

context

Soil, sand, pebbles and boulders are simply rocks that have been broken down into smaller particles. The natural processes of rocks breaking down are caused by wind, water, temperature and

other factors. Humans also can speed up these changes through their actions, some of which can have negative effects on the environment.

Break it down

The process of breaking down rocks into smaller pieces is called **weathering**.

Once weathered, any material that is loose can be moved away by the wind; water from rain, creeks and rivers; and the ice of glaciers. This movement is called **erosion**. The material that is washed away is called **sediment** and is the first step in making sedimentary rocks.

Rocks seem tough but can be broken down in a variety of ways.



Fig 9.4.1 Extreme erosion—wind dumped 140 000 tonnes of soil from farmland on Melbourne in 1983.

Physical weathering

Physical weathering (sometimes called **mechanical weathering**) is when rocks break into smaller pieces. Waves crashing on rocky shores break down our coasts. Dramatic changes in temperature break rock into small flakes—water expands when it freezes and can split rocks if it freezes in cracks on frosty nights.



Fig 9.4.2 Surf is constantly pounding away at the rocks making up the coast. This is physical weathering in action.

The small particles of soil and sand that are carried away by wind and water have an abrasive action, which can act like sandpaper on other rocks that they scrape across. Farming and drought loosen the soil and can speed up erosion by the wind.

Chemical weathering

Chemical reactions can also happen to rocks, changing their composition and properties, and even dissolving them. Such reactions are known as **chemical weathering**.

Burning fossil fuels and other industrial activity adds harmful pollutants to the air. Some of these pollutants are acidic and can dissolve in rainwater to form acid rain. **Acid rain** is a product of pollution that can speed up the process of chemical weathering. It can also have many effects on the environment, including:



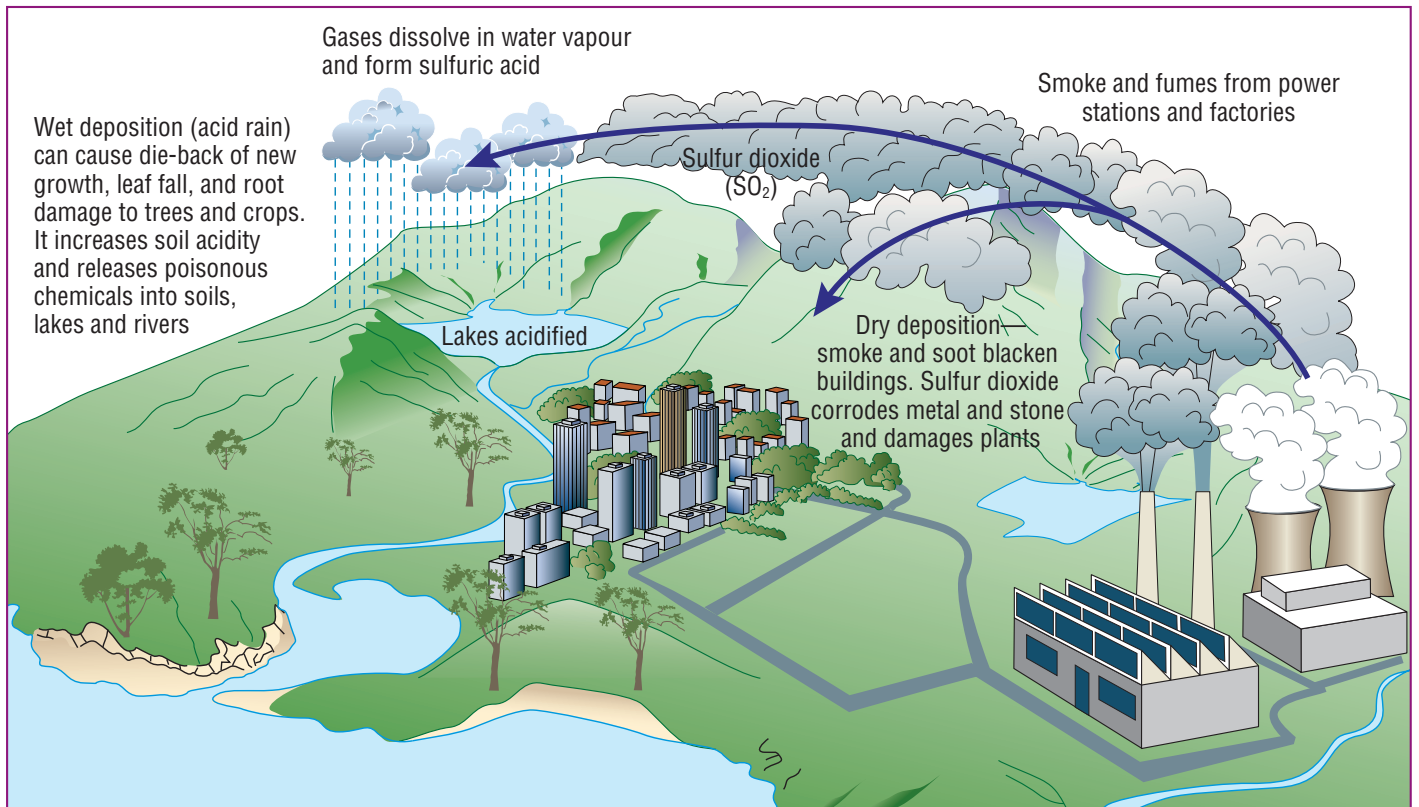


Fig 9.4.3 Industrial waste gases pollute the water cycle, forming acid rain.

