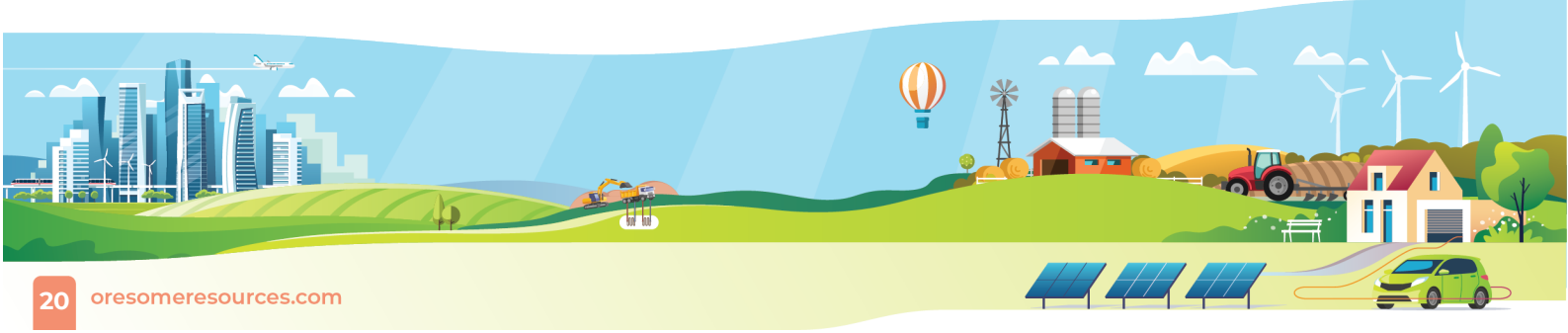
1. Introduce the Lesson: Students are to be involved in 3 activities: Firstly to remeasure the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity is a field trip around the school, local neighbourhood or to a mine to find examples of weathering and erosion which will be recorded. Finally any digital evidence of weathering and erosion needs to be saved onto computer for lesson 5.
2. **Student Activity 1 - Revisit your mountain.** As a class group, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information.
3. **Student Activity 2 - Field Trip** around school or local neighbourhood, and (if possible) to local mine. Just around the corner from the school (near the golf course) is a former quarry. The photo on the last page of the field trip activity shows the obvious erosion occurring. It may be possible to visit this site. A worksheet is provided for the exploration of the school grounds. However, a similar sheet could be created if class is taken beyond the school. An interesting activity would be to compare an open cut mine and the local environment – students could postulate what erosion mitigation occurs at mines.
4. **Student Activity 3 - Saving data.** Updating of class table on mountain data. Saving photos and or GPS, GIS coordinates of locations onto computer.
5. Lesson is concluded with students writing a recount of the main ideas in each of the activities they did.

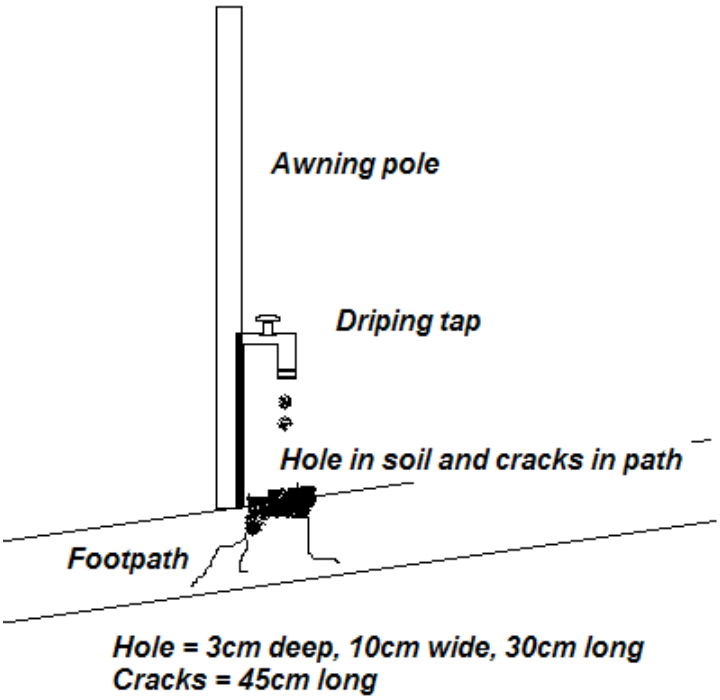
Observe the level of sophistication of the sentence structure used in the recount.

Student Activity 2 – Field trip into local environment

In this activity you will need to use the following equipment:

- A meter rule or a measuring tape
- Camera
- GPS or GIS device (Optional – ask your teacher)
- Paper and pencil to record sketches and measurements.





Once you have the equipment, do the following:

1. Head out of your classroom to where your teacher has directed you begin your search for evidence of weathering and erosion.

2. Walk slowly and look carefully at garden beds, tracks, down pipes and so on. You are looking to find examples of erosion and weathering – like a washed out area or trampled zone.

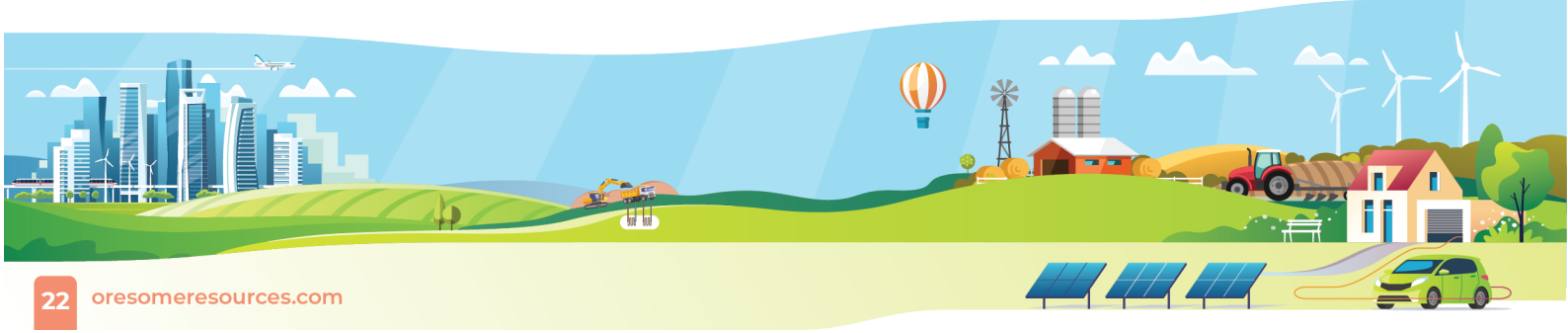
3. When you have found an example you need to document it thoroughly. When documented, find another example and document it.

Take a photo of the erosion. Also draw a diagram and include measurements of your erosion example (the diagram will help show where measurements go on your photo in a later lesson).

How can someone stop this erosion?

What was the location of the erosion?

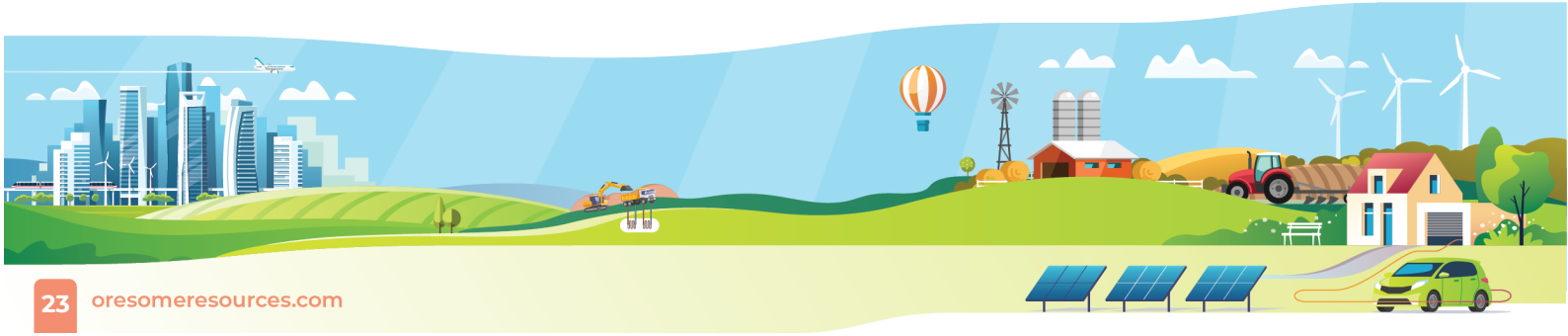
4. Repeat step 3 twice more (or until your teacher instructs you to return to classroom).



Take a photo of your second erosion example. Also draw a diagram and include measurements of your erosion example

How can someone stop this erosion?

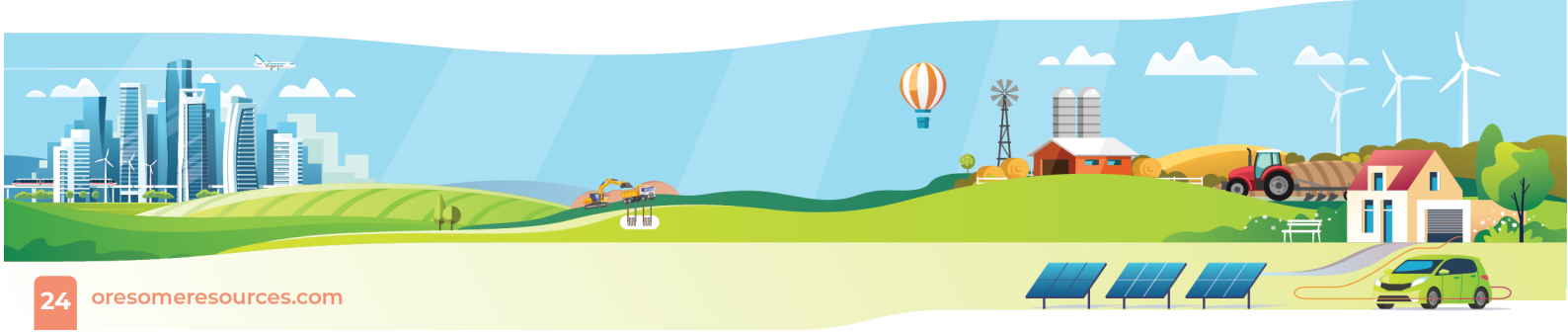
What was the location of the erosion?



Take a photo of your third erosion example. Also draw a diagram and include measurements of your erosion example

How can someone stop this erosion?

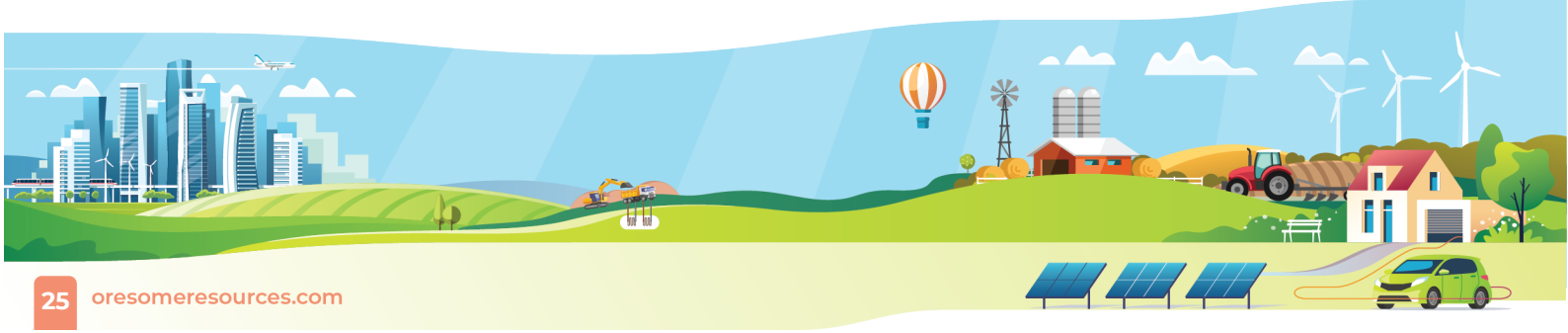
What was the location of the erosion?



Take a photo of your fourth erosion example. Also draw a diagram and include measurements of your erosion example

How can someone stop this erosion?

What was the location of the erosion?



5. Save all electronic data (from camera or GPS/GIS devices) to computer (your teacher will help you locate your space and folders.

Lesson 3: Modelling Small Scale Water Erosion

Modelling water erosion using small trays allows students to understand a fair test, hypothesise, identify variables and manipulate them. It will be important to relate the model to the real world – road cuttings, need for a slope to allow movement of water, open cut mines etc. Although potentially a messy activity, it is important for students to run their own experiments, in pairs, with minimal teacher guidance. This will allow the students to develop skills in following a protocol and thinking independently.

