

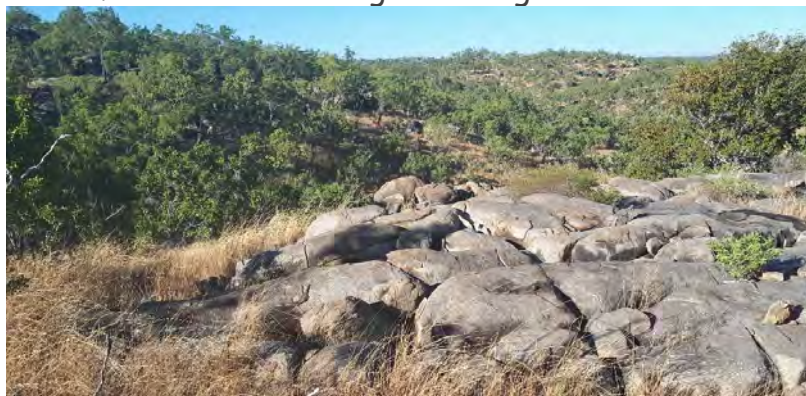


Landscape Changes and Timescale - Teacher's Notes

Landscape Changes and Timescale - Classroom Discussion

During Northern Territory's geological history there have been massive changes in the landscape. Broadly speaking, the geological history of the NT can be summarised as three major periods of inundation by oceans, separated by three longer periods with only relatively minor episodes of inundation. This history can be summarised as follows:

1. A long episode of sedimentation, of sand and mud, from rivers and oceans began ~1.8 billion years ago. Bacteria growing during this time formed stromatolites. Their fossilised remains can still be found in the NT today. The early part of this sedimentation coincided with the collision of an early tectonic plate containing the Top End of the NT with a separate plate containing the Kimberley in WA. This collision is thought to have caused huge amounts of magmatic activity which produced many granites. Together, these rocks were buried, heated and squashed. More recently these rocks were uplifted, forming the relatively low-lying granite and gneiss landscapes that occur:
 - between Palmerston, Wadeye, Katherine and Jabiru,
 - around Tennant Creek,
 - between Alice Springs and the Tanami, and
 - south of Uluru in the Musgrave Ranges.



Granite landscape along Kakadu Highway, NE of Pine Creek





Landscape Changes and Timescale - Teacher's Notes

2. Another long episode of sedimentation from rivers and oceans occurred ~600 million years ago. During this time much of the NT was covered by inland seas in which early marine creatures thrived (e.g. trilobites, gastropods and brachiopods). Fossils of these creatures can still be found today in the NT.



Trilobite (left) & Ammonites (right) from Central Australia

3. One of the world's largest lava flows occurred ~500 million years ago in western NT, originating near Kalkarindji. This lava flow covered 30% of the NT, reaching as far away as Queensland, Alice Springs and into northern WA and SA. The enormous quantity of carbon dioxide released during these eruptions is thought to have been a factor in the end-Botomian mass extinction event (part of the Cambrian Period) during which 50-80% of all marine species became extinct.



Rock core of a Kalkarindji lava flow (white dots were gas bubbles)





Landscape Changes and Timescale - Teacher's Notes

4. The Central Australia tectonic plate collided with the rest of the Northern Territory ~400 million years ago. This collision was so big that it is thought to be comparable to the collision between the plates containing India and China, which is still growing the Himalayan Mountains today. The collision buried, heated and squashed many rocks, we see many of these around Alice Springs today. It also created many fault lines. These are why the quartzite ridge between Ellery Creek Big Hole and Heavitree Gap runs East-West (perpendicular to the orientation of the collision) and why it is repeated to the north at Stanley Chasm and to the south between Pine Gap and Mount Blatherskite.



Uplifted MacDonnell Ranges west of Alice Springs

5. A final period of inundation occurred in the Top End ~100 million years ago, while Australia was breaking away from Antarctica. During this time much of the Top End became covered in a thin fossil-rich layer of mudstone and sandstone. Darwin is built on top of this layer, and it can be seen capping many of the hills around Pine Creek. The fossils tell us that the oceans were rich with ammonites, sharks and ichthyosaurs.



Fossil-rich layer capping hills between Adelaide River and Pine Creek





Landscape Changes and Timescale - Teacher's Notes

6. Sea level rise following the most recent Ice Age (Pleistocene) has inundated large areas of coastal NT and led to the formation of the flood plains that occur between Darwin and Jabiru. Aboriginal oral history and rock art record the change of areas from fresh water systems to salt water with a corresponding change in aquatic life.



