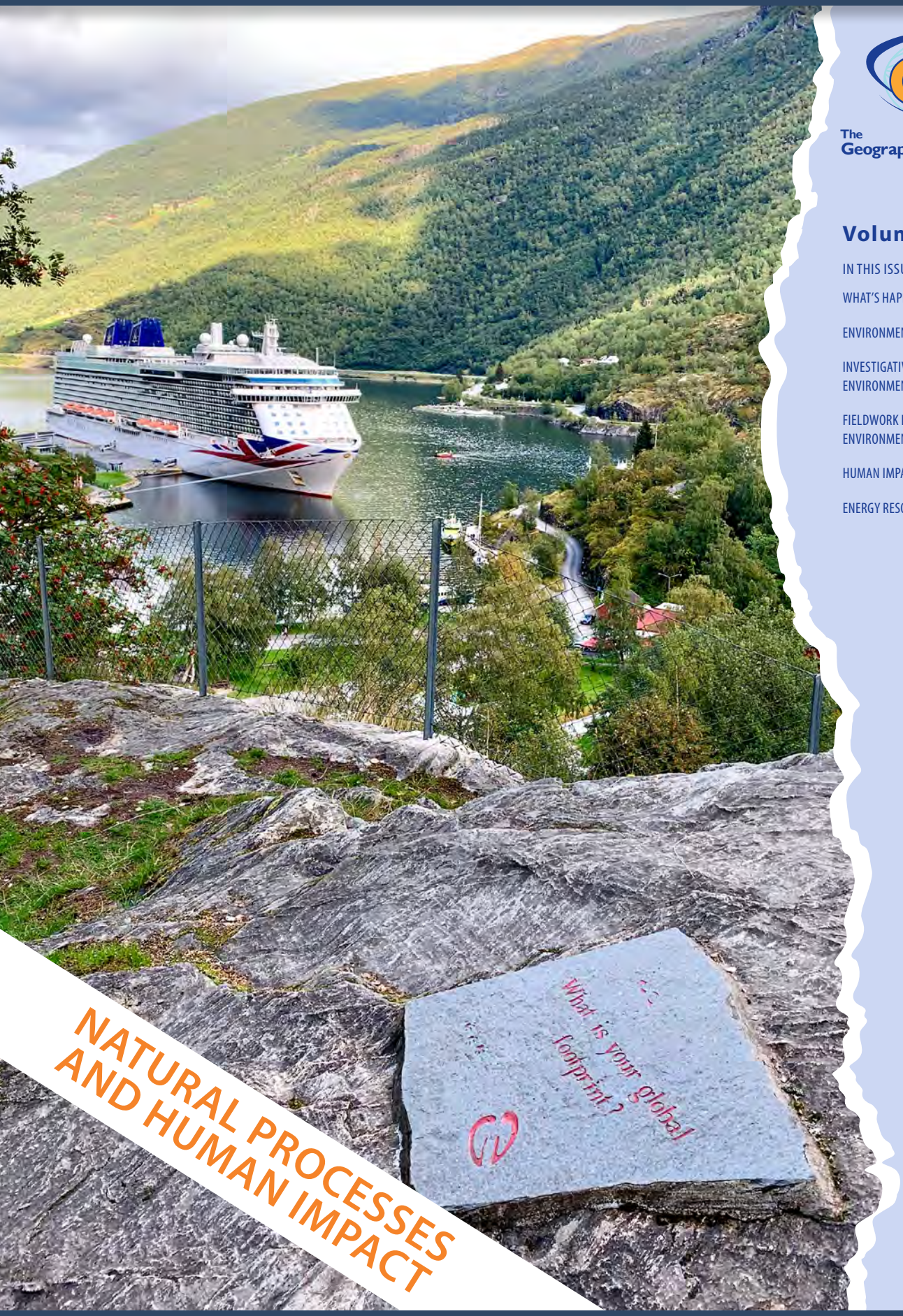
GEOGRAPHY BULLETIN



The Geography Teachers Association of NSW & ACT Inc.

Volume 51 No 3 2019

IN THIS ISSUE:

NATURAL PROCESSES AND HUMAN IMPACT

PROJECTS • REPORTS • RESOURCES • ARTICLES • REVIEWS

EXECUTIVE 2019

GEOGRAPHY BULLETIN

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The Geography Teachers Association of NSW & ACT Inc.

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***Covers:** A cruise ship moored in the fiord at Flam in Norway. Ironically, an art installation along a walking trail above Flam refers to people's ecological footprint. The sustainability of cruising has been questioned in recent times. Image source: L Chaffer*

The Geography Bulletin is a quarterly journal of The Geography Teachers' Association of New South Wales. The 'Bulletin' embraces those natural and human phenomena which fashion the character of the Earth's surface. In addition to this it sees Geography as incorporating 'issues' which confront the discipline and its students. The Geography Bulletin is designed to serve teachers and students of Geography. The journal has a specific role in providing material to help meet the requirements of the Geography syllabuses. As an evolving journal the Geography Bulletin attempts to satisfy the requirements of a broad readership and in so doing improve its service to teachers. Those individuals wishing to contribute to the publication are directed to the 'Advice to contributors' inside the back cover. Articles are submitted to two referees. Any decisions as to the applicability to secondary and/or tertiary education are made by the referees. Authors, it is suggested, should direct articles according to editorial policy.

GEOGRAPHY BULLETIN

Volume 51, No3 2019
EDITOR: Lorraine Chaffer

CONTENTS

EDITORIAL

EDITORIAL

Welcome to the third edition of the Geography Bulletin for 2019. This edition has a content focus on physical geography and human impacts. A big thank you to all contributors.