In this lesson, students will:

- Construct a small model to explore erosion
- Identify and manipulate variables (slope and water intensity) impacting on soil erosion

Lesson-level Content Descriptions

- Awareness of local environment
- Identifying and explaining examples of erosion
- Documenting scientific phenomenon

Lesson Outcomes

The assessment focus of this lesson is formative. The student may be able to:

- Accurately record measurement data
- Follow procedural instructions

Preparation List

For the whole class:

- Digital camera (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table

For each group (pairs):

- Computer for data storage

For each student:

- Copies of the worksheets

Activity Sequence

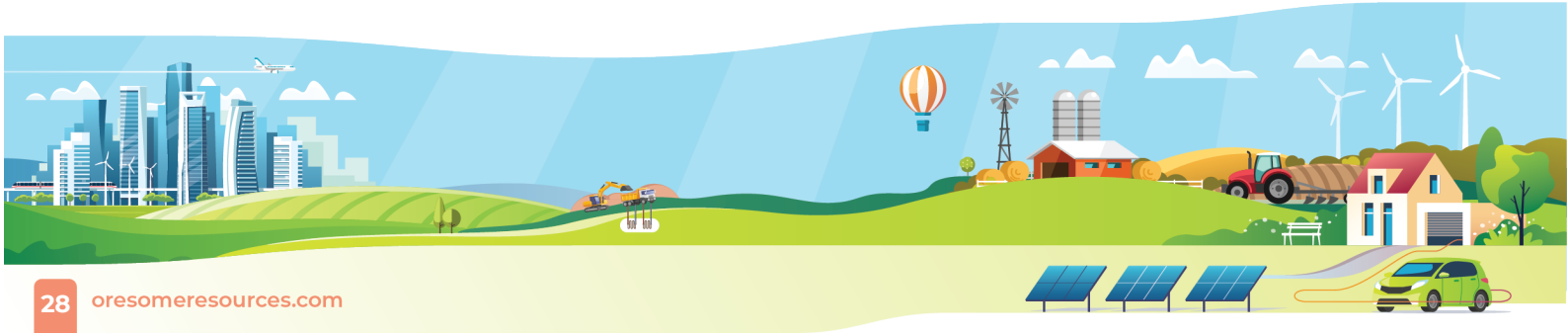
1. Introduce the Lesson: Begin with a brief explanation of a fair test – only ever manipulating one variable at a time and keeping all others the same. Students are to be involved in a guided inquiry lesson. Students need to read the limited instructions provided. Think about how to interpret the instructions and conduct the activities in order to answer the question sheet. Finally any digital evidence of weathering and erosion needs to be saved onto computer for lesson 5.
2. Student Activity 1 - Revisit your mountain. As a class group or in pairs, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information.
3. Student Activity 2 – Build a model to show water erosion.
4. Lesson is concluded with students writing a recount of the main ideas in each of the activities they did.

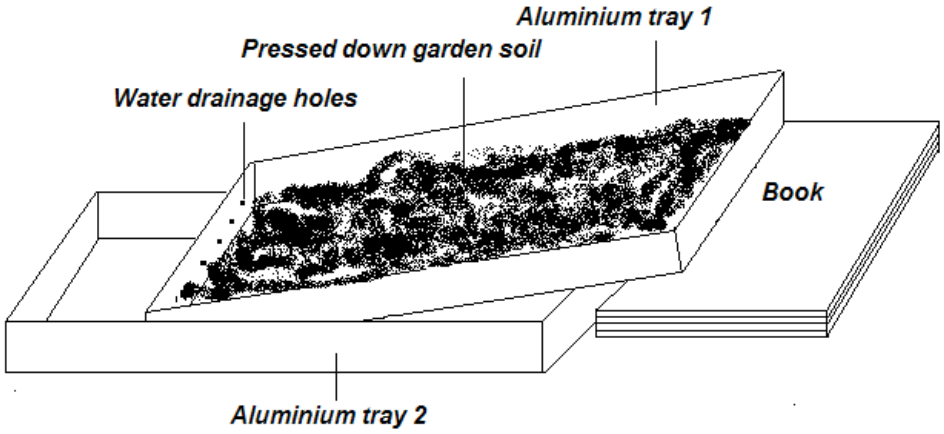
Observe the level of sophistication of the sentence structure used in the recount.

Student Activity 1 – Water erosion model

In this activity you will need to use the following equipment:

- 2 large disposable aluminium lasagne trays
- enough garden soil to fill tray 1,
- water in a small watering can or bottle,
- newspapers
- a few books to create a slope for your trays
- a drawing compass or nail
- camera





Once you have the equipment, do the following:

- Place several sheets of newspaper across the desk top and construct your model on top of the newspaper.
- Pour the garden soil into one of the trays so that it makes a layer on the bottom about 3cm deep. Smooth the soil out so that it is as even as possible on the top.
- Poke into the soil a few small rocks.
- Use the drawing compass needle to punch 6 small water drainage holes in one end of the tray.
- Place the second aluminium tray under the end of the dirt-filled pan where the holes are. (The second tray will catch the water as it leaves the top tray.)
- Slip a book under the other end of the dirt-filled tray so that it is propped up higher than the end with the holes punched in it.
- Take a photo of your model to remind you of your starting model.

1. Have either you or your partner pour little drops of water, from a height of about 5cm, starting at the highest part of the tray 1, so the water can run down the soil.

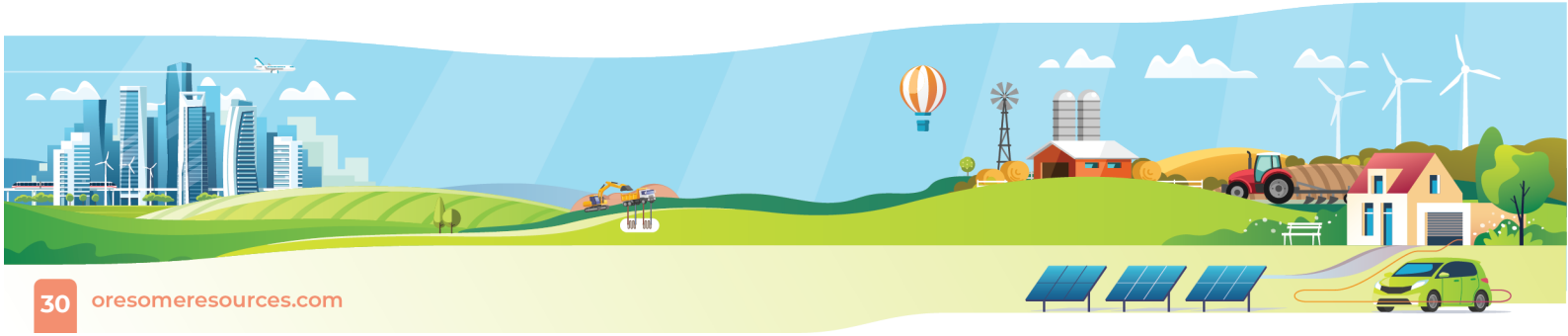
Did you notice any changes are taking place in the tray? Were the rocks or soil moving out of position? Draw a sketch of the surface of your soil and rocks.

Take a photo of your model.

2. Now have you or your partner pour larger amounts of water (again from a height of about 5cm) at the highest part of the tray 1, so the water can run down the soil.

Did you notice any changes are taking place in the tray? Were the rocks or soil moving out of position? Draw a sketch of the surface of your soil and rocks.

Take a photo of your model.



By changing the amount of water you are adding to your model, you are changing a variable. You can change another variable in your model – that of slope. When we change a variable in a model, we should try to keep everything else the same.

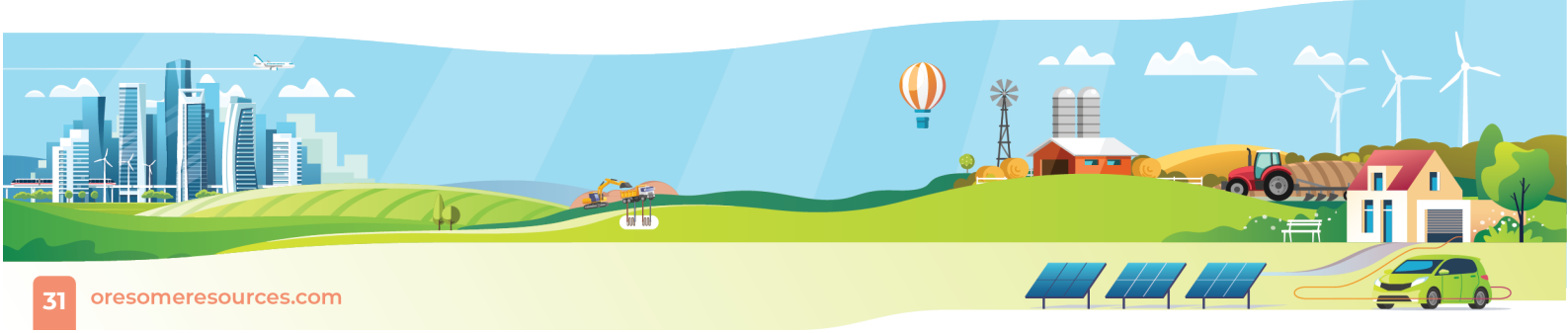
3. Place a second book under your tray. This will increase your slope. Now pour more water onto the model (try to pour the same amount of water as in step 2).

What difference did the steeper slope have on your erosion? Draw a sketch of the surface of your soil and rocks. Take a photo of your model.

4. Dig around in your tray and create a few hills and valleys. The variable you are now changing is the landscape.

5. Predict where the water will go. _____

6. Now pour more water onto the model (try to pour the same amount of water as in step 2).



What difference do valleys and hills make on erosion? Were the rocks or soil moving out of position? Draw a sketch of the surface of your soil and rocks.

Was your prediction correct?

Take a photo of your model.

You have made a model and changed three variables in the model. What were the three variables you changed?

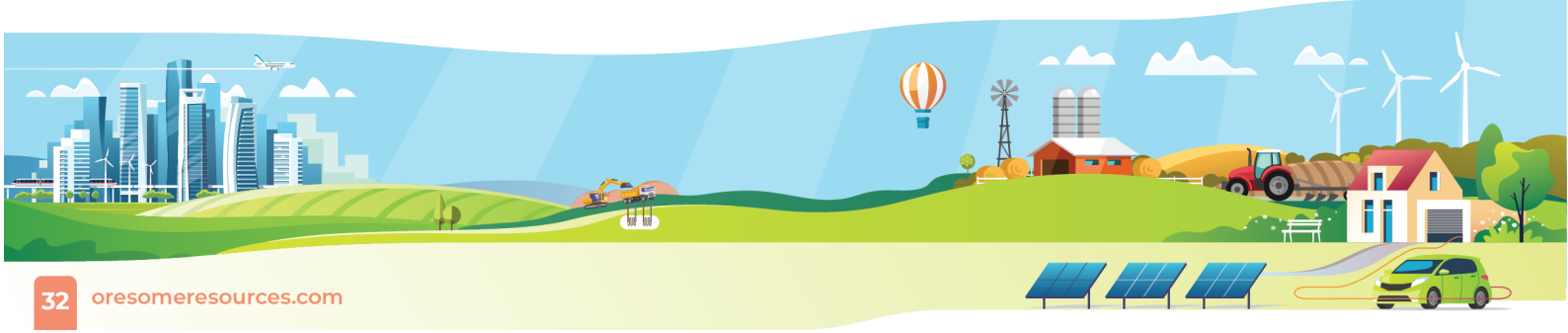
Complete each sentence explaining how the variable effects erosion. The first one has been done for you.

a) The more water that falls on the ground, the greater the erosion.
b) The _____the slope of the land, the _____ the erosion.
c) Rocks, hills and valleys affect erosion by

_____

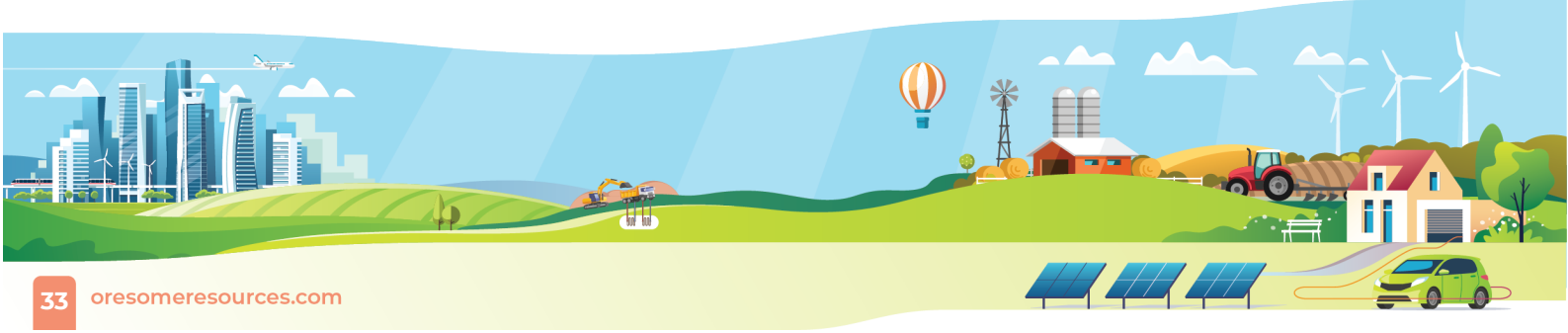
_____

_____



7. ***EXTENSION***: design an investigation that will allow you to change the variable of water weight. Use your 2 trays and garden soil. (Consider changing the 5cm height you poured the water from)

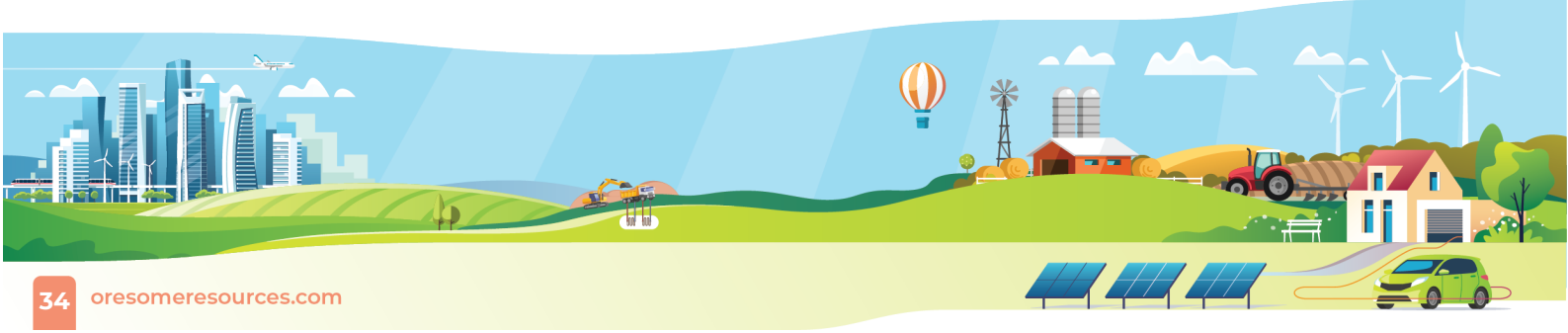
Draw a sketch of how you plan on testing the water weight variable.