- dissolving statues and buildings made of certain rocks, such as marble
- killing fish and animals in rivers and lakes
- killing forests, leading to erosion
- making soils too acidic for plants and crops to grow.



Biological weathering

Other weathering can be caused by animals scratching and breaking apart rocks with their tracks, as they look for food and when they build burrows. Seeds can settle and grow in small cracks in rocks, and tree roots can search out cracks for a better grip. As these plants grow, so do their roots, forcing the crack wider until eventually the rock splits.

Any weathering due to living things is called **biological weathering**.

Worksheet 9.3 Weathering

People and erosion

Science has produced many inventions. These need to be built and fuelled, often from materials found in the Earth's crust. Humans have changed the surface of the Earth dramatically, particularly in the past 200 years since the Industrial Revolution.

We have physically broken down rocks by mining them, sometimes using explosives, and by landscaping the

Earth with roads, houses and cities.

Exhaust gases from cars and factories have added destructive gases to the air. These can slowly chemically weather away rock on mountainsides and the rock used for city buildings.

Building houses, roads and their cuttings, breakwaters and piers in the sea, and ploughing on farms all change how water and wind flow. Without careful planning, these changes can increase the amount of soil and sand that is washed away. Plant cover and the roots of trees help to keep soil bound together and make it less likely to be eroded. Drought, overgrazing and forest clearing can remove grass and plant cover, allowing the wind and water to remove the soil.



Fig 9.4.4 An example of biological weathering—the growing roots of this tree will soon split open the rock.

What can we do?

Human activities, including scientific and technological activities, have played a role in increasing erosion and in causing other kinds of environmental damage. Science and technology can also play an important role in protecting the environment and developing solutions to environmental problems.

Contour ploughing (where furrows run around a hill and not down it) on farms, gutters and the sealing of roads are all used to direct water in order to minimise erosion. Livestock numbers are monitored, particularly in times of drought, to minimise overgrazing. Wind speed can be reduced by windbreaks and stands of trees.

Models of buildings, piers and breakwaters can be used to simulate erosion and plans can be changed to minimise problems before building starts.

Choosing to walk or ride instead of driving a car can mean that you are producing less harmful gases that will form acid rain and contribute to climate change.

Modern car exhaust systems must have catalytic converters that reduce the amount of pollutants pumped into the air. New hybrid petrol/electric cars are available that produce less than half the pollution of normal cars. Industrial chimneys can have 'scrubbers' attached to remove some of the dangerous chemicals discharged from them, and industrial processes can be changed to release less harmful pollutants.

There are things we can all do to help. Think about it!



Fig 9.4.6 Kangaroos have soft feet that cause less weathering and erosion of dry, fragile Australian soils than the hard hooves of cattle.



Science Clip

Roo steaks and burgers

Animals such as sheep and cattle are well adapted for moist climates like England because they have hard hooves, but their hooves can break down the soil in Australia's drier climate and contribute to weathering and erosion. Kangaroos are well adapted to living in Australia and have softer feet that don't damage the soil. Many people are realising that, as well as being tasty and nutritious, kangaroo meat can also be a better environmental choice than beef or lamb.

Career Profile

Environmental scientist

Science has had a large impact on our society and especially on the environment. **Environmental scientists** have the important job of measuring, recording and finding methods to control the harmful effects of human activity on our environment.

Environmental scientists can be involved in:

- investigating the effects of chemical spills and accidents on the environment
- assisting farmers, industry and others in methods to reduce their negative effect on the environment
- testing pollution in water, soil and air
- assessing the environmental impact of new housing estates and industrial developments
- upholding anti-pollution laws.

A good environmental scientist will be able to:

- work as part of a large team
- communicate by writing clear, accurate reports
- apply the scientific method to an investigation
- be passionate about environmental issues.



Fig 9.4.5 Environmental scientists often research and gather data about wildlife populations.

9.4 QUESTIONS

Remembering

- 1 List three different kinds of weathering, **stating** what each one involves.
- 2 **State** what type of weathering is involved in:
 - a mechanical weathering
 - b decomposition.
- 3 List four ways in which weathered material can be moved.

Understanding

- 4 **Clarify** the meanings of the following terms: **L**
 - a soil
 - b decomposition
 - c weathering
 - d sediment.
- 5 **Explain** the difference between erosion and weathering.
- 6 **Describe** what happens to water when it freezes.
- 7 It is dangerous to leave a filled glass bottle in the freezer. **Explain** why.
- 8 **Explain** two ways in which humans and science have accelerated weathering.
- 9 **Describe** how acid rain speeds up chemical weathering.
- 10 Many ancient statues in cities have changed shape in the past 50 years. **Propose** a reason why. **Identify** which parts of a statue are most likely to be weathered and **explain** why.
- 11 Chemical weathering is more likely in the city than the country. **Explain** why.
- 12 In your own words, **summarise** what an environmental scientist does.

Applying

- 13 **Identify** three causes of:
 - a mechanical weathering
 - b biological weathering.
- 14 **Identify** the chemical released into the air that speeds up chemical weathering. **Explain** how this chemical gets into the air.
- 15 **Identify** two things that *you* can do that will help stop or slow weathering and erosion.

Analysing

- 16 **Compare** the similarities and differences between sand and boulders.

Evaluating

- 17 **Propose** who should take responsibility of stopping the weathering caused by humans.
- 18 Develop an argument and **justify** your position as to why you think humans have or have not sped up erosion and weathering.

Creating

- 19 The Environment Protection Authority (EPA) has responsibility for protecting the environment. An environmental scientist employed by the EPA gets up and watches a morning news report that there has been an oil spill in Sydney Harbour. Write a diary describing their day, starting from when they hear the news.