In the section titled What's happening in our schools there are three reports

- The Refugee Challenge – a report by *Holly Burgmann* on a simulation incursion run at Riverside Girls High school for Stage 5 Human Wellbeing.
- Keeping it local – a reflection by *Kay Dunbar* on challenges faced in engaging Stage 5 students with geography through local fieldwork.
- Australian Geography Competition – ACT Winners is a short piece by *Carol Pogson* on the success of Canberra Grammar School in the Australian Geography Competition.

The following feature articles have a focus on Geographical Inquiry Skills used to investigate physical geography topics in Stages 4 and 5.

- The IB Middle Years Program for Stage 4 by *Adrian Harrison* explains how his school programmed an investigation of Landforms and Landscapes to meet the demands of the IB and the NSW Geography Syllabus. The task and marking guidelines are included.
- In Investigating Subarctic and Subantarctic Tundra Environments *Louise Swanson* has provided background information on biophysical processes, causes of environmental change and management of tundra environments. Several student activities developed by Louise appear in Appendix 1.
- Fieldwork Minnamurra River: From source to sea is a fieldwork program developed during the Kiama Regional Conference by *Andy Grant, Suzanne Johnson, Mark Peters and David Brennan*. The fieldwork was for Stage 5 students studying Environmental Change and Management. See Appendix 2: Fieldwork data collection worksheets

Dr Susan Bliss has written a very comprehensive and detailed article on the Ecological Footprint of people on Earth's biophysical resources (biocapacity). Susan has also provided an extensive variety of student activities that can be found in Appendix 3 & 4.

Martin Pluss's article, Perspectives on global and Australian energy markets, looks at energy from an economic and business perspective. A perfect basis for discussion about energy resources and energy markets for Stage 6 Natural Resources.

Pathways with Geography: Poster

As an initiative to assist teachers to promote the study of Geography in schools we are currently producing classroom posters for sale through the website.

See the flyer in this issue for the first of these posters.

NEW GTA NSW & ACT Website

After much feedback and planning GTA NSW & ACT have launched their new website to service the needs of members and provide easy access to material for professional learning and classroom teaching. Visit the site at www.gtansw.org.au

A new feature of the website is a section for competitions. Two upcoming competitions are:

- Arthur Phillip Fieldwork – entries open for 2019. Closing date Wednesday 20 November.
- Geospatial Australia Competition 2019 (Winners and runners up in 2018 were NSW schools)

Lorraine Chaffer, Editor

Inaugural Geography Teacher Tour of China

For the first time GTA NSW & ACT will take a tour group to China in April 2020 to study places and environments directly linked to the NSW Geography Syllabus K–10.

With 30 hours NESA accreditation and focused workshops to develop resources while on tour, this is an opportunity to expand your content knowledge and target the Asia Cross Curriculum Priority.

For further information visit the GTA website – you will find a link to the flyer on the sliding banner which has the information needed to register for the tour.

Save the Date

Annual Conference 2020 – Thursday 21 and Friday 22 May

Scoop.it!

Scoop.it! is a media curation website and source of contemporary resources, particularly useful for teachers who do not use Geography Facebook Groups.

GTA NSW & ACT has many Scoop.it! pages on which current resources are posted.The image at right shows some Scoop.it! pages curated for GTA NSW & ACT.

Lorraine Chaffer

EDITORIAL

AGTA•19 THE INNOVATIVE GEOGRAPHER: A BRIEF REPORT

Lorraine Chaffer
President GTA NSW & ACT, AGTA director

The Australian Geography Teachers Association biennial conference AGTA 19 ***The Innovative Geographer*** *held at the Gold Coast Convention Centre was a wonderful success thanks to the hard work of conference convenor Rebecca Nicholas and the Geography Teachers Association of Queensland.*

A total of 231 teachers from across Australia attended a selection of masterclasses, workshops, keynote addresses, fieldwork and social events during the 4-day event. It was wonderful to see the mix of pre-service, inexperienced, experienced and retired teachers collaborating, sharing and inspiring each other and conversing with keynote speakers, workshop presenters, representatives of professional associations and exhibitors.

Keynote and guest speakers included:

- Kerry O'Brien, a distinguished and respected journalist spoke about his personal connections to place
- Andrew Fletcher coordinator for Environmental Science and remote Sensing of the Environment units at QUT showed the power of GIS in mapping a changing Earth.
- Rod Lane (Macquarie University NSW) and Jeana Kriewaldt (University of Melbourne) presented a thought-provoking address on the meaning and purpose of Pedagogical Innovation in Geography
- Damon Gameau, Australian filmmaker and director of '2040' shared his reason for making the film 2040 and illustrated the power of regenerative practices in addressing climate change.
- Jenny Woodward from ABC News Brisbane spoke at the Geographers Breakfast about her experiences as a weather broadcaster.
- Brett Leahy demonstrated his emerging and immersive resource titled Virtual Songlines.

Fifty teachers from NSW and ACT attended including three GTA NSW & ACT sponsored teachers Sally Miller, Harrison Smith and Nicole Gray from northern NSW. Eight GTA NSW & ACT board members attended and / or presented at the conference. Many thanks to President Lorraine Chaffer, Vice Presidents Louise Swanson, Susan Caldis, Sharon Mclean and Grant Kleeman and councilors Alexandria Warnock, Michael Da Rosa and Catherine Donnelly for supporting this conference at your own expense and contributing to the professional learning of the Australian community of geography teachers.

AGTA AWARDS

The Australian Geography Teachers' Association Awards are given biennially for products of Australian origin associated with the teaching of geography in schools. The award winners were presented at the Conference dinner. Each award recipient receives a citation bearing the emblem of AGTA and the right to display this emblem as the association's endorsement of the product.