What variable are you changing?_____
What variables are you keeping the same?
1) _____
2) _____
3) _____
4) _____
Show and describe this sketch to your teacher.
Do not do the water weight test until your teacher says you have planned your test well enough.
In the boxes below, sketch what happened to the soil as you changed the variable to test the water weight.

Sketch 1	Sketch 2

Can you relate this to changes caused by the weight of water in various places around the earth?



8. ***EXTENSION***: Link your water erosion model and mitigation in an open cut mine. Describe the variables that are involved?

_____

_____

_____

_____

Lesson 4: Sedimentation

Sediments and how they deposit

In this lesson, students will:

- Explore how plant life decreases erosion
- Explore sedimentation and run off

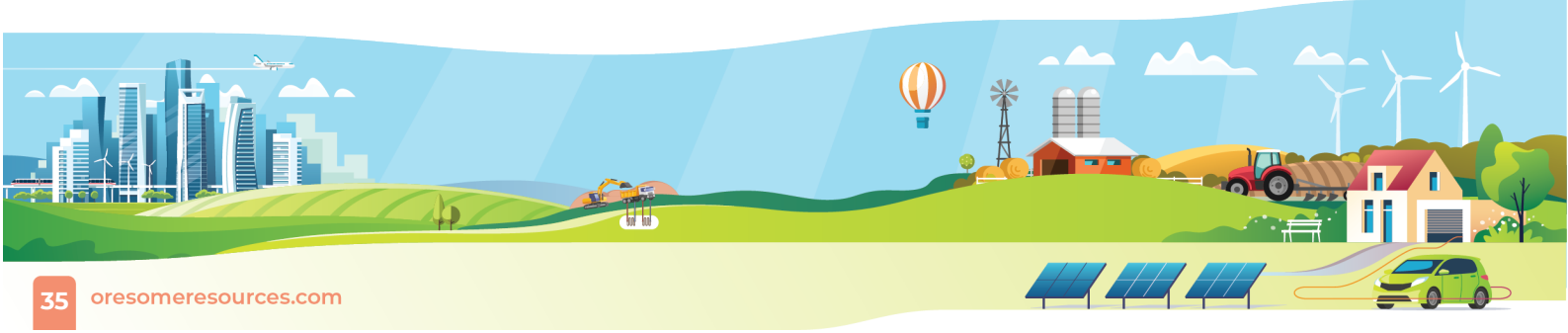
Lesson-level Content Descriptions

- Vegetation reduces erosion
- Soil in run off impacts on water quality
- Documenting scientific phenomenon

Lesson Outcomes

This lesson is formative. Students may be able to:

- Accurately record measurement data
- Follow procedural instructions



Preparation List

For the whole class:

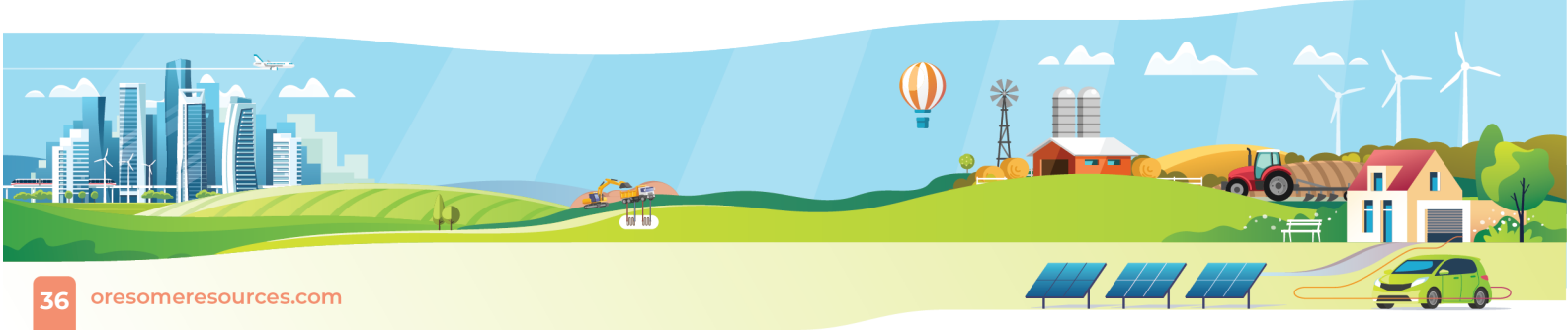
- Digital cameras (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table

For each group (pairs):

- A biscuit tray or pan that does not leak
- 2 plastic flat bottomed disposable cups
- A small bowl or cup of water
- A pair of scissors
- 1 tablespoon or measuring cylinder (15ml)
- 3 hand full's of soil (soil that will run off when rained on – no clay or rocks or potting soil)
- 1 hand full of grass clippings or dried weeds (cut small)
- Newspaper sheets to keep desk clean
- Camera
- Paper and pencil to record sketches and measurements

For each student:

- Computer for data storage
- Copies of the worksheets



Activity Sequence

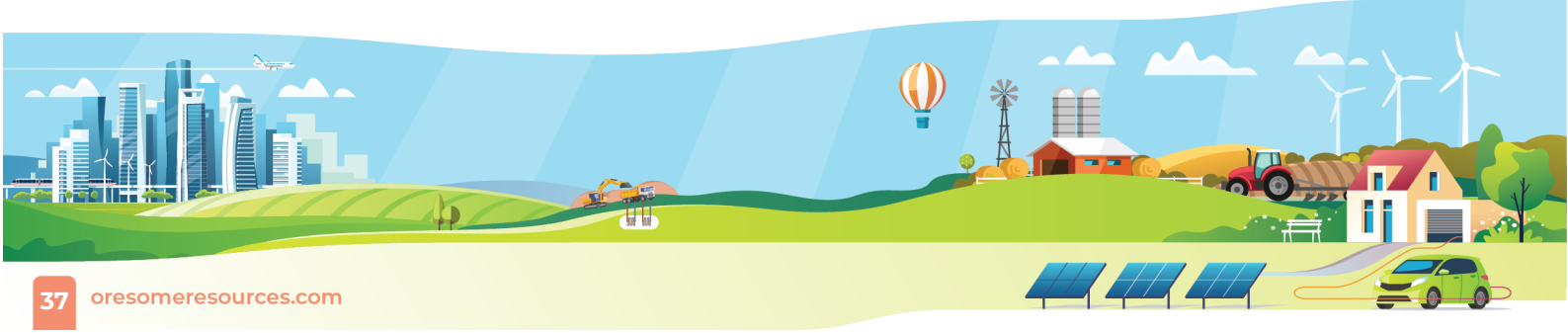
1. Introduce the Lesson: Students are to be involved in 4 activities: Firstly to remeasure the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity is an investigation into the impact of vegetation on erosion. The third activity is to look at sedimentation in water samples. Finally any digital images and data needs to saved onto computer for lesson 5.
2. **Student Activity 1 - Revisit your mountain.** As a class group, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information.
3. **Student Activity 2 – Vegetation and erosion.**
4. **Student Activity 3 – Saving data**. Updating of class table on mountain data. Saving photos and data onto computer.
5. Hold a class discussion to ensure students understand that plant matter helps prevent erosion, and when erosion does occur, it is a water pollutant often making the water unfit for drinking.
6. Lesson is concluded with students writing a recount of the main ideas in each of the activities they did.

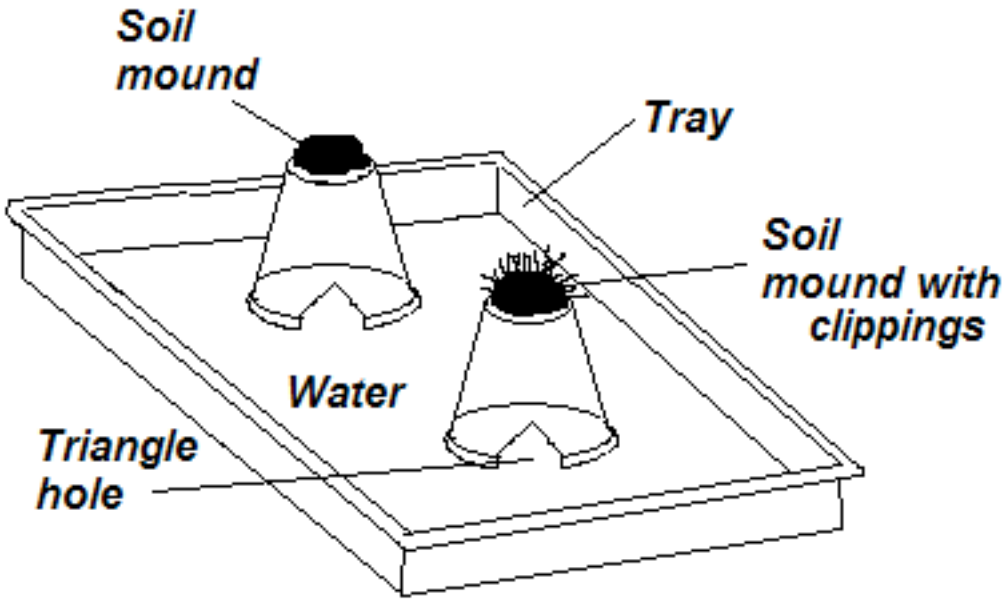
Observe the level of sophistication of the sentence structure used in the recount.

Student Activity 2 – Vegetation and Erosion

In this activity you will need to use the following equipment:

- A biscuit tray or pan that does not leak
- 2 plastic flat bottomed disposable cups
- A bowl of water
- A pair of scissors
- 1 tablespoon or measuring cylinder (15ml)
- 2 hand full's of soil (soil that will run off when rained on – no clay or rocks or potting soil)
- 1 hand full of grass clippings or dried weeds (cut small)
- Newspaper sheets
- Camera
- Paper and pencil to record sketches and measurements





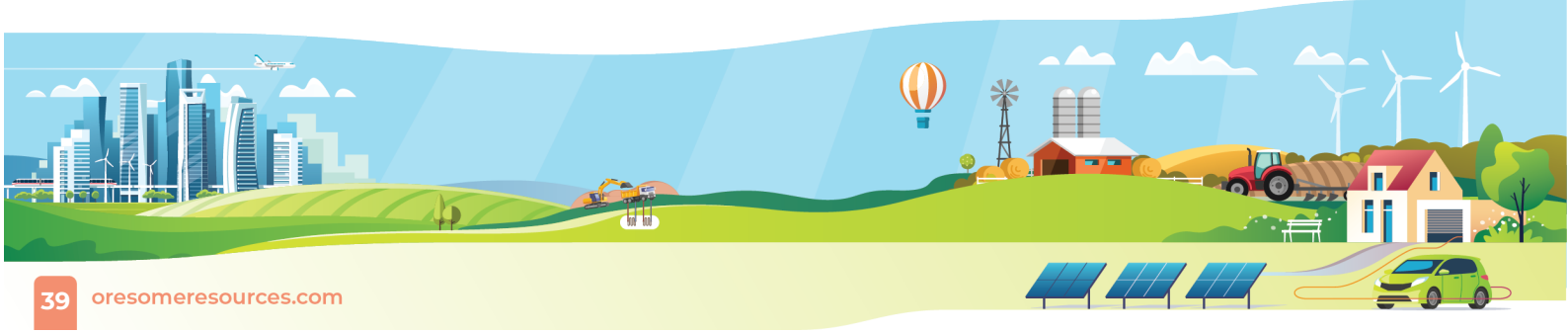
Once you have the equipment, build your model by doing the following:

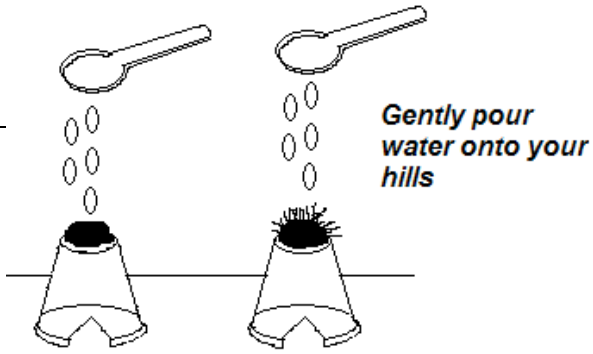
1. Place sheets of newspaper on table and on these place your biscuit tray or pan.
2. Pour about half the water into the pan (this is the lake or river).
3. Create 2 hills using the disposable cups. Into the side of each cup you need to cut out (using the scissors) a triangular hole in the side of the cup (so your hill will stand upside down in your water). Place your hills at opposite ends of your tray.
4. Scoop up a tablespoon of soil and place it in a mound on one cup.
5. Scoop up another tablespoon of soil and mix it with the dried weeds or grass clipping. Place the mixture on top of the other cup. Try to make each soil mound the same shape and size.