Kakadu flood plain

7. As recently as ~20,000 years ago, the NT was home to many species of megafauna. Animals such as the Diprotodon (rhinoceros-sized mega-wombat) and the Thunderbird/Dromornis (2.5 m tall ostrich-like goose) lived in forests of soft leaved trees. The climate changed and became drier and harsher. The trees died and were replaced by hard leaved eucalypts and spinifex started to colonise the grasslands. The arrival of Aboriginal people with their fire stick farming about 60,000 years ago coincided with the last of these amazing creatures. The changes in vegetation and climate enabled the development of sand dune systems.



Thunderbird (left) eucalypt & spinifex dominated landscape north of Alice Springs (right)





Landscape Changes and Timescale - Teacher's Notes

8. The arrival of Europeans, with their introduced animals and plants, have also caused change. Introduced grasses, combined with changes in the seasonal timing and size of fires, result in more intense fires that cause significant loss in biodiversity and systemic changes to ecosystems (e.g. woodlands becoming savannah).



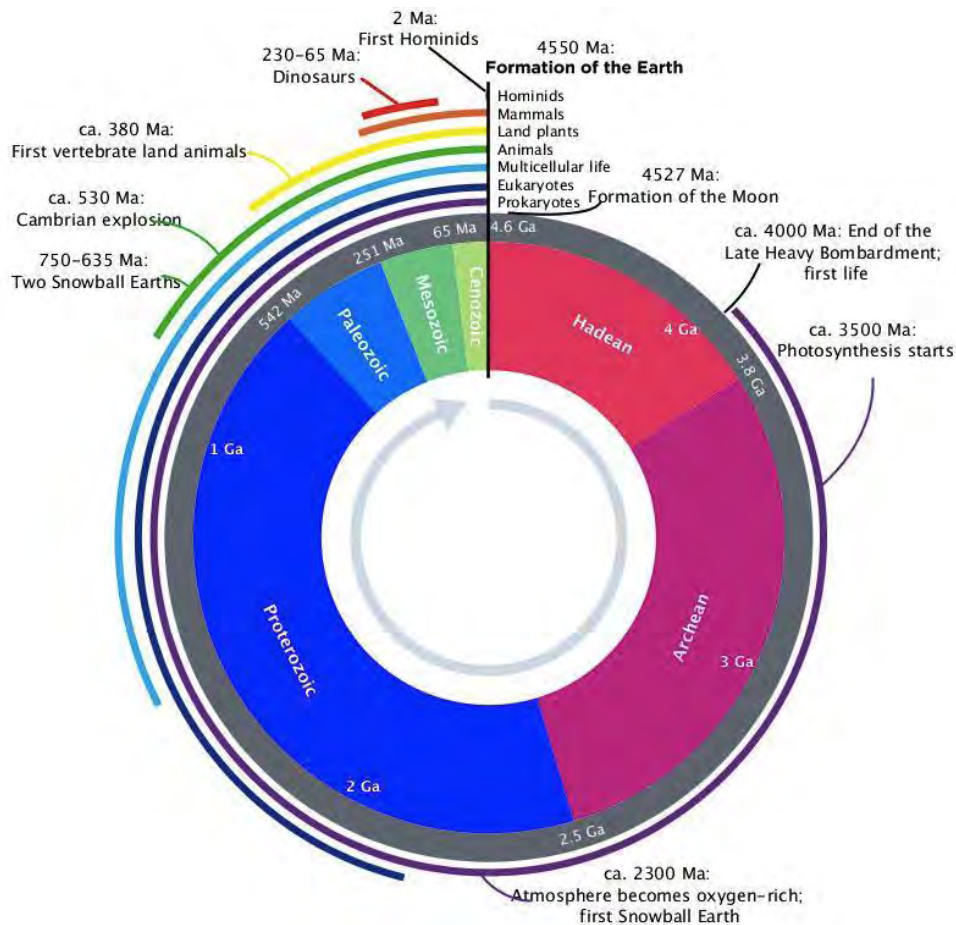
Destabilised ecosystem east of Katherine

Our planet formed about 4.6 billion years ago. Natural landscapes have changed significantly over geological time. Indeed, the major geological time units have been named and divided by these major changes in landscape which resulted in changes to animal life and plant life. About 66 million years ago, massive volcanic outpourings of lava, coinciding with a major meteorite impact, contributed to the K/T (also known as the K/Pg) extinction event that caused the death of ~75% of animals on Earth, including the dinosaurs. All life on our planet at present evolved from the survivors of this event. After this, the great supercontinent of Gondwana broke up releasing the Australian tectonic plate to travel south round the pole to its present position. The different climatic zones it travelled through created different landscapes.