GTA NSW & ACT received two 2019 AGTA Awards:

- WINNER of the Primary Geography Resource category for Primary Geography Alive
- HIGHLY COMMENDED in the Not-for-profit category for The Geography Bulletin Edition 50, Volume 3, 2018

See the AGTA website for award categories and winners.

DON BIDDLE AWARD

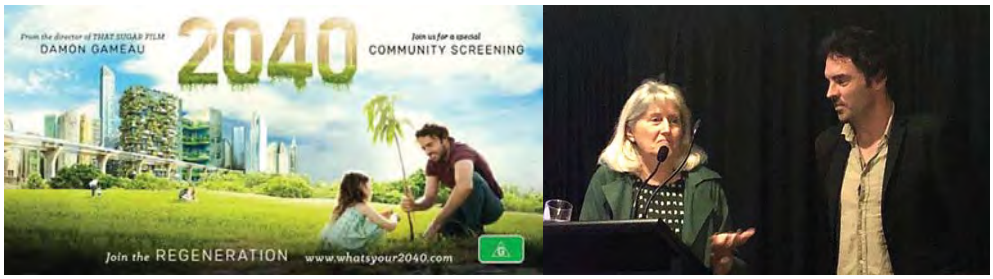
The Don Biddle Award recognises and honours the outstanding contributions by individuals to geographical education in Australia through their work with the Australian Geography Teachers Association.

The 2019 recipients of the Don Biddle Award are:

- Greg Calvert
- Rebecca Nicholas

Greg and Rebecca received their awards at the AGTA Conference Dinner and their citations will be published on the AGTA website.

DID YOU MISS THE 2019 AGTA CONFERENCE?
START PLANNING NOW FOR THE 2021 CONFERENCE IN HOBART.



Damon Gameau spoke about his film 2040 at the conference dinner, to a very appreciative audience. Damon is being thanked for his film about hope and regeneration by GTA NSW & ACT president Lorraine Chaffer

LEFT: Promotion image

The Gold Coast Convention Centre was a fantastic Conference venue catering to over 60 workshops in 3 days. As well as full day fieldtrips, participants were able to join mini fieldtrips to experience and learn about:

- *urban planning and coastal geography career pathways at Griffith University*
- *using drones in the classroom with She Maps at Benowa State High School*
- *a local economic activity study at Black Hops brewery*

A highlight for many NSW & ACT GTA Councillors was joining our interstate counterparts from GTANT, TGTA and GAWA to discuss all things geography during the full day Fieldwork trip to Byron Bay. The focus was on Sustainable Tourism and included visits to Byron Bay Lighthouse, The Farm and Husk Distillery.

Photos supplied by L Chaffer, AGTA19 The Innovative Geographer Facebook page and conference participants

THE REFUGEE CHALLENGE

LEFT: Student facilitators helped run the simulation for Year 10.

Stage 5: Human Wellbeing
A Case Study on Refugees using THE REFUGEE CHALLENGE Simulation Incursion

Holly Burgmann, Riverside Girls High School

Syllabus link: Improving human wellbeing

Students:

- investigate initiatives to improve human wellbeing in Australia and other countries, for example: (ACHGK081)
  - proposal for action by governments, organisations or individuals to improve the wellbeing of ONE group in Australia

Resource overview:

1. Post simulation reflection questions
2. Wellbeing comparison
3. Human Rights and Refugees
4. Mapping Refugees
5. Group presentation: Response Proposal
6. Reflection writing task (individual)

What is the Refugee Challenge?

The Refugee Challenge is a simulation experience run by an external operator that provides insight to the lives of 70.8 million people around the world in refugee like situations. Through the simulation, students walk in the shoes of a refugee and experience challenges that refugees around the world encounter. It is a physical simulation where the journey is created through actors, set design, and audio-visual aspects.

Refugee Camp Setup in the school Hall.

Students construct temporary shelters in the refugee camp from the materials provided

Students visit the aid organisation to "register" and apply for shelter

Students experiencing school in the refugee camp in Arabic.

The following components are included in the simulation:

- Fleeing from home countries
- Crossing a border
- Living in a refugee camp or foreign city
- A boat journey
- Processing by immigration officials at a detention centre
- Videos about refugee issues and human rights

The activity runs for 2 hours including a briefing before the simulation, the simulation itself and a debrief afterwards. Students also hear from someone with a history and lived experience of poor human wellbeing and this nurtures a deeper interaction with the class material. The simulation is facilitated by *The Refugee Challenge* team and a group of student facilitators who sets up the simulation at your school. Prior to the simulation, the student facilitators are trained to create a safe simulation environment. *The Refugee Challenge* is a non-political activity and complies with the Department of Education's Controversial issues policy. At our school the whole of year 10 experienced *The Refugee Challenge* for the topic Human Wellbeing.

Market scene where students barter for food and clean water

1. Post simulation reflection questions

Activity 1: INITIAL REFLECTION QUESTIONS

1. **Describe your experience as a refugee in 5 words.**
2. **What was the hardest thing you experienced in the simulation? Why?**
3. **In what ways did it change your view of refugees in the world?**
4. **What is one thing your learnt in the debrief?**
5. **How does the wellbeing of refugees differ from our own? 1 TEEL paragraph.**

"For example, in the simulation experience...."

2. Wellbeing comparison table

Activity 2: Comparison

"Human wellbeing is the recognition that everyone around the world, regardless of geography, age, culture, religion or political environment, aspires to live well. Wellbeing is not necessarily bound by income, rather, it is an individual's thoughts and feelings about how well they are doing in life, contentment with material possessions and having relationships that enable them to achieve their goals."