Predict what will happen if you gently pour water over each hill.

Draw a sketch of your prediction.

6. Gently dribble a tablespoon of water on each hill.





Did the water soak into the soil? Why?

Continue to 'rain' water on each hill. How many spoons of rain were needed to soak the soil and make erosion occur?

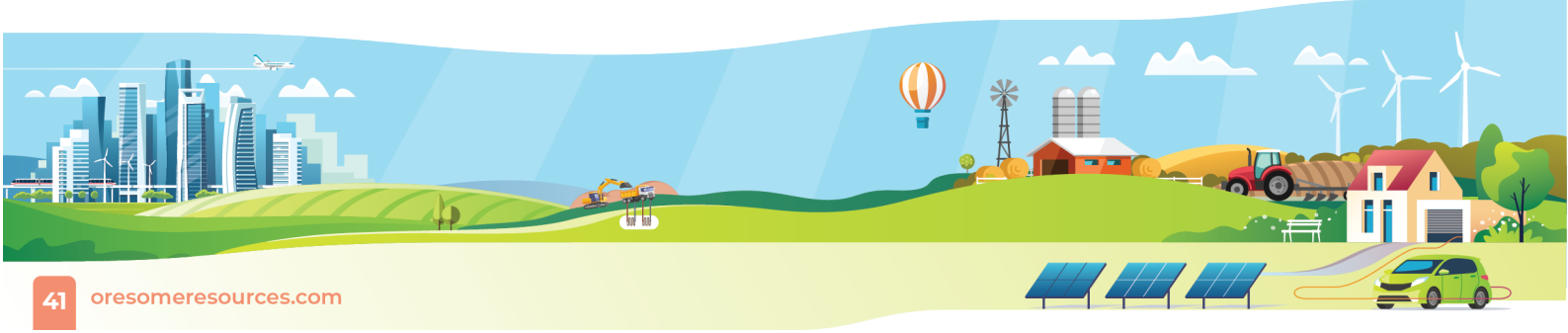
Was the amount of rain the same for each hill? Explain your answer.

Look at the water in the tray. What do you notice about the water near each hill?

The soil in the water is called sediment. Sketch your 2 hills and label the erosion and sediment – try to make the amount of erosion and sediment accurate.

Extension 1: What do you think the erosion sediment does to stream water and the animals that live in is?

Extension 2: If you wanted to stop erosion occurring on the slope of an open cut mine, how would you do this? Draw a sketch of this would look.



Student Activity 3 – Sediment in Water

In this activity you will need to use the following equipment:

- A computer and Internet

Once you have got onto the computer, do the following:

1. Open a word document and put your name in the header. Save this file with the title Water erosion by „(last name) .. (include your last name in the file name so your teacher knows it is your work)
2. Use the Google images facility to find an image of flooded Dalby. Copy this image into your word document.
3. Describe your photo. What is interesting in the photo?
4. Watch the ABC news item about the Dalby flood over the 2010 -2011 summer. http://www.youtube.com/watch?v=ShSUETYsKSs
5. Answer the following questions. Write your answers in sentences in your word document. Make sure you regularly save your work.

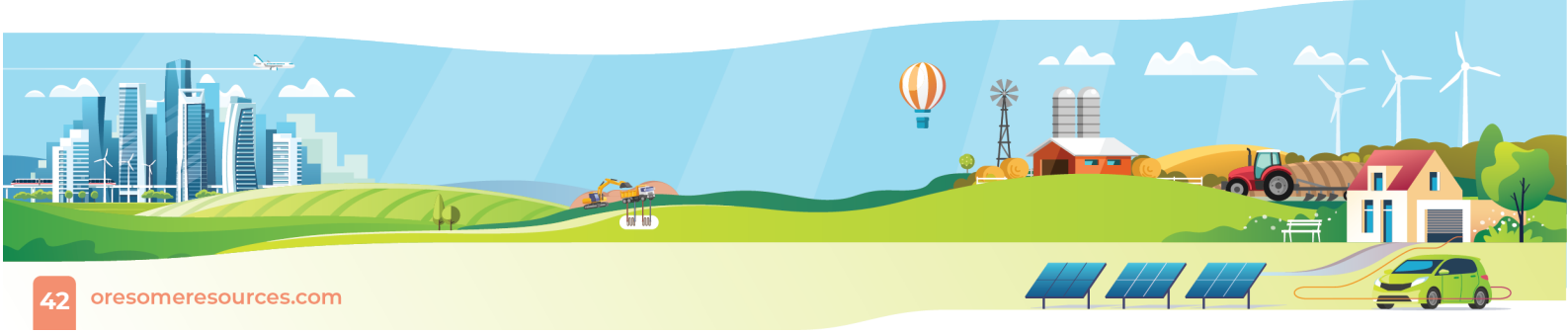
a. What do you notice about the colour of the flood water?

b. What is causing the water to be so dirty?

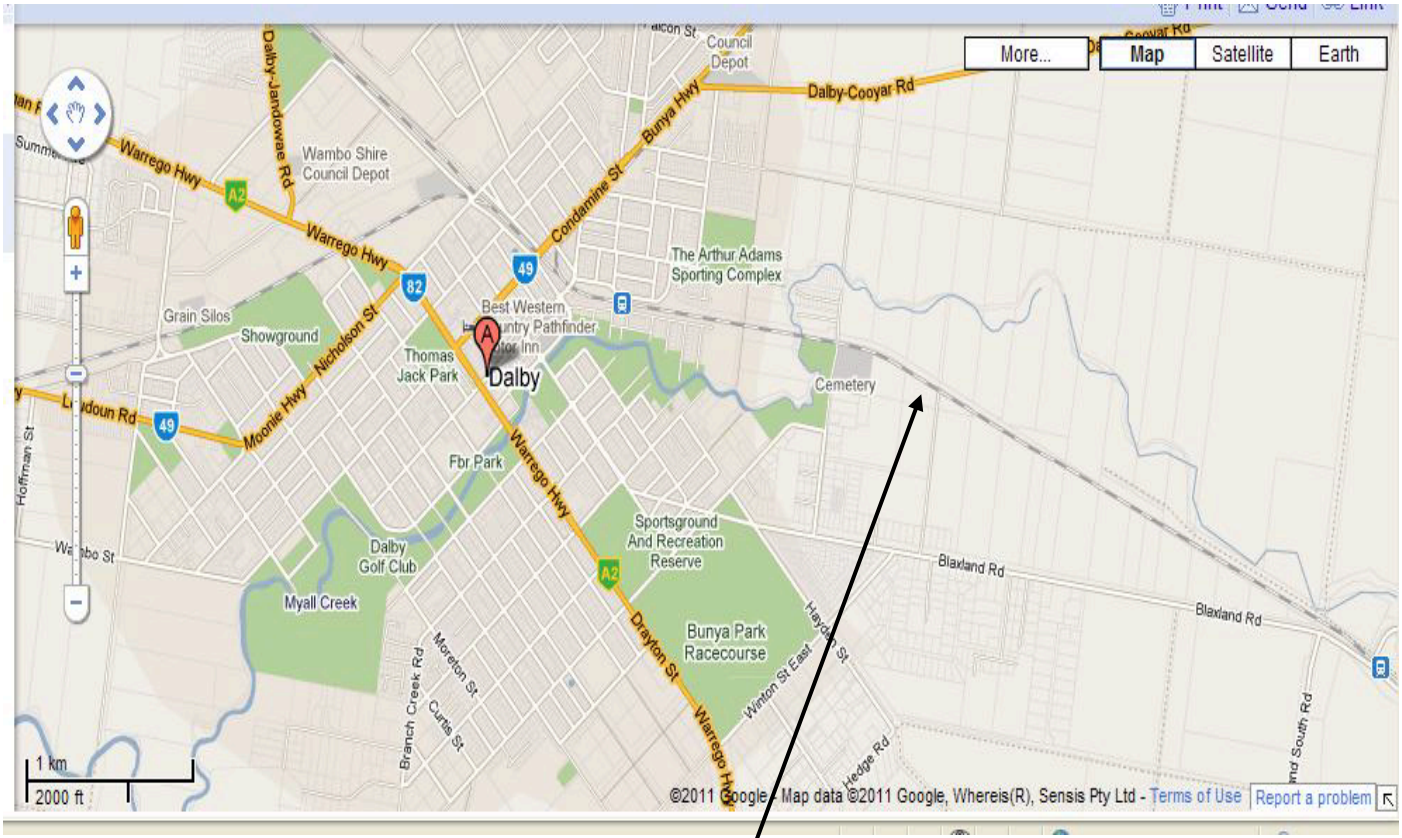
c. If the flooding was caused by too much rain, how did the soil get into the water?

d. What is the process called where water washes away soil from farming land?

e. Copy the map below into your word document. Find Myall Creek on the Google map below. What do you notice about a lot of the land around the creek as it goes through Dalby? Do you think there is erosion where Myall Creek flows through town? Explain



your answers. If you are referring to the map in your answer, you might like to draw arrows and label the map to show what you are writing about. (An example showing the train line has been done for you.)



Train line

Lesson 5: ICT Lesson, Poster Creation for Water Erosion Management

Poster creation

In this lesson, students will:

- Create a poster to show their understanding of erosion and its prevention

Lesson-level Content Descriptions

- Ability to use ICT to demonstrate erosion understanding
- Identifying and explaining examples of erosion
- Documenting scientific phenomenon

Lesson Outcomes

The assessment focus of this lesson is summative. Students may able to:

- Explain erosion examples
- Create informative poster presentation

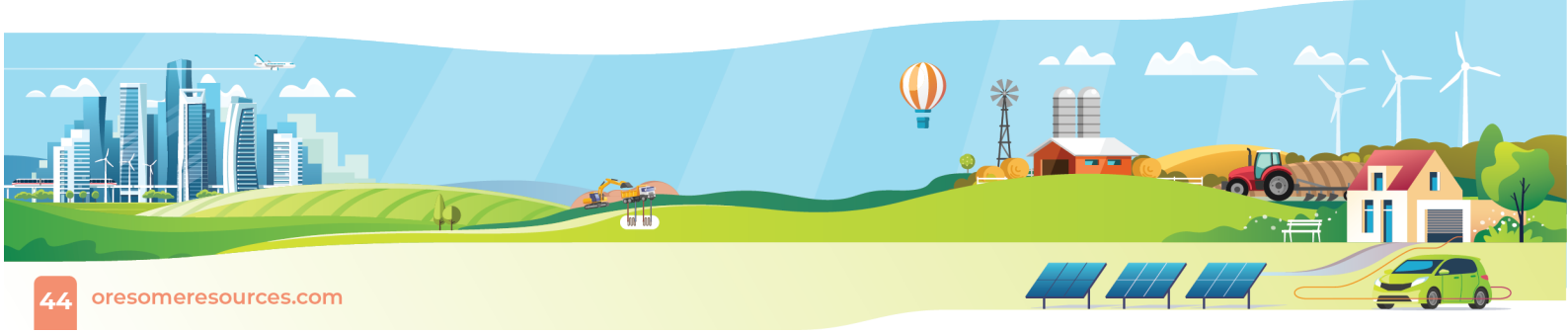
Preparation List

For the whole class:

- Digital cameras (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table
- Computer for data storage

For each student:

- computer and access to stored files
- Internet (optional)
- Erosion poster task sheet



Activity Sequence

1. Introduce the Lesson: Students are to be involved in 2 activities: Firstly to remeasure the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity involves the students each creating a poster to show what water erosion is, what damage it can do and possible prevention measures.
2. **Student Activity 1 - Revisit your mountain.** As a class group, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information.
3. **Student Activity 2 – Create a poster** to help farmers or miners understand erosion and how to prevent erosion

Student Activity 2 – Erosion Poster

In this activity you will need to use the following equipment:

- A computer and the files you have been saving.

In this activity you are to create a poster on the computer.