Landscape Changes and Timescale - Teacher's Notes



History of Earth ([wikipedia](https://en.wikipedia.org/wiki/History_of_Earth))

Natural landscapes and features are those that have only been slightly affected by humans. It is difficult to find truly natural landscapes in Australia as most accessible areas have roads.

Managed landscapes have been partly modified by humans, to suit their purposes. Farming land and park land are reasonable examples.

Constructed landscapes have been built by humans.





Landscape Changes and Timescale - Teacher's Notes

Landscapes - Student Activity (with pictures)

Changes in natural features in a landscape are created by:

- Long term geological activity
- Shorter term weathering agents such as rain, wind, flowing water, ice and heat from the Sun
- Long- and short-term changes in climate



Douglas River passing over rock bars with thick vegetation along riverbanks

Natural landscape features are those that **already existed before the advent of humans and still exist now**. These tend to be geographic features such as mountains, rivers, plains, volcanoes, oceans, beaches and forests.

Managed features are changes made by humans to natural features so that they can more easily access and control Earth's resources. Such as, pathways in national parks, toilets in nature reserves, grassed playing fields in schools and drainage channels across areas liable to flood. Managed features can also be seen where one type of vegetation has been replaced by another, such as when a woodland forest has been replaced by mango trees for farming, or when one kind of animal is replaced by another such as cattle grazing where kangaroos and emus used to.





Landscape Changes and Timescale - Teacher's Notes

Constructed features are features built by people such as, houses, schools, roads, railways, airports, dams, irrigation ditches sewers, power stations, mines and ports.

Materials

- 12 or more laminated pictures of different landscapes (or project the photographs included in this package onto a screen)
- 4 different coloured whiteboard markers



City with roads, buildings and non-native vegetation.

Method

These pictures may be expanded to A3 size, printed and laminated so a student or group can mark them with whiteboard markers, to highlight the location of any built features and natural features. If the pictures are printed and laminated, then they can be cleaned and used in subsequent years.

Students are issued with a picture and should then give three good reasons why their picture is of a natural, managed or constructed landscape. They both identify and describe the features in the picture.

Alternatively, students can annotate the pictures projected onto a whiteboard.

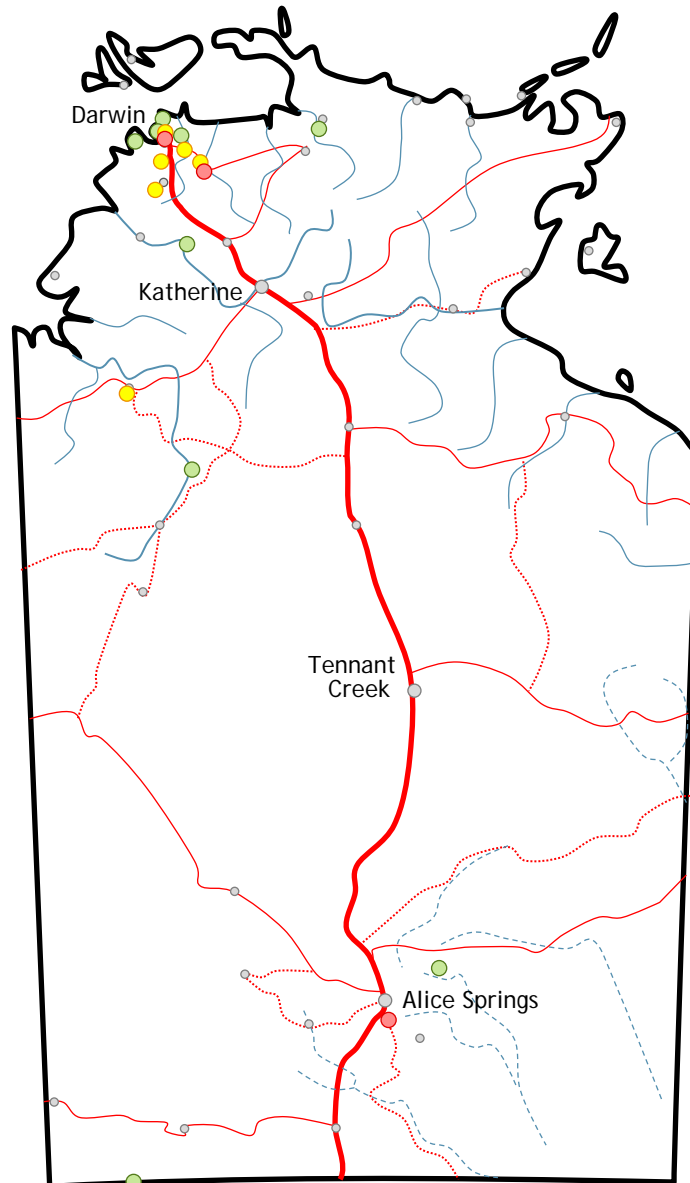
Extension

Take your students for a walk round your local environment and ask them to identify the natural, managed and constructed features.