Create a table which compares our own wellbeing with the wellbeing of refugees around the world. Think about things like possessions, food, water, health, education, security, family etc.

OUR WELLBEING	REFUGEES' WELLBEING

3. Class work on Human Rights and Refugees

CONTEXT:
WHAT ARE HUMAN RIGHTS?

Human Rights

The Universal Declaration of Human Rights:

- Proclaimed at the United Nations General Assembly in Paris on 10 December 1948
- Contains 30 articles affirming an individual's rights
- Was drafted in the aftermath of the devastation of World War II
- 48 countries voted in favour of the Declaration
- Not legally binding

1 All human beings are born free and equal in dignity and rights.
2 These rights belong to everybody – no discrimination.
3 We all have the right to life, freedom and safety.
4 No slavery.
5 No torture.
6 We all have the same right to use the law.
7 The law is the same for everyone. It must treat us all fairly.
8 Fair treatment by fair courts.
9 No unfair detainment.
10 The right to trial.
11 Innocent until proven guilty.
12 The right to privacy.
13 Freedom to move.
14 The right to asylum.
15 The right to a nationality.
16 The right to marriage and family.
17 The right to your own things
18 Freedom of thought.
19 Free to say what you want.
20 Meet where you like.
21 The right to democracy.
22 The right to social security.
23 Workers' rights.
24 The right to leisure.
25 A bed and some food.
26 The right to education.
27 Culture and copyright.
28 A free and fair world. There must be proper order so we can all enjoy rights and freedoms in our own country and all over the world.
29 Our responsibilities. We have a duty to other people, and we should protect their rights and freedoms.
30 Nobody can take away these rights and freedoms from us.

To do: i) Write 3 ways these rights affect you...
ii) Which rights do you think many refugees and asylum seekers may not have

The 1951 Refugee Convention

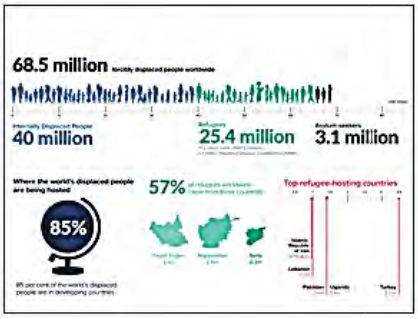
- Drafted in the aftermath of WW2:
- Article 16: Access to courts of law
- Article 17: The right to work
- Article 26: Freedom of movement
- Article 31: Non-discriminatory about mode of arrival 'shall not impose penalties'
- Articles 32 and 33: Expulsion and Return

WHAT ARE REFUGEES?

Where are they from?
Where do they go?

TERMINOLGY

Refugee	Asylum Seeker	Migrant	Internally Displaced Person
Someone who has a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, and who cannot return home because of this persecution. This definition including guidelines on how obligatory countries should care for refugees is outlined in the 1951 UN Refugee Convention.	Someone who is seeking protection as a refugee. The term is given to people who have not yet had their status determined; they may be a refugee but we do not yet know until their claims are heard and evaluated. *Remember: All refugees were asylum seekers once.	Someone who chooses to move to another country, usually for work, education or family reasons. Unlike refugees who feel it is necessary to leave their countries, migrants make this choice voluntarily, and can return home when they wish.	Someone who has fled their home but remains within the borders of their country. Given the definition of a refugee stipulates that the person must be outside their home country IDPs are not technically refugees. However, if they were to cross their country's border into a neighbouring country they may fit the definition.



68.5 Million
Forcibly Displaced at the end of 2017
(Up from 65.6 end 2016)

- Internally Displaced Persons (IDPs) – 40 million
- Refugees – 25.4 million
- Asylum Seekers – 3.1 million waiting decision on applications
- Stateless people – 10 million
- On average 44,400 people were displaced from their homes every day – 1 every 2 seconds
- 52% are children under the age of 18