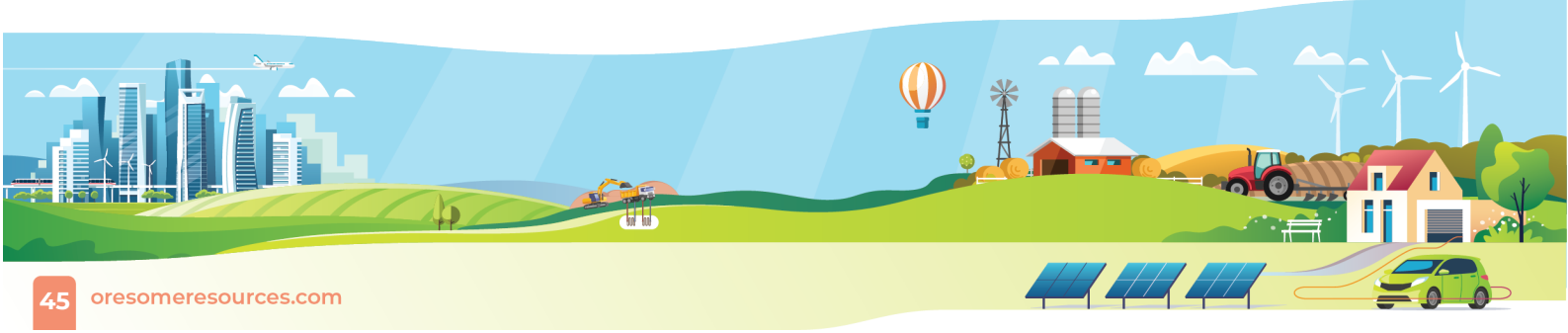
- You need to decide who the poster is for – a farmer or a mining company
  - Who is your poster for? _____

- Your poster needs to explain three things:
  - what erosion is
  - how it is caused, and
  - how the farmer or mining company can prevent erosion

- You have a lot of saved photos from your investigations to use as pictures on the poster. Your teacher may let you get more pictures off the Internet.

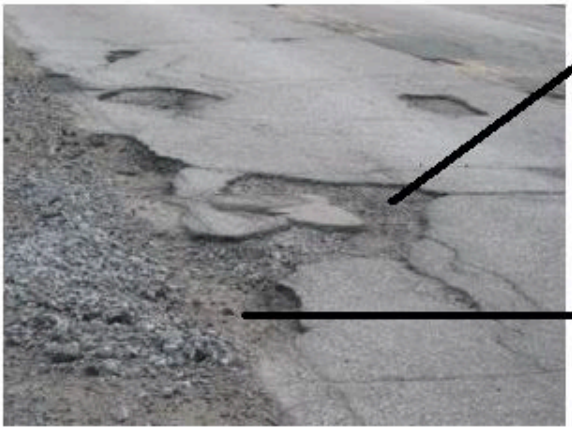
- Make sure you save your poster as you are making it. Save the poster with a file name that has your last name in it so your teacher knows it is yours.

- An example poster has been made to show the Towns Council people about erosion (your poster should be different to this example as this one is for the Council, and yours is for a farmer or mining company).



Stop allowing erosion on our roads.

Erosion takes the soil from the edge of a road and washes it away making pot holes.



Put in curbs and channeling along our streets to protect our roads

Lesson 6: Wind Erosion and Safety

Modelling Wind Erosion and considering irresponsible behaviour in the face of natural disasters.

In this lesson, students will:

- View You-tube videos and participate in class discussion on responsible behaviour
- Design a fair test to model wind erosion

Lesson-level Content Descriptions

- Explain wind erosion and consider safety obligations
- Design an investigation to model wind erosion
- Documenting scientific phenomenon

Lesson Outcomes

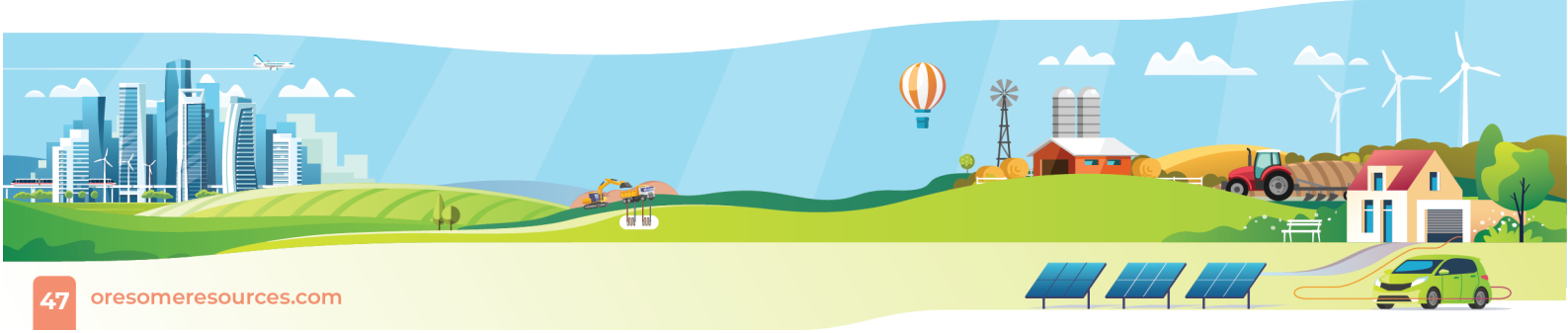
The focus of this lesson is formative. Students may able to:

- Accurately record measurement data
- Design own investigation
- Explain safety issues

Preparation List

For the whole class:

- Digital cameras (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table
- Computer for data storage
- Computer with internet to view videos



For each group (pairs):

- Paper and pencils to plan investigation
- Resource order sheet

For each student:

- Copies of the worksheet

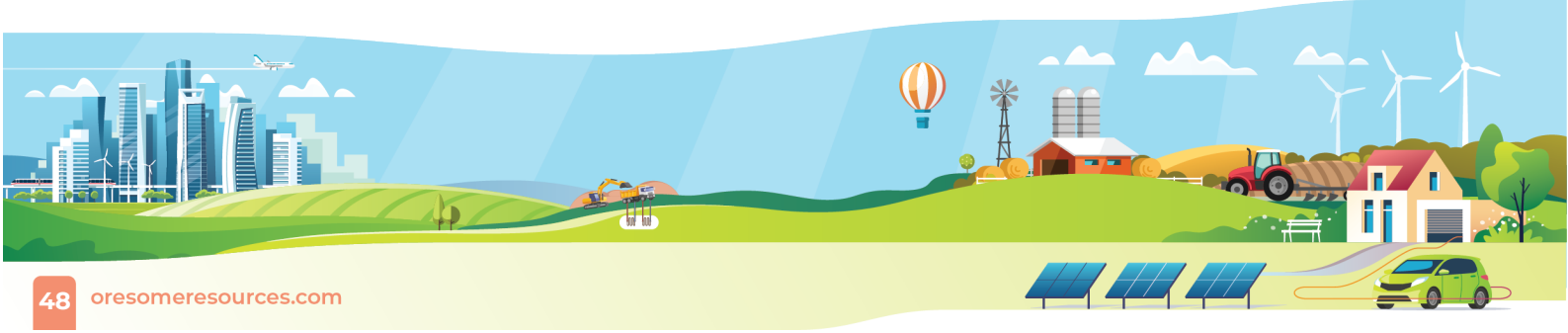
Activity Sequence

1. Introduce the Lesson: Students are to be involved in 3 activities: Firstly to remeasure the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity is to participate in a class discussion relating to wind erosion videos. The final activity is to plan, with a partner, an investigation to be done in the following lesson which models wind erosion.

2. **Student Activity 1 - Revisit your mountain.** As a class group, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information.

3. **Student Activity 2 – Show the 3 You-tube videos.** The first one to show is the Phoenix wind storm http://www.youtube.com/watch?v=3TH_4lL_DjE. Discuss how such footage would have been obtained (probably light aircraft or helicopter), what are the indicators that the storm is fast moving (think size of building and clearly seen movement towards the town), what would the air movement be like at the front of the storm? (clockwise vertical swirling – rounded front of storm).

   Second video is from Broken Hill http://www.youtube.com/watch?v=95tmYmeHf84&feature=related. Discuss the physical attributes of the storm seeking explanation for each - size, colour etc. Discuss the safety of deliberately driving into the storm – should these people be doing this? Why or why not? What are the implications of their actions? Who else is affected by the driver's choice to drive into a sand storm? (encourage broad impact on community rescue, family if there is an accident).



Final video is from September 23, 2009 in Brisbane http://www.youtube.com/watch?v=vUsn3fmnK04. The car is travelling along the South East Freeway and then Riverside Expressway (speed limit is 90 km/hr, then 70 km/hr). The city building are on the right, the Brisbane River and Southbank are on the left. It appears the driver is holding the camera as he drives. What can you tell about the soil in the air? (Think colour – red from desert, not farming soil as wrong colour; and particle size – very small and fine, if larger it would be too heavy to stay in air when wind drops a little).

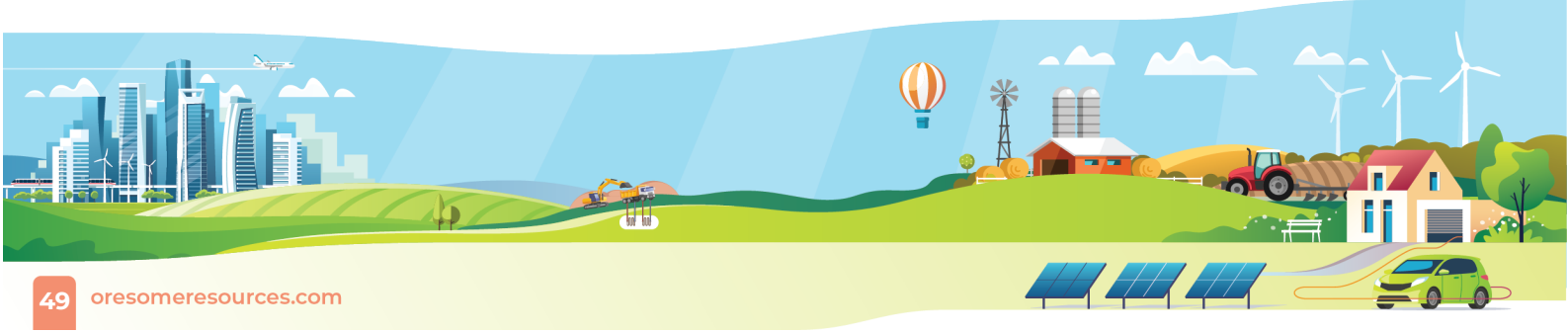
4. **Student Activity 3 – Planning the wind erosion investigation.** Students plan an investigation on wind erosion. They are to be encouraged to test for at least 1 variable. In this lesson they plan and list the equipment they need, and then complete an order form with teacher assistance. If students do not have the ability to imagine and list equipment, teacher can have a 'pile of junk' students can select equipment from. The 'pile of junk' could include:
    - Different types of sand or soil – some fine grained, others rocky
    - A variety of trays or boxes
    - Drinking straws
    - Desk fans
    - Water supply
    - Plasticine
    - Paddle pop sticks
    - Small toy cars or buildings

5. Lesson is concluded with students writing a list of equipment they need for following lesson.

Observe the level of conceptualisation and sophistication of the plan and ability to list equipment.

Additional Resources

- http://www.youtube.com/watch?v=3TH_4IL_DjE - Phoenix video
- http://www.youtube.com/watch?v=95tmYmeHf84&feature=related - Broken Hill
- http://www.youtube.com/watch?v=vUsn3fmnK04 - Brisbane video

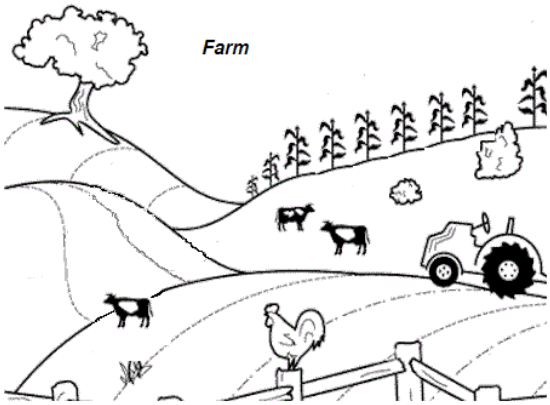


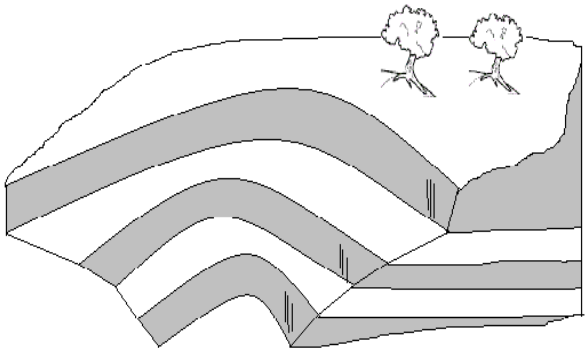
Student Activity 3 - Modelling Wind Erosion : Planning the investigation

In the next lesson you will model wind erosion – similar to the investigations you did on modelling water erosion. But this time you have to design the model yourself.

Work through the following questions with your partner, and when you have finished meet with your teacher to get your equipment order checked.

1. Select either a farm site or a mining site to explore wind erosion. Which site did you select? Circle the one you want to do.