Landscape Changes and Timescale - Teacher's Notes



Location of supplied photos

Green: Natural landscapes

Yellow: Managed landscapes

Red: Constructed landscapes



Santos & ESWA supporting earth science education



Landscape Changes and Timescale - Teacher's Notes

Aboriginal Dreaming - Classroom Discussion

Some Aboriginal cultures believe that a giant rainbow serpent (known by many different names by different Aboriginal peoples) is associated with creating the landscape and fresh water sources. In the Dreaming stories of the Noongar people of Western Australia, a large snake or serpent, called The Wagyl, shaped the landscape where its body moved over the unformed land. It pushed up mountains and created valleys and rivers where it moved over the land. Spots where it stopped to rest at night later became good meeting places. Where its body squirmed, it left low hollows away from the wind where good fresh water collected. Some believe that the Wagyl makes the thunder and lightning and that it lives deep underground in freshwater springs. There are many depictions of this being in Australian rock art and paintings.



Rainbow serpent painting

Rock shelters throughout Northern Territory often contain artwork of a snake image.

In the Dreamtime stories from country that lie north and inland from Kalgoorlie, a similar serpent is said to be responsible for chewing gnamma holes out of the rock. These



Gnamma hole



Santos & ESWA supporting earth science education



Landscape Changes and Timescale - Teacher's Notes

collect and store freshwater after rain. Aboriginal people would cover them with more rock or brush to stop animals contaminating them and defended them as a precious resource in hard country. The gnamma hole (above) at Barlangi rock near Sandstone, WA has lost its cap and has filled in. It is over 1m deep. Similar holes occur in the NT.

Concentric circles carved into rock or painted onto rock often mark the location of a good water source. Perhaps the petroglyph represented circular ripples spreading from a stone dropped into water. Groups would defend their water resources and the game which were concentrated around them. The rock on the right is near Puunu waterhole near Mt Newman, WA.



Petroglyph

Aboriginal people believed that the landscape was created in the Dreaming before the world, as we know it, began.

Geologists and geographers believe that earth forces such as weathering, erosion, mountain building, faulting and other tectonic forces are continually shaping and reshaping the surface of our planet.





Landscape Changes and Timescale - Teacher's Notes

Sandpit Landscapes - Classroom Discussion

Raindrops quickly change the shape of unconsolidated material but have little short-term effect on rocks.

Ideally, the sandpit you use for this activity should be bordered by rock. If not, please have several pieces of rock (road gravel is fine) or concrete handy.

If you do not have plastic droppers, like Pasteur pipettes, a straw can be used. The straw is held vertically, and half immersed in water. A finger is used to seal the upper opening of the straw and it can be raised out of the water still retaining water. It can be taken (still sealed by the finger) to where it is needed and water drops "milked" out by the other hand.

Materials

- Sandpit and rocks (or cement)
- Buckets & spades
- Four containers of water (ice cream containers are an ideal size)
- A straw, dropper or a Pasteur pipette for each student

Method

1. Take students to sandpit and ask them to quickly landscape the sand into mountains.
2. Demonstrate to the students how to use the straw to make a water dropper (or how to use the pipettes).
3. Students drop 30 raindrops on one part of their mountain landscape and observe any changes.





Landscape Changes and Timescale - Teacher's Notes

4. Repeat, dropping all the water from their straws at once on another part of the mountain range to represent the flow of a river.
5. Repeat the last two activities on rock, to see the effect of rain and a river on the rock.

Questions for discussion

1. Does rain have a short-term effect on soil and sand? **Yes**
2. Does rain have a short-term effect on rock? **No**

Over millions of years rain and running water, and others forms of weathering and erosion, eventually wear away mountains.

Suggested Activities

Dick Roughsey's book - The Rainbow Serpent

This beautifully illustrated book explains how our landscape was formed and how rainbow lorikeets got their colours.

Students may wish to draw or paint the serpent.

Local elders may be invited to discuss the importance of Country and of local landscape features.