Graphing

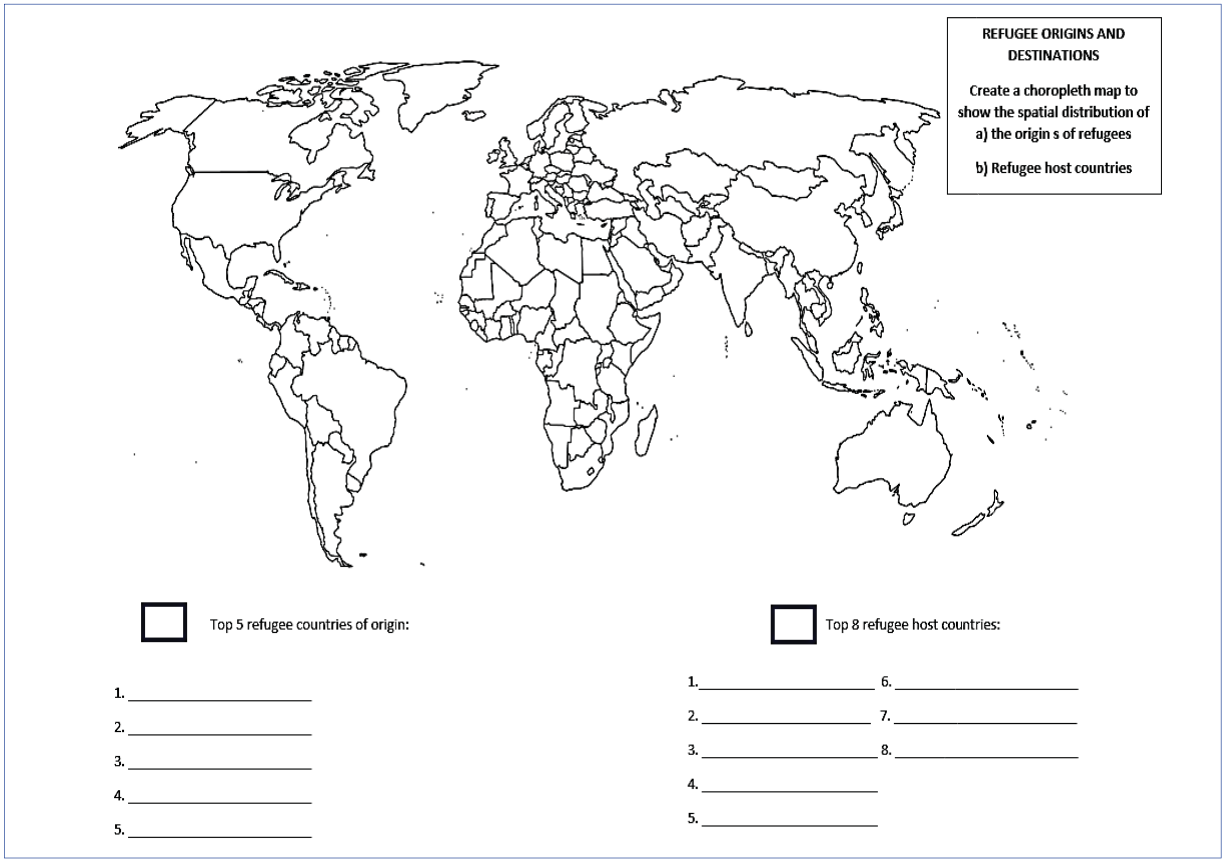
From the information on the previous slide, create a column graph showing the amount of people that are:

a) Internally displaced
b) Refugee
c) Asylum seekers (awaiting decision on application)

68% of all refugees worldwide are from top 5 countries -

- the **Syrian Arab Republic** (6.3 million),
- **Afghanistan** (2.6 million),
- **South Sudan** (2.4 million)
- **Myanmar** (1.2 million)
- **Somalia** (986,400)

4. Mapping Refugees



5. Group presentation: Response Proposal

Group Presentation

Inquiry questions:

- ✓ **What is the wellbeing of refugees like around the world and Australia?**
- ✓ **How can people respond to this issue for a better future?**

In groups of 3-4, you are to create a presentation (google slides presentation, multimedia presentation, a podcast or another method of your choice) that completes the following:

1. Describe the factors which impact the wellbeing of refugees around the world.

2. Propose one way that governments, groups or individuals in Australia can respond to the challenges of refugee wellbeing for a better future.

In your presentation you should refer to class material, research as well as your experience in The Refugee Challenge simulation.

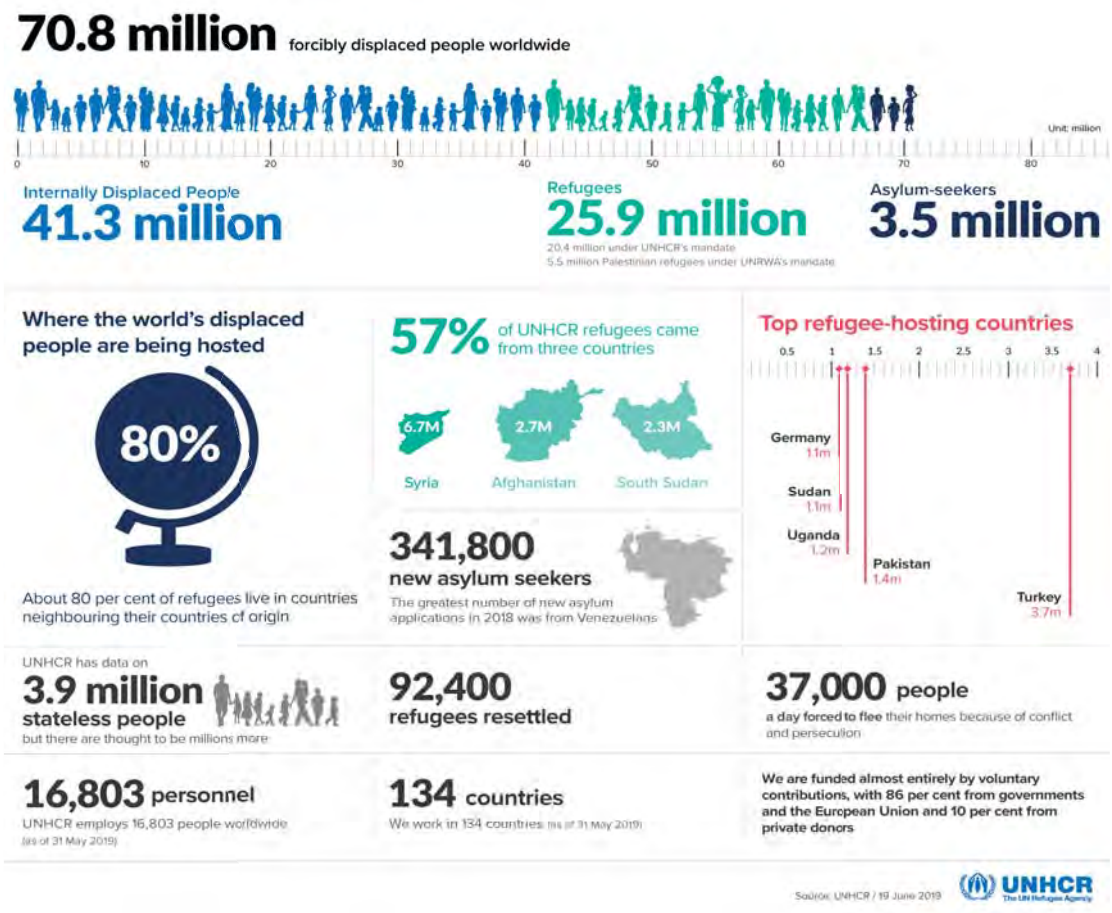
6. Reflection writing task (individual)

REFLECTION WRITING TASK (20 minutes):

"Explain how your response to refugee wellbeing in Australia can lead to a better future."