Open cut mine

2. Imagine you and your partner are at the farm or mine. Where do you think the wind erosion will occur?

_____

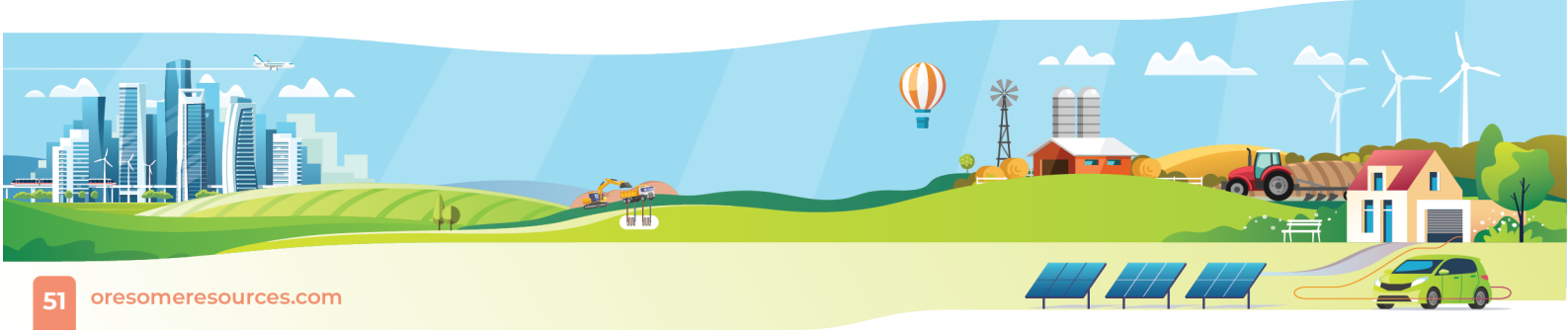
3. Draw a sketch of this bit of the farm or mine.

4. Draw another sketch in Box 1 of how you could make a model this part of the farm or mine. Make sure you label everything in your sketch (hint: label what you would use to make the ground)

Box 1.

5. Now that you have a model farm or mine, describe how you will create the wind to blow away the soil - What will you use? How will you control the wind so it is not too windy or just a gentle breeze? Underline all the equipment you will need to create and control the wind.

Box 2.



6. In box 1 and 2 you have all the equipment you think you need to model wind erosion. What variable will you focus on? (Hint, in the water erosion you looked at slope, landscape, vegetation, and water weight).

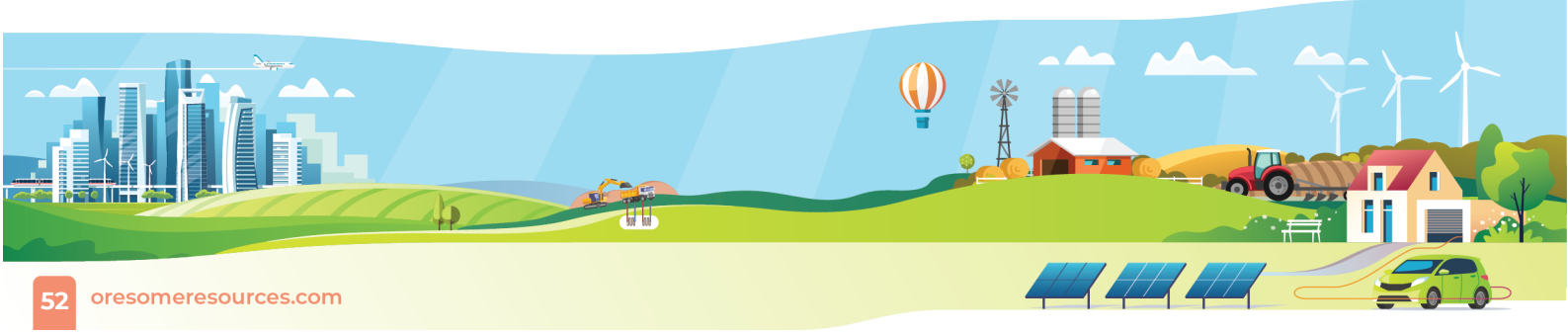
_____

7. In box 3 describe how you will change this variable and keep everything else the same.

Box 3.

8. You now need to complete the Equipment Order Form on the following page. You will find that the labels in Box 1, the underlined words in Box 2 and ideas in Box 3 will provide you with this information.

9. When you have finished the Equipment Order Form, take it and this sheet to your teacher so it can be checked.



Equipment Order Form

Names: 1)_____

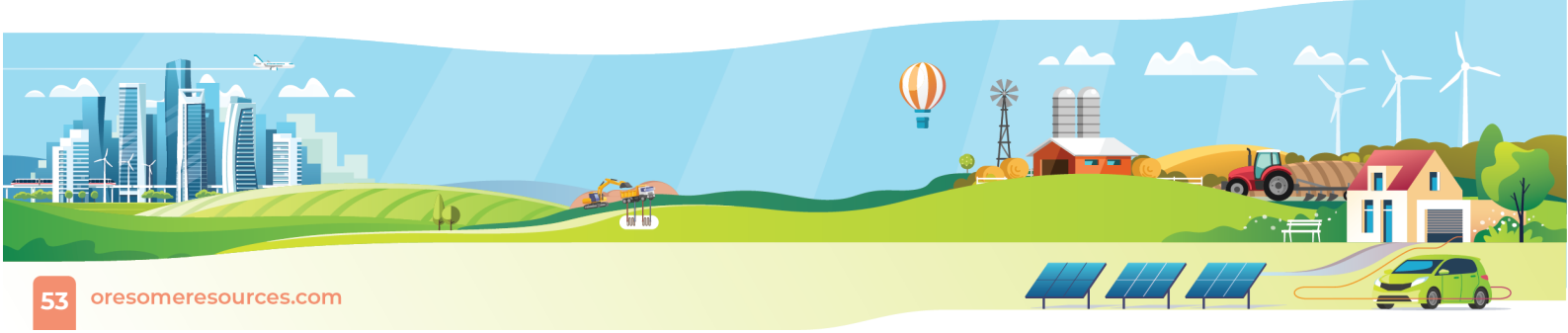
2) _____

Date equipment needed (check on a calendar when your next lesson is): _____

Fill in the following table:

Item	How many or how much	What will you use it for?
Camera	1	To take photos as we do the modelling

Use the back of the sheet if you need more rows.



Lesson 7: Modelling Small Scale Wind Erosion

In this lesson, students will:

- Engage in an open inquiry lesson
- Access equipment ordered in previous lesson
- Build and test wind erosion model

Lesson-level Content Descriptions

- Awareness of local environment
- Identifying and explaining examples of wind erosion
- Documenting scientific phenomenon

Lesson Outcomes

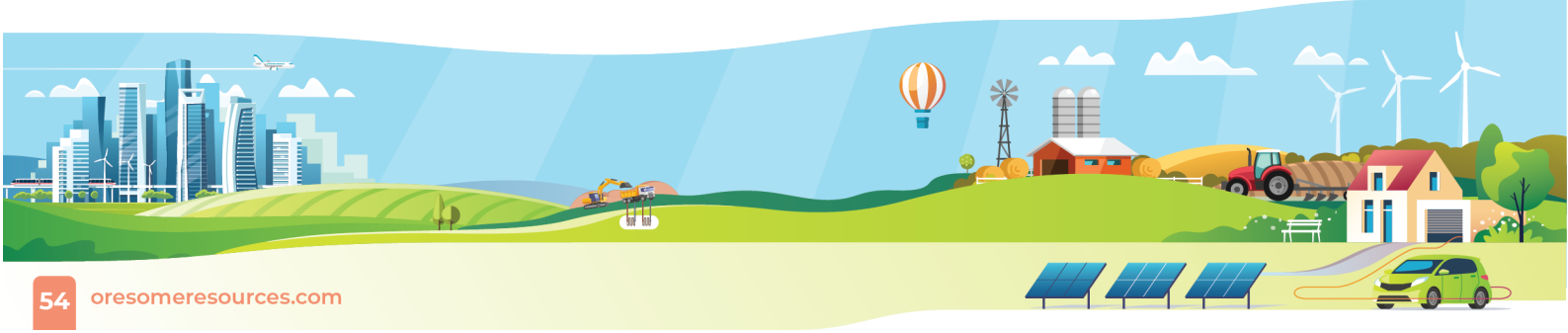
The assessment focus of this lesson is summative. Students may able to:

- Accurately record measurement data
- Conduct open inquiry
- Explain modelling

Preparation List

For the whole class:

- Digital cameras (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table
- Computer for data storage



For each group (pairs):

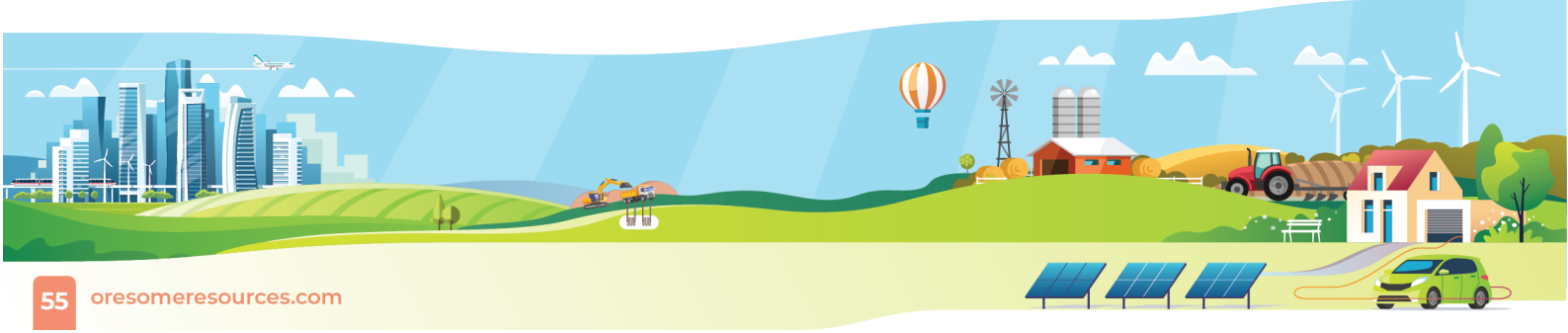
- The equipment they ordered in previous lesson
- Cameras to record findings

For each student:

- Paper and pencils

Activity Sequence

1. Introduce the Lesson: Students are to be involved in 4 activities: Firstly to remeasure the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity involves an open inquiry where pairs of students are constructing and testing the model they designed in previous lesson. The third activity involves saving the photographic evidence into the storyboard file. An example of a story board file is provided in additional resources. Finally, each completed story board is printed and displayed in classroom. Students can do a brief oral explanation to class of what they did and what they found.
2. **Student Activity 1 - Revisit your mountain.** As a class group, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information.
3. **Student Activity 2 – Teacher provides access to equipment** and students build and test model.
4. **Student Activity 3 – Copy photos or movies into the story board file** provided by your teacher.
5. **Student Activity 4 – Print off story board and display** in classroom – explain to peers.

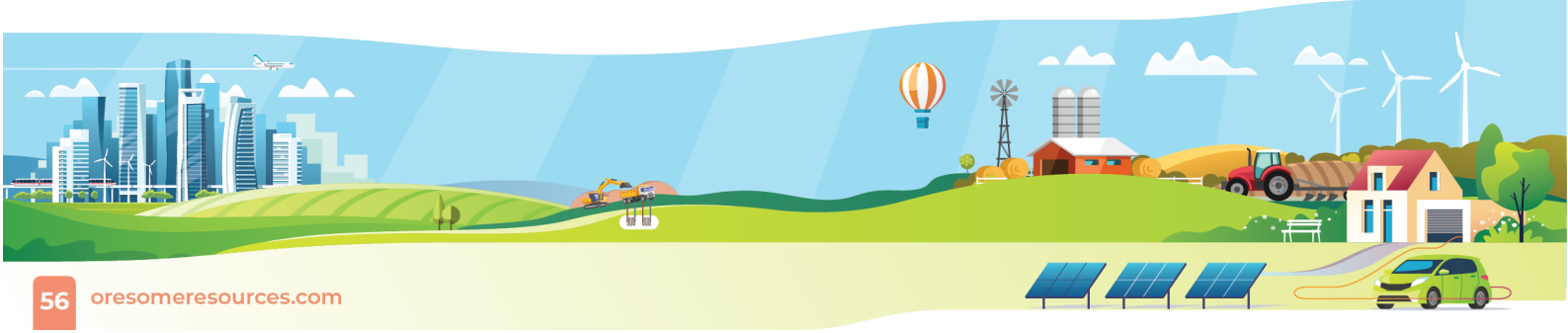


Additional Resources

- Story Board file – create a word document which contains the following table. Students upload photos of various stages of their investigation – one photograph per cell. A short description is written for each photo. Chronological order is essential.

Photo 1 Description	Photo 2 Description	Photo 3 Description	Photo 4 Description
Photo 5 Description	Photo 6 Description	Photo 7 Description	Photo 8 Description
Photo 9 Description	Photo 10 Description	Photo 11 Description	Photo 12 Description
Photo 13 Description	Photo 14 Description	Photo 15 Description	Photo 16 Description

Make another story board table if you have more photos or movies.



Wind Erosion Model – Open Inquiry Investigation

In the last lesson you ordered equipment for your wind erosion model.

From your teacher you need to get all the equipment you ordered and begin to make your model. Hopefully you ordered all the equipment.

If you find you need extra 'stuff', talk to your teacher. DO NOT TAKE ANY 'STUFF' FROM OTHER STUDENTS. They need all their 'stuff' – they ordered it.

