

WithOnePlanet

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Investigate

Lesson 4

Teacher notes

Tip-toe through the greenhouse

Years **9 to 10**



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INQuIRY



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Open education
An xpend Foundation initiative

Tip-toe through the greenhouse

Lesson 4: Teacher notes

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This document provides the teacher with the details of the lesson.

At a glance

To provide students with some examples of ecological tipping points that occurred in earlier geologic time periods.

To facilitate students' understanding of the irreversible nature of ecological tipping points.

To provide students with some projected future tipping points as a result of current greenhouse gas emission rates and to facilitate in students' understanding that these tipping points can be averted through direct human action.

To support students to conduct specific research and investigation in order to answer their own essential question developed during the *Question* phase of the *INQuIRY* process.

Lesson focus

The *Investigate* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records, such as science journal entries. The *Investigate* phase ensures all students have a shared experience that can be discussed and explained.

In the *Investigate* phase students develop a literacy product to represent their developing understanding. They discuss and identify patterns and relationships within their observations. Students consider the current views of scientists and deepen their own understanding.

Assessment guide

This assessment guide supports teachers in identifying the types of assessment that are appropriate for this lesson.

Formative assessment is an important aspect of the *Investigate* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. It involves monitoring students' developing understanding of:

> ecological tipping points and the role they can play in climate change.

Key lesson objectives

Science

Students will be able to represent their current understanding as they:

- develop an understanding of ecological tipping points and how they work
- identify some projected tipping points caused by the enhanced greenhouse effect and suggest ways of avoiding them.

This lesson also provides opportunities to monitor the development of students' general capabilities.

Literacy

Students will be able to:

- > contribute to discussions about tipping points and their possible impacts on climate change
- > record understandings and ideas using summaries, diagrams and drawings.

Teacher background information

Small changes can make a big difference for the Earth system. Beyond certain thresholds, known as ‘tipping points’, ecosystems may collapse and transform into distinctly different states.

The tipping points are a major concern for decision-makers because of their potentially large impacts on biodiversity, ecosystem services, climate change and human well-being. According to the Global Biodiversity Outlook synthesis report it can be extremely difficult for societies to adapt to rapid and potentially irreversible shifts in the functioning and character of an ecosystem on which they depend. While it is almost certain that tipping points will occur in the future, the dynamics in most cases cannot yet be predicted with enough precision and advance warning to allow for specific and targeted approaches to avoid them, or to mitigate their impacts. Responsible risk management may therefore require a precautionary approach to human activities known to drive biodiversity loss.

A **tipping point** is defined in Biodiversity Information Systems for Europe 2013 as a situation in which an ecosystem experiences a shift to a new state, with significant changes to biodiversity and the services to people it underpins, at a regional or global scale. Tipping points also have at least one of the following characteristics:

- > The change becomes self-perpetuating through positive feedbacks, for example deforestation reduces regional rainfall, which increases fire-risk, which causes forest dieback and further drying.
- > There is a threshold beyond which an abrupt shift of ecological states occurs, although the threshold point can rarely be predicted with precision.
- > The changes are long-lasting and hard to reverse.
- > There is a significant time lag between the pressures driving the change and the appearance of impacts, creating great difficulties in ecological management.

Source:

Biodiversity Information System for Europe 2013, *Tipping Points*, viewed 19 December 2013, <<http://biodiversity.europa.eu/topics/tipping-points>>.

Equipment

- > The Scales and tipping points demonstration (see Lesson steps for details) requires an old-fashioned set of scales and enough masses of known weight so that the scales can be balanced.
- > Students will each require a copy of *Tip-toe through the greenhouse jigsaw activity - Student worksheet*
- > Students will require access to the internet.

Preparation

- > Read through Scales and tipping points Lesson steps and prepare the equipment.
- > Read through the *Tip-toe through the greenhouse jigsaw activity – Student worksheets*. Check that the students can access the research websites provided in the worksheet.
- > Check that the videos and animation mentioned in the Lesson steps are accessible

Lesson steps

1. The following two electronic resources are good summaries of the Earth’s climate system and can be used to revise students’ prior knowledge of the greenhouse effect and the enhanced greenhouse effect.



The Greenhouse Effect:

<http://www.climatechange.gov.au/greenhouse-effect>



Climate Change in a Nutshell 2: What is climate?

<http://vimeo.com/19798261>

2. Scales and tipping points introductory activity:

- > Place a set of old-fashioned scales in a place where all students can see.
- > Place a known mass on one side of the scales. Make sure that students are unable to see the value of that mass.
- > Ask students to respond to the question: *How much mass do you think I can put on the other side of the scales before the scales tip over?*
- > One by one, add smaller masses to the other side of the scales, noting if the scales tip at all when each mass is added.
- > Add more mass until the mass on both sides of the scale is reached. Students are to note the total mass required for this equilibrium point to be reached.
- > Again pose the question: *How much mass do you think I can put on the other side of the scales before the scales tip over?* (Facilitate the idea that ANY mass, however big or small, will cause the scales to tip over.)
- > Add some more mass to the scales and note that the scales tip over.

3. Explain to students that the scales have a tipping point.

Use the following questions as prompts for a discussion about tipping points:

- > What was the 'tipping point' for the scales in this activity?
- > What happened to the scales at this tipping point?
- > What are some other examples of situations where there is a tipping point? (Some examples include sea level rise, black holes, ...).
- > What are other words or phrases for 'tipping point'? (Some responses may include threshold, point of no return, ...).
- > Do tipping points exist for the Earth? What are some examples? (Some responses may include 'runaway climate change', polar ice-cap melting, extinction, ...).
- > Do introduced species cause ecosystems to cross thresholds? What are some examples? (Some responses may include cane toads, rabbits, foxes, ...).

4. Students to watch the video



Wake up, freak out, then get a grip:

<http://vimeo.com/1709110>

NOTE: The video discusses tipping points in the context of runaway climate change and presents the case that lack of immediate action might be catastrophic. This could be confronting for some students. It is recommended that you preview the video and determine its suitability for the students in your class.

It is worthwhile having a brief discussion following the video, in order to explain to students the following points:

- > Evidence for these tipping points existing is under some scientific debate.
- > These tipping points have not yet been reached.
- > There are many ways that they can be avoided.

5. Students to complete *Tip-toe through the greenhouse jigsaw - Student worksheet*.

Source:

The Greenhouse Effect: online video viewed 24 February 2014, <<http://www.climatechange.gov.au/greenhouse-effect>>.

Climate Change in a Nutshell 2: *What is climate?* online video viewed 24 February 2014, <<http://vimeo.com/19798261>>.

Leo Murray: *Wake up, freak out, then get a grip*: online video viewed 24 February 2014, <vimeo.com/1709110>.