In your answer include:

- What is the proposal/project?
- What wellbeing issue/s is it addressing (cause)?
- What results of the proposal/project do you hope to achieve (effect)?
- Refer to research and your experience in The Refugee Challenge

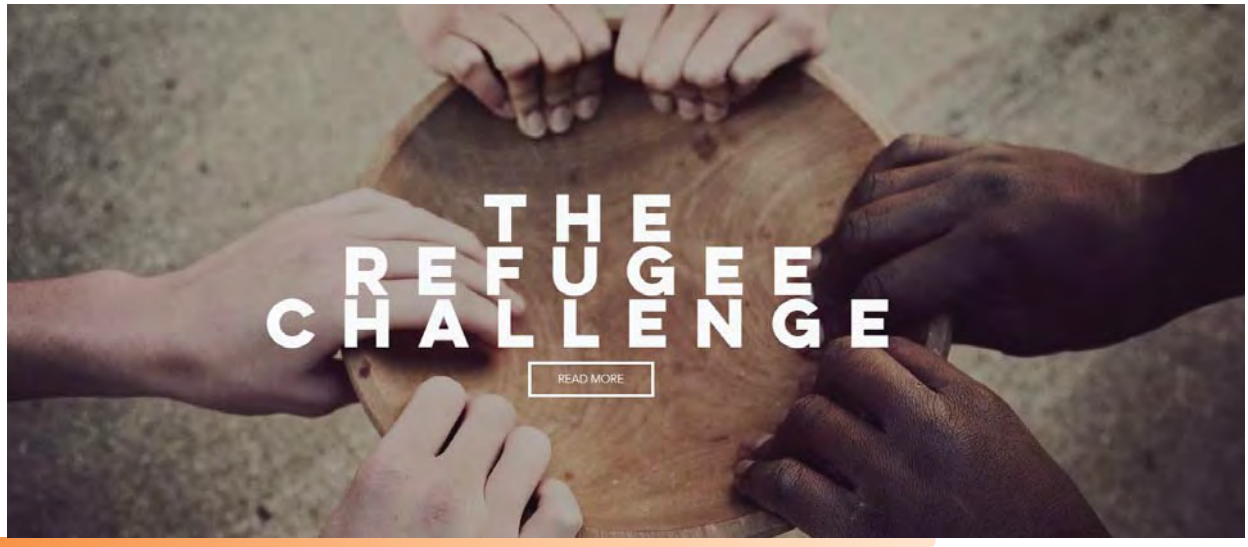


Debrief after the simulation

Feedback from students who experienced the simulation and case study was overwhelmingly positive and included:

- *"I have learnt how much fear and trauma refugees go through just to find shelter and be safe, which we take for granted"*
- *"The way refugees are treated was very eye-opening."*
- *"Their basic human rights were not given to them"* and
- *"In the future I won't take things for granted, I want to support refugees".*

If you have any questions or would like access to the complete resource material, please contact holly.burgmann1@det.nsw.edu.au. Additionally, if you are interested in running *The Refugee Challenge* at your school, please contact info@therefugeechallenge.com.au.



KEEPING IT LOCAL


https://narrandera.com.au/attractions-around-narrandera/narrandera-wetlands/

Annual Conference Selective Tours Scholarship winner,
Kay Dunbar, Head Teacher, HSIE/CAPA, Narrandera High School

In an attempt to promote Geography as a relevant and future focused subject at my small rural high school, all fieldwork is designed around our local community and the environment we live and work in.

Context

To put this Year 10 Wetlands Fieldwork excursion (*Environmental and Change Management*) into context I feel I need to explain the thinking and motivation behind it.

Firstly, we run a compressed curriculum at Narrandera High, which means our Year 10 students roll-over to Year 11 in week 6 of Term 4. Consequently, students choose their senior subjects week 2 of Term 3. With this in mind and being painfully aware that senior Geography has not run at Narrandera High in living memory, I deliberately planned to run this excursion the week before subject selection to encourage students to consider selecting Geography as one of their HSC subjects.

The second consideration in planning this excursion was to make it interesting for the students. We have a lot of boys that are starting to lose interest in school after recently completing their two weeks of work experience. This excursion was a way to show students the skills they can learn, while studying Geography, which will help them gain employment in the future. The last consideration was to involve experts from the community, which also helps promote conversation around the validity of Geography to a broader audience.

Narrandera Wetlands

The Narrandera Wetlands, off Bundidgerry Creek, was constructed in early 2005 to filter stormwater before it entered the river. The constructed wetlands project is a result of a partnership between Narrandera Shire Council and Narrandera Landcare Group who were successful in securing funding from the Federal and State Governments (Narrandera Tourist Information Centre).

Organisation for the excursion

The idea for the excursion came to me after attending the GTA Annual Conference. The enthusiasm of teachers for Geography empowered me to be more proactive in promoting the subject in my school and community.