1. When you have set up your equipment draw a sketch of it below.

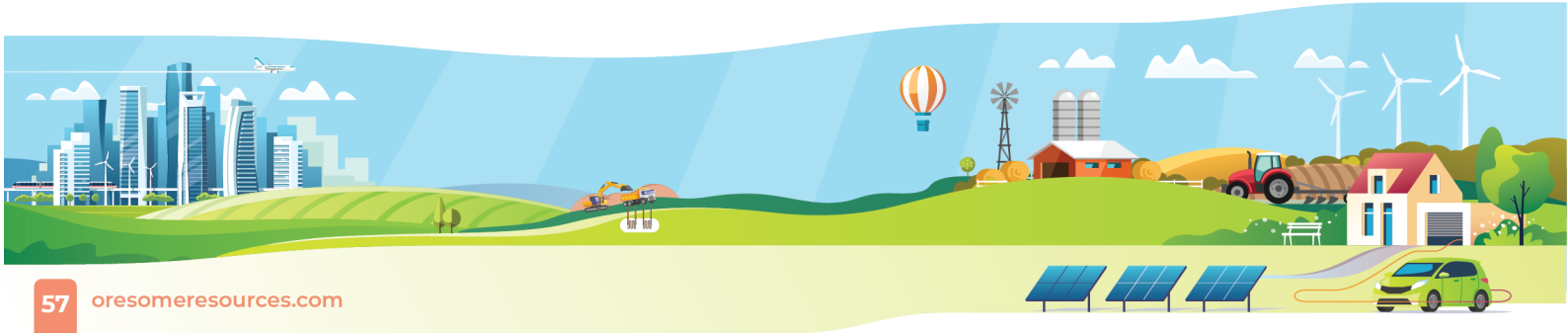
Sketch of our experiment with important bits labelled

2. Before you start your testing, describe what you think will happen to the soil as you change your test variable:

_____

_____

_____

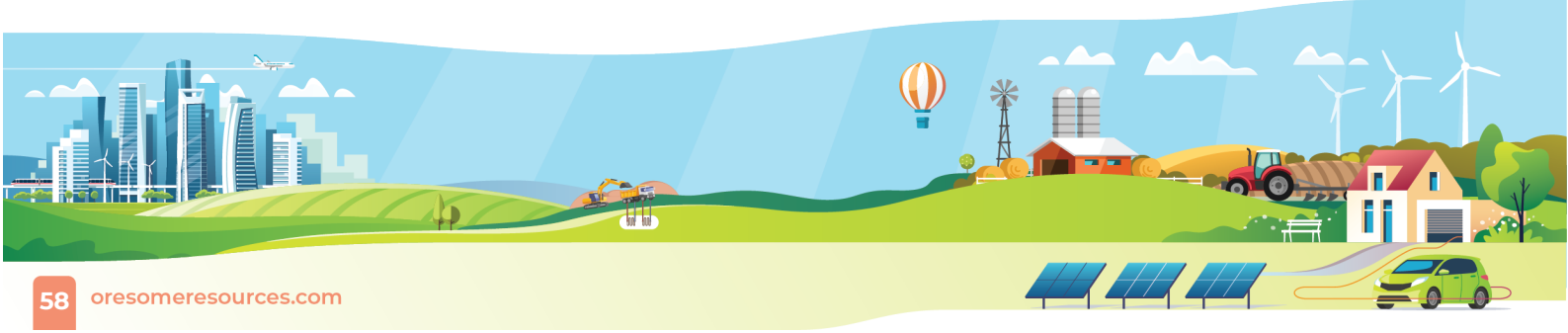


3. As you build and test your model, take photos as you work. Below is a list of some of the photos you will probably need to take. You can take extra ones if you want:
    a. Photo of equipment
    b. Photo of equipment set up
    c. Photo of the wind maker
    d. Photo of making wind
    e. Photo of variable being tested

4. CLEAN AWAY all your equipment (follow teacher directions)

5. SAVE ALL YOUR PHOTOS INTO THE STORY BOARD FILE

6. Print a copy of your story board and ask teacher where you can display it. You may be asked to tell your friends about your open inquiry investigation.



Lesson 8: Remediation for Mining and Farming Soil

Remediation and prevention of erosion is essential.

In this lesson, students will:

- Play an online game where they earn points for solving Tangram puzzles for farm stewardship
- Participate in a “slice of soil” modelling exercise
- Investigate wind and water erosion prevention issues common to both farming and mining.

Lesson-level Content Descriptions

- Land stewardship is essential to protect our farming resources
- Amount of viable farming soils is small
- Commonalities between farming and mining

Lesson Outcomes

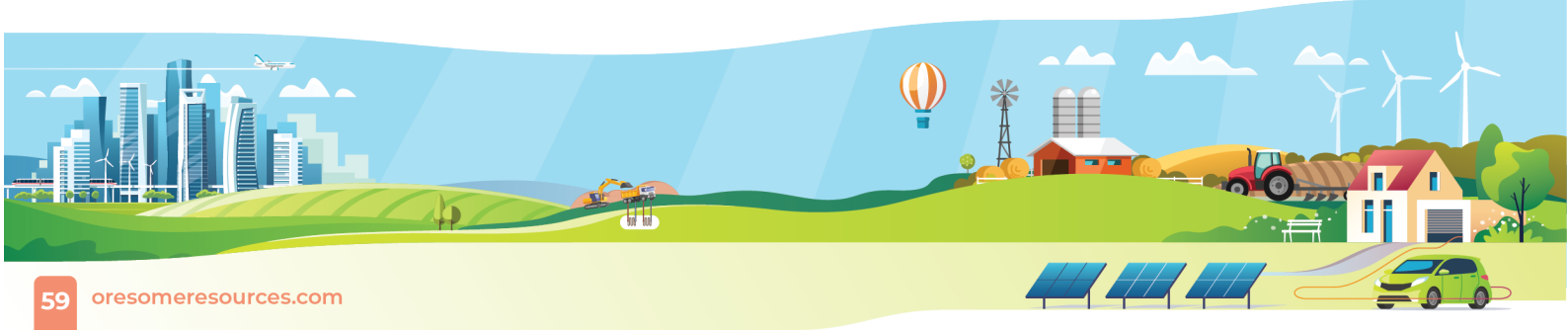
The assessment focus of this lesson is formative: Students may able to:

- Link erosion between different contexts
- Accurately record measurement data

Preparation List

For the whole class:

- Digital cameras (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table



For each student:

- Computer and internet
- An apple
- A knife to cut apple
- A vegetable peeler

Activity Sequence

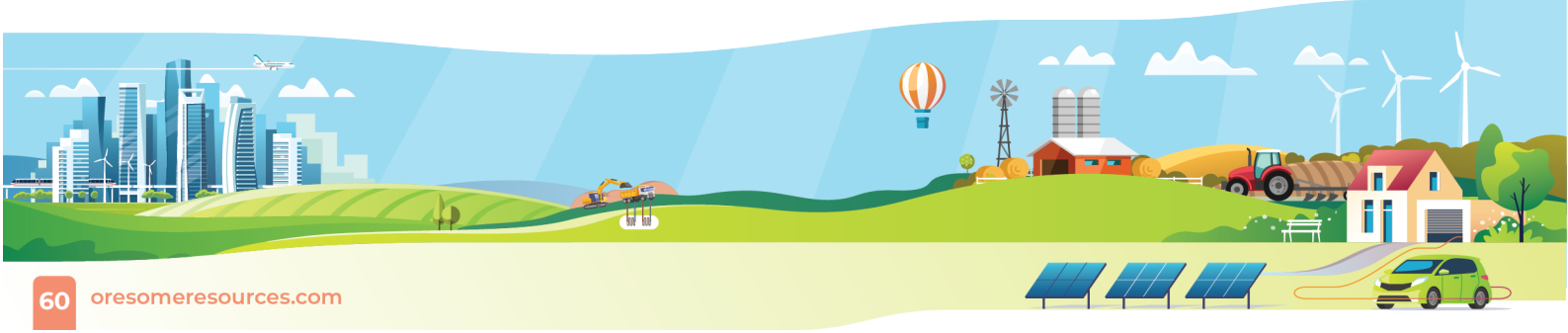
1. Introduce the Lesson: Students are to be involved in 3 activities: Firstly to remeasure the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity is to play an online Tangram game http://www.myamericanfarm.org/games/keys_to_stewardship/ . The third activity is an apple cutting activity to look at amount of farm soil on the earth. Finally students will compare wind and water erosion prevention for farms and mine sites.

2. **Student Activity 1 - Revisit your mountain**. As a class group, revisit the location where you built your mountain. Measure the height and base of the mountain and take a photograph (optional). Record information. This will be your final visit to your mountain.

3. **Student Activity 2 - Online Tangram game**
http://www.myamericanfarm.org/games/keys_to_stewardship/ .

4. **Student Activity 3 – A slice of** soil – involves working with fractions. Teacher needs to consider if students have background knowledge. See additional resources.

5. **Student Activity 4 – Class brainstorm** of similarities and differences between wind and water erosion relating to farming and mining.



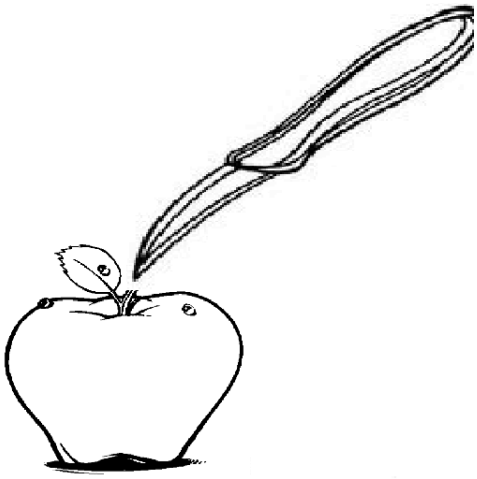
Additional Resources

Apple cutting activity - A SLICE OF SOIL.

Soil is one of our most important natural resources on the earth's surface. Complete this activity with your students to show just how little soil we have to grow our food.

You'll need an apple, a knife, and vegetable peeler. An over ripe apple is best for students as it will be softer and therefore easier to cut. However, a fresh apple can be eaten afterwards.

- Cut an apple into four equal parts (1/4 pieces). Three parts represent the oceans of the world. The fourth part represents the land area.
- Cut the land section in half lengthwise. Now you have two 1/8 pieces. One section represents land such as deserts, swamps, Antarctic, Arctic, and mountain regions. The other 1/8 section represents land where people can live and may or may not be able to grow food.
- Slice this 1/8 section crosswise into four equal parts. Three of these 1/32 sections represent the areas of the world that are too rocky, too wet, too hot, or where soils are too poor to grow food. Plus, we can't grow food on some land because cities and other man-made structures are built on it.
- Carefully peel the last 1/32 section. The peel on this small piece represents the amount of soil on which we have to grow food. This amount of soil will never get any bigger.
- Consider this: With so little soil and so many people on the earth, how are we able to grow enough food to feed everybody? After completing this activity, do you feel it is important to conserve the soil we use to grow our food or not?



Keys to Stewardship – online game

Stewardship is the word used to say someone is looking after something. So stewardship of the land means a farmer is looking after the land he or she farms.

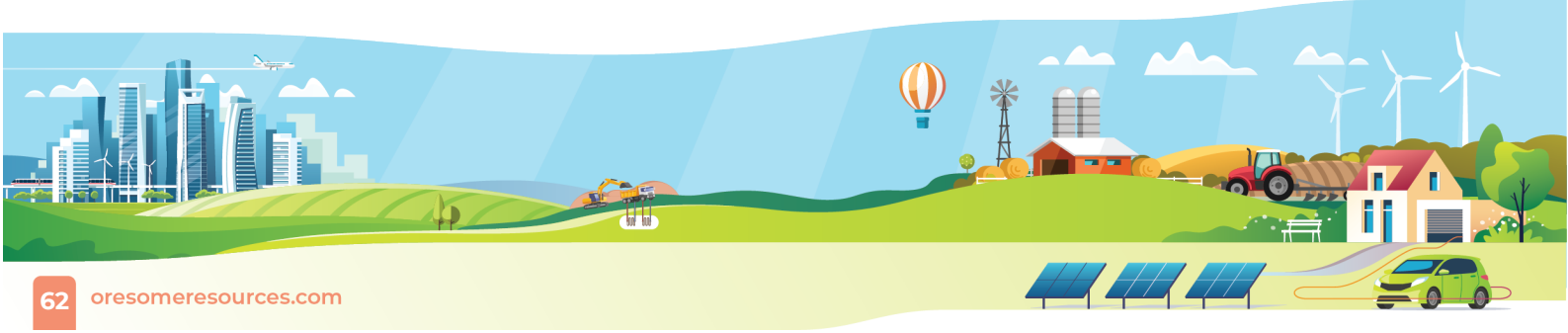
In this activity you will play Tangrams online. You need to access the following website:

http://www.myamericanfarm.org/games/keys_to_stewardship/

Each Puzzle you play will solve a theme (e.g. crop rotation) will give you a fact. Read each fact, and write down the main idea in the table below. One has been done for you.

Theme	Main idea
Crop Rotation	Needs less pesticide and herbicide

Compare your table of themes and ideas with the rest of the class. Add any new ones to your table.



Lesson 9: The meaning of our mountain

Analysing the data collected each week from 'the mountain'. Appropriate selection of graph is important.

In this lesson, students will:

- Look for trends in numerical data
- Convert numerical data into graphical form
- Write an explanation for own observations

Lesson-level Content Descriptions

- Compare and look for declining measurement trends
- Choose appropriate type of graph to represent time based data
- Construct written explanation

Lesson Outcomes

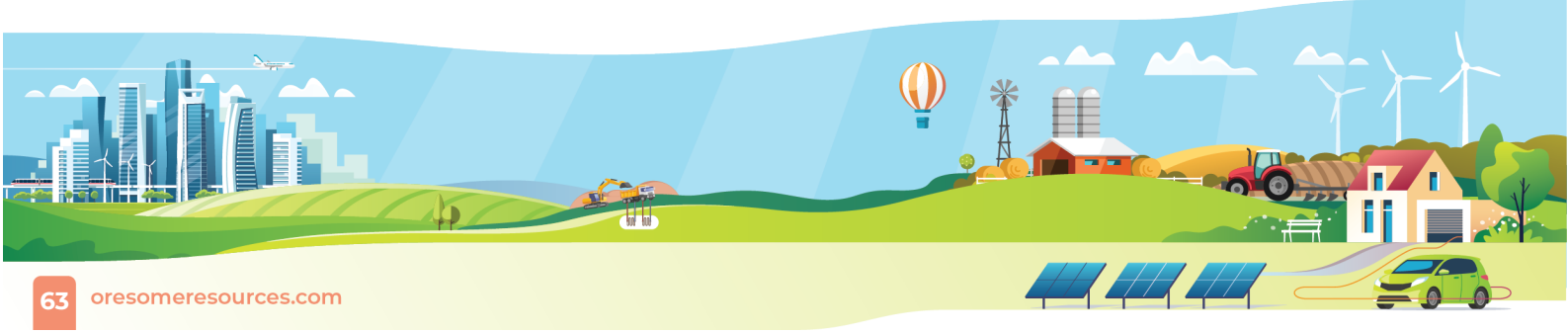
The assessment focus of this lesson is summative. The weekly observation activities provide the stimulus for students to engage in the analysis and explanation of their own data. Students may able to:

- Compare data
- Represent data accurately
- Interpret data
- Describe trends and provide explanations

Preparation List

For the whole class:

- Digital cameras (to record changes in mountain and evidence of weathering and erosion)
- A long piece of rope (to record base measurements of mountain)
- 5 meter measuring tape (to measure rope)
- 2 meter rules (to measure mountain height)
- Class mountain data table

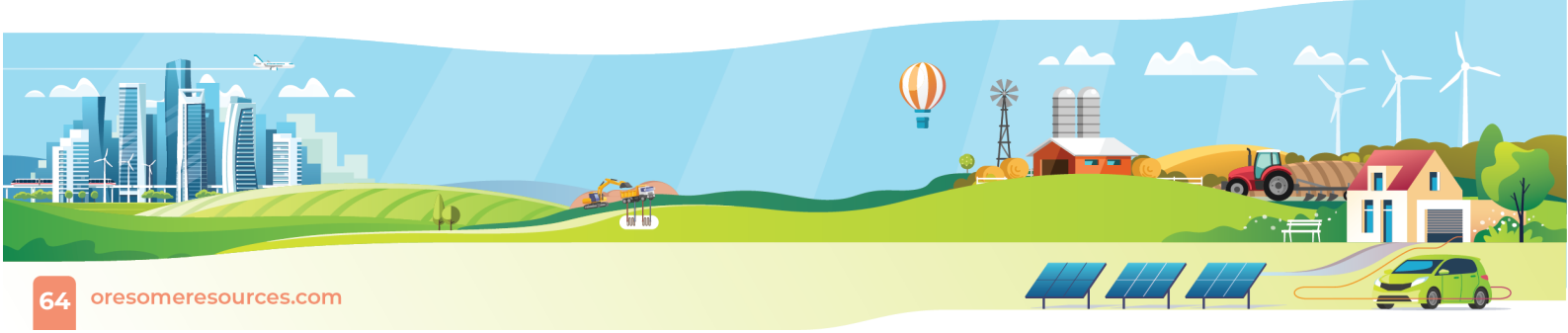


For each student:

- Computer
- Copy of the class mountain data table (or a large version easily read by all students)

Activity Sequence

1. Introduce the Lesson: Students are to be involved in 3 activities: Firstly to remeasure, for the final time, the mountain and to note any changes. It is important to try to make suggestions as to what caused the changes. The second activity, participate in a class analysis of the data. This will involve looking for trends and patterns in their measurements on the class mountain data table. Hopefully a student will offer the notion that patterns will be more easily seen if a graph is drawn. The third activity is computer based with each student constructing a graph. Prior to accessing the computer, a discussion needs to introduce the idea of appropriate type of graph. Students may have encountered bar and frequency histograms, however as time (weeks) is involved, a line graph is appropriate. Finally, the students write a report explaining what happened to their mountain. The explanation should include ideas of cause and effect and feature key words – chemical and physical erosion, sediment, water, wind, slope, measurement.
2. **Student Activity 1 – Class discussion** looking for numerical trends in the mountain measurements. (look for height measurement decreases, base measurement increases, causes from weather conditions and interesting photos)
3. **Student Activity 2 – Lead into graphical representation** (graphs) discussion – need for and appropriate type.
4. **Student Activity 3 – Students create a line graph** on computer (Teacher direction may be necessary)
5. **Student Activity 4 – Students create a written explanation** (it is recommended that the key words are provided on the whiteboard and students need to write at least one sentence using each word).



Appendix 1: The 5Es Instructional Model

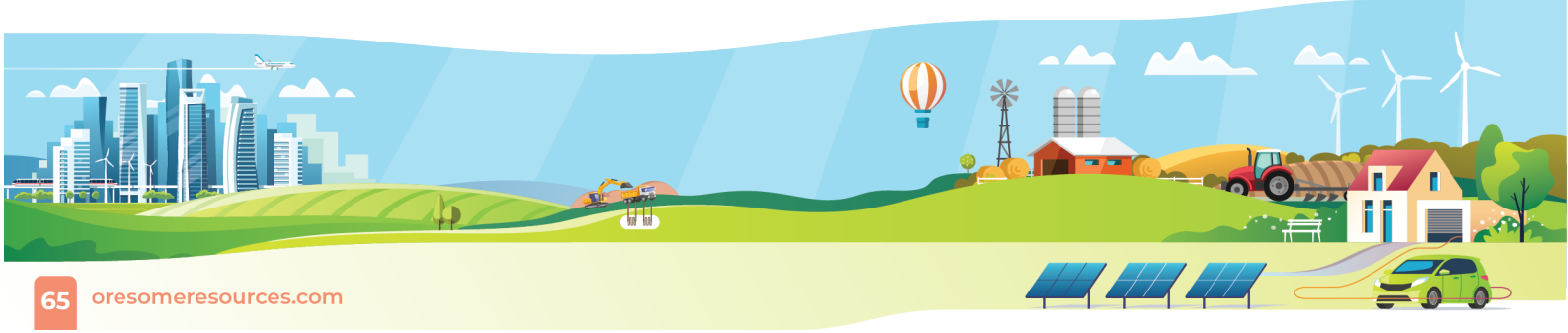
The Australian Curriculum: Science describes the discipline of science as an empirical way in which to answer interesting questions about the biological, physical and technological world in which we live. The answers to such questions then form the basis for our actions as we participate in the activities of the world. Importantly, science is perceived to be a dynamic organisation of ideas, formed through collaborative processes, and based upon humans' creative response to the world in which they live.

Thus, learning science should reflect those characteristics – student's should be encouraged to actively participate in this human endeavour as they collaboratively make sense of their own lived world, under the guidance of their teacher. Classroom experiences should nurture curiosity and creativity and develop a deep understanding of the world, upon which the student's future participation in activities may be based. Put simply, science inquiry should be the over-arching organiser of learning science.

Numerous more specific models of inquiry-based science learning have been proposed, including the 5Es model proposed by Bybee and which has seen numerous variations. In this unit, Bybee's model has been used as the basis for organising the material. A key feature of the 5Es model is that students actively, under the guidance of the teacher, make sense of experiences and thus develop conceptual understanding. That is, classroom activity reflects the nature of science practice. This is in contrast to more traditional science teaching, in which concepts are first presented by the teacher and then students participate in activities that put those concepts into action.

It should be noted that the model used to organise this material is only a guideline – this science material is the basis for good classroom teaching that is responsive to the particular needs of the students. Thus, whilst the materials present a generally linear sequence of learning activities, the teacher should be prepared to routinely return to previous activities and associated learning aims, and so traversing the 5Es model in a somewhat iterative fashion.

The 5Es model organises learning activities into five distinct phases: Explanation, Exploration, Explanation, Elaboration, and Evaluation. In the following sections, the variant of the 5Es model used in these science materials is presented. Specifically, each of the five phases is described, including the nature of the learning activities and outcomes expected in each phase. The structuring of the unit around these 5 phases is then summarised.



Phase 1: Engage

The general aim of the Engage phase is to spark the students' curiosity and to reveal their existing understanding of the concepts to be developed across the unit. Short activities are used with which to engage the students in the content matter and to start develop questions that may be addressed in the activities of future phases. Thus, in the engage phase assessment has a diagnostic nature and generates evidence upon which the teacher can draw to tailor future activities that will extend and/or refine the students' conceptual understanding.

Phase 2: Explore

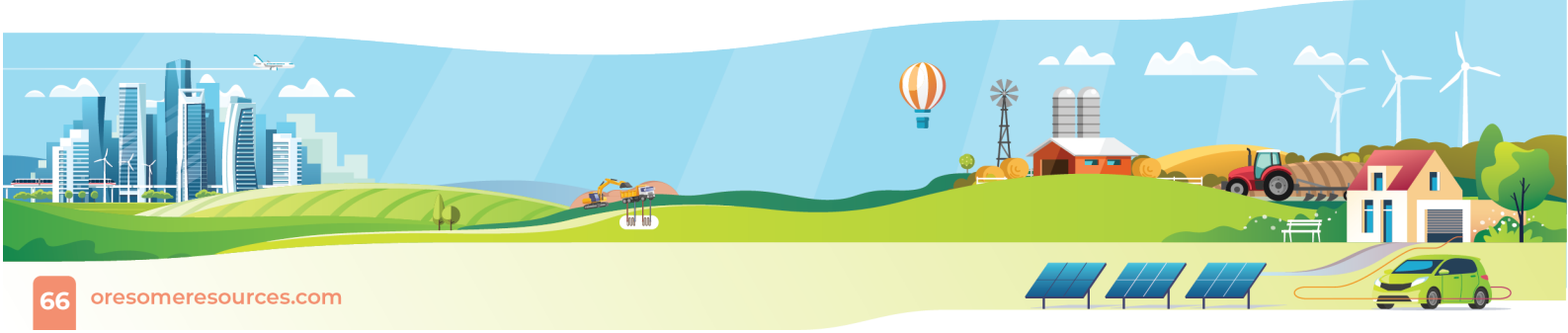
The general aim of the Explore phase is to involve students in hands-on experiences of the scientific phenomena to be understood. The students will draw upon existing knowledge and understanding to conduct investigative activities that generate data which will be analysed and discussed in the Explain phase. These activities constitute formative assessment that focuses primarily upon investigative skills, which may then be further developed in subsequent activities of this and future phases.

Phase 3: Explain

The general aim of the Explain phase is to analyse the data generated in the Explore phase's investigative activities, to identify and discuss patterns or relationships in that data, and thus construct generalisations that advance their conceptual understanding. This analysis may focus upon a particular aspect or sub-set of the data or experiences, or may span all activities of the Explore phase. Hence, then Explore and Explain phases may be quite tightly linked as the students iteratively develop their conceptual understanding. To make such sense of the observed phenomena, the students may look to external sources, including expert scientific opinion. Such construction of meaning may involve significant scaffolding by the teacher to reveal, shape and formalise these generalisations. Key to this phase is the student's expression of their developing conceptual understanding, and thus this phase embeds the formative assessment of such conceptual understanding.

Phase 4: Elaborate

In the preceding phase(s), students have experienced the relevant phenomena, have gathered data, and have then formed generalising concepts that explain their observations and experiences. In the Elaborate phase, the students draw upon this new-found conceptual understanding to plan and conduct an investigation in a new, previously un-experienced context. This investigative activity should challenge students, and thus elaborate upon both their investigative skills and conceptual understanding. In terms of assessment, this phase of



learning provides an opportunity for the teacher to summatively ascertain the investigative skills of the learner.

Phase 5: Evaluate

In this final phase of the instructional model, emphasis is placed upon the student expressing their conceptual understanding by way of some written, oral or visual artefact. Not only does this expression of understanding provide an opportunity to summatively assess the learner's conceptual understanding, it also provides an opportunity for the student to reflect upon their own learning.

In this unit, the engage phase is implemented in the first lesson. Subsequently, the students conceptual understanding of science, along with their procedural skills and broader understandings of science and its role in society, are progressively developed through iterations of explore and explain phases of activity. Embedded in these activities are opportunities for the teacher to formatively assess the students developing understanding. Then, with this newly developed understanding in mind, the students are presented with a new context in which to apply, with relative autonomy, their understanding as they solve a new problem – thus implementing the elaborate phase of the 5Es model. This application of knowledge is complemented by the creation of one or more artefacts, through which the learner is able to critically express their conceptual understanding, thus implementing the evaluate phase of the model. Similar to the iterative explore and explain phases, these latter activities embed opportunities for the teacher to make summative assessments of the learners procedural, conceptual and broader understandings of science.