Modelling tipping points – by hands

Demonstrating tipping points in the Earth's system with the hands of three people

See how tipping points work using a block of wood:

Block in a stable position, tilt it a bit and it will return to its stable position.

Block at its tipping point.

(*Block photos, Chris King*)

Block in a new stable position, you can tilt it a bit and it will return to its stable position.

A tipping point in climate change is when the climate of a planet like the Earth 'flips over', from one stable range of climate conditions to another. This idea is often used when discussing the temperature of the Earth. Since the end of the ice age about 10,000 years ago, the Earth has had a stable mean temperature, of about 14°C, with only about 1°C variation year by year.

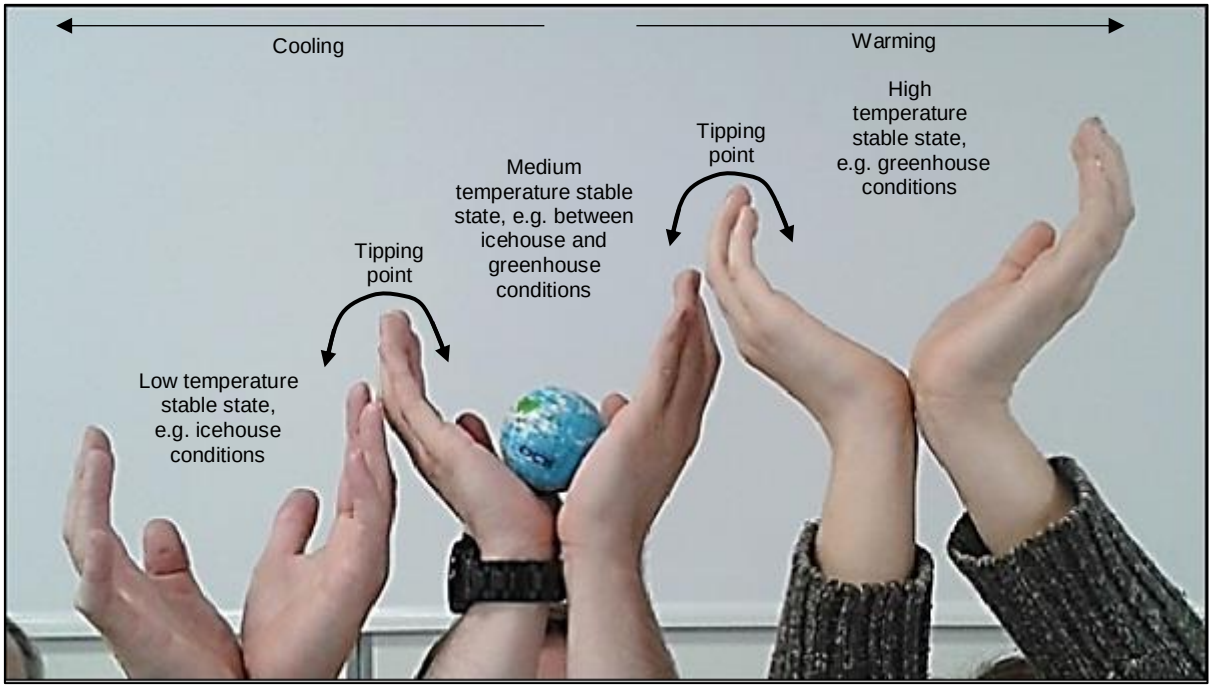
During the rest of the ice age, back to around 2 million years ago, the Earth's temperature was also fairly stable, at around 11°C, but changes were much greater, with variations up to 10°C. In spite of great changes during the last 2 million years, the Earth's climate has always 'bounced back' to give a stable mean temperature. So, it seems that the Earth's temperature has been in a stable state of 11-14°C for the past two million years.

However, we know that Earth's temperature has been stable at different mean temperatures in the past:

- during the Eocene period (56-34Ma), the Earth was so warm that there was no ice at the North or South pole – times when the Earth has no ice are called 'greenhouse Earth' times;
- the Earth has had at least five 'ice ages' in the past – these are often called 'icehouse Earth' conditions, when the polar regions were covered by ice for many millions of years

These studies show that the Earth seems to have several stable temperature states. In each state, although temperatures vary, they always come back to the same mean temperature. A 'tipping point' is the change from one stable state to another.

Ask three of your pupils to model tipping points with their hands as in this photograph.



Hands modelling tipping points. *(Clara Meir).*

In this model, the temperature, shown in the 'medium temperature state' conditions of the person in the middle, is represented by the model globe. If the globe is moved to cooler conditions up along the palm on the left-hand-side, it always returns (or rolls back) to the 'stable state conditions' where the palms of the hands join.

If it is moved to warmer conditions, up along the palm on the right-hand-side, it rolls back again when released. But if the temperature rises so much that it rolls up and over the tipping point into the 'high temperature state', it has moved into new high temperature conditions.

It is likely to remain in the high temperature state for a long time, with temperatures varying up and

down, before eventually tipping over into another stable state, which could be higher or lower.

The back up

Title: Modelling tipping points – by hands.

Subtitle: Demonstrating tipping points in the Earth's system with the hands of three people.

Topic: An activity to demonstrate the concept of tipping points in climate change.

Age range of pupils: 16+ years

Time needed to complete activity: 10 minutes

Pupil learning outcomes: Pupils can:
- explain the concept of tipping points in climate change;
- demonstrate how this this idea works using a ball and the hands of three people.

Context:
Concepts of tipping points are often discussed in climate change and there are several well-known films based on the sudden change of climate to a new ice age or to much hotter conditions. This activity demonstrates this concept.

Following up the activity:
Ask pupils to devise other ways of demonstrating tipping points. Ideas they might suggest include:
- a washer on a suitably bent piece of wire;
- a poorly-designed roller coaster.

Underlying principles:
- When systems have several stable states, the sudden change over from one state to another is the 'tipping point'.
- Tipping points can be modelled in different ways

Thinking skill development:
Developing the idea of climate fluctuations and tipping points involves construction, with debate around these ideas causing cognitive conflict and metacognition, whilst application to 'real world' conditions involves bridging skills.

Resource list:
- a small ball, such as a table tennis ball or a globe stress ball
- the hands of three people

Source: Devised by Chris King of the Earthlearningidea Team.

The Earthlearningidea hand-modelling activities	
Modelling Earth processes	The rock cycle at your fingertips: modelling the rock cycle with your fingers
	Plate margins by hand: modelling plate margins and plate movement with your hands
	Modelling by hand 'when the youngest rock is not on top': illustrating how rock sequences can have older rocks on top of younger ones
	Modelling unconformity – by hand: using your hands to demonstrate how unconformities form
Modelling structural geology nomenclature	Modelling Earth stresses isometrically: using your hands to model Earth stresses
	Modelling folding – by hand: using your hands to demonstrate different fold features
	Right way up or upside down? - modelling anti- and synforms by hand: use your hands to show how folds can be the right way up or inverted
	Visualising plunging folds - with a piece of paper and your hands: using your hands and folded and torn paper to show the patterns made by plunging folds
	Modelling faulting – by hand: using your hands to demonstrate different fault features
Climate change activities	The Earth during Milankovitch cycles – by hand: modelling the Earth's squashed orbit, tilt and wobble using your hands
	Modelling tipping points – by hands: demonstrating tipping points in the Earth's system with the hands of three pupils