I began by contacting our local council as I believed they were responsible for the maintenance of the Wetlands. Council suggested I contact Landcare, which I did and thankfully they were very keen to assist. We negotiated the time and what activities we would conduct. It was decided that Landcare would explain the purpose and function of constructing the wetlands and the ongoing impact on the environment and community. Landcare were also to run a Mini Beasts identification activity and myself and two other teachers would run the quadrant and weather observations, water and soil testing activities.

The Excursion

The driving questions for this excursion were:

- How do environments function?
- Why is an understanding of environmental processes and interconnections essential for sustainable management of environments?

Students were supplied with a booklet in which they had to record their findings and test results.

Activities included:

- Two writing tasks
  - *In geographical terms, explain why the wetlands were created here.*
  - *Using the knowledge you have acquired through your fieldwork, write a letter to Council and Landcare suggesting changes and improvements to the wetlands that will benefit the community.*
- Weather observations (Kestrel anemometer): Beaufort Wind Scale, temperature, humidity, cloud cover
- Soil Survey: identification, texture, pH
- Mini Beast: identification and count to gauge health of water/environment
- Water Testing: turbidity, salinity, temperature, nitrogen, phosphorous, pH
- Quadrant: plant identification, fauna identification
- Human Impacts

Reflection

We only had 120 minutes, which included travel time, to conduct our fieldwork. Students had approximately 20 minutes at each station, however we only got through three rotations. Students were cooperative and very engaged in all the activities.

In hindsight, I think we tried to do too much in a short amount of time. Consequently, class time will be allocated so students can complete the activities in the booklet. This will also allow students who were absent to use the equipment and get some results.

In terms of achieving the goal of promoting Geography as a senior subject, I feel that some students will at least consider it now. I feel that parents and the community is also becoming familiar with the skills we can teach their children through my promotion of everything we do on the school Facebook page.

Senior subject selection is this week so I will have to let you know if I was successful in getting Senior Geography running or not.

Acknowledgements

Darron Watt – Wagga Wagga Environmental Education Centre, for supplying us with all the fieldwork equipment

Nella Smith – Narrandera Landcare

AUSTRALIAN GEOGRAPHY COMPETITION – ACT WINNERS

For the 20th consecutive year, geography students from Canberra Grammar School in the ACT have again excelled in the Combined Territories division of the Australian Geography Competition, achieving first place. Additionally, for the last 11 years, Canberra Grammar School has consistently claimed one of the top 5 positions in the country – this year gaining fourth place in Australia.

Geography is such an important part of the School's educational offering, as it teaches students the importance of both physical and human geography, equips them with a range of specialised skills, and helps students develop an appreciation and respect for different viewpoints and ideas, at a local, national and international level' said Dr Justin Garrick, Head of Canberra Grammar School.

Canberra Grammar School's outstanding results were evident across all year levels with 124 High Distinctions and over 100 Distinctions. Individual achievements included; Thomas Lin (Year 8) gaining equal first place in Australia in his year group, Daniel McCormack (Year 9) first place in the Combined Territories and Otto Power (Yr 12) first place in the Combined Territories. All will receive medals, a certificate and book voucher.

Further, Canberra Grammar School's Tyra Kuan (Year 11) has been selected to represent the ACT at Geography's Big Week Out being held on Kangaroo Island, South Australia in early December this year. From this event, four students will be chosen as members of the team, which will represent Australia at the 2020 International Geography Olympiad in Istanbul,

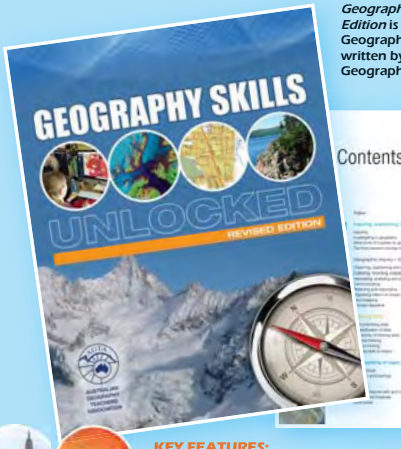
Carol Pogson
Head of Geography
Canberra Grammar School
Australian Capital Territory

The Australian Geography Competition is a joint initiative of the Royal Geographical Society of Queensland and the Australian Geography Teachers' Association. For further information go to www.geographycompetition.org.au/content/about-competition

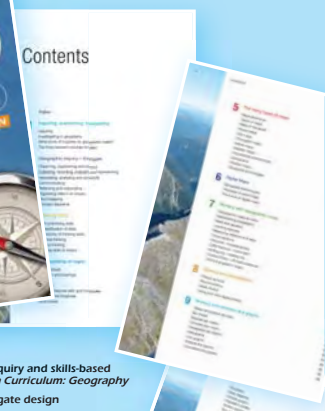
TEACHING RESOURCES

AGTA ANNOUNCES A REVISED EDITION OF THIS POPULAR BOOK

GEOGRAPHY SKILLS UNLOCKED, the essential skills book for Australian secondary schools



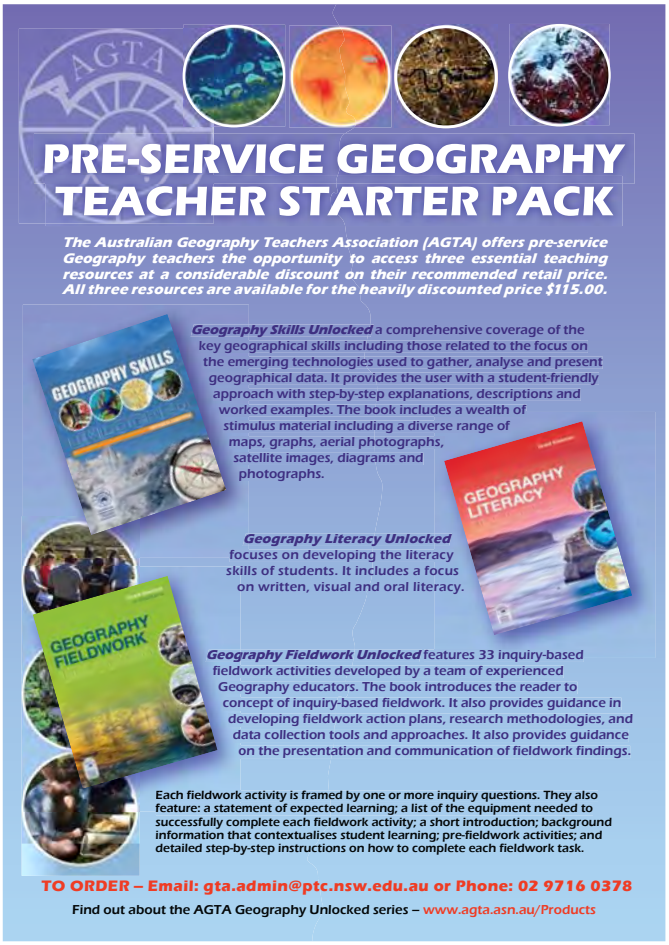
Geography Skills Unlocked – Revised Edition is published by the Australian Geography Teachers Association and written by a team of experienced Geography teachers.



KEY FEATURES:

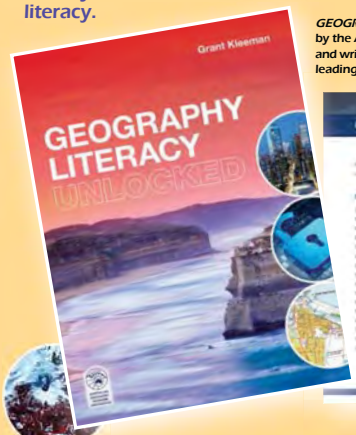
- Contents aligned to the inquiry and skills-based requirements of *Australian Curriculum: Geography*
- An engaging, easy to navigate design
- A student friendly approach with step-by-step explanations, descriptions and worked examples
- A focus on emerging technologies used to gather, analyse and present geographical data
- *GeoSkills* and *GeoInquiry* activities that scaffold student learning
- A wealth of stimulus material including a diverse range of maps, graphs, aerial photographs, satellite images, diagrams and photographs
- Examples drawn from each Australian state and territory with additional international material
- Key terms explained in embedded glossary boxes

GEOGRAPHY SKILLS UNLOCKED can be ordered online from AGTA – **www.agta.asn.au/Products**



AGTA ANNOUNCES AN ESSENTIAL NEW GEOGRAPHY RESOURCE

GEOGRAPHY LITERACY UNLOCKED has been written for secondary geography students seeking to improve their literacy skills. It includes a focus on written, visual and oral literacy.



GEOGRAPHY LITERACY UNLOCKED is published by the Australian Geography Teachers Association and written by Dr Grant Kleeman. One of Australia's leading geography educators.

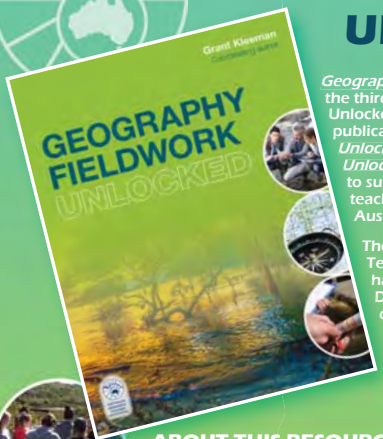
KEY FEATURES:

- An engaging, easy-to-navigate design
- A student-friendly approach featuring step-by-step explanations and annotated exemplars
- A focus on the basics of effective written communication – spelling, punctuation, tense and the use of connectives
- Descriptions of the principal text types used in geography, supported by annotated examples
- Guidance for writers in quoting, paraphrasing, summarising and referencing the work of others
- A focus on the responsible use of social media
- A comprehensive coverage of the principal forms of visual and oral texts students encounter in geography
- Templates or scaffolds to support the interpretative skills students are expected to demonstrate.

GEOGRAPHY LITERACY UNLOCKED is available for purchase from the GTANSW website: **www.gtansw.org.au**

NEW TO THE AGTA GEOGRAPHY UNLOCKED SERIES

GEOGRAPHY FIELDWORK UNLOCKED



Geography Fieldwork Unlocked is the third book in the Geography Unlocked series. Like companion publications – *Geography Skills Unlocked* and *Geography Literacy Unlocked* – the resource seeks to support and enhance the teaching of Geography in Australian Schools.

The Australian Geography Teachers Association (AGTA) has published the book with Dr Grant Kleeman, one of Australia's leading Geography educators, acting as coordinating author.

→ **NOW AVAILABLE**

ABOUT THIS RESOURCE

Geography Fieldwork Unlocked features 34 inquiry-based fieldwork activities developed by a team of experienced Geography educators

Section 1 of the book introduces the reader to inquiry-based fieldwork. It also provides guidance in developing fieldwork action plans, research methodologies, and data collection tools and approaches. It also provides guidance on the presentation and communication of fieldwork findings.

Section 2 features nine fieldwork activities for primary students (Years F/K–6). Each of these activities has been designed to develop students' conceptual understanding and the skills associated with inquiry-based learning.

Section 3 showcases 25 fieldwork activities aligned to the topics studied by students in Years 7–10.

Each fieldwork activity is framed by one or more inquiry questions. They also feature: a statement of expected learning; a list of the equipment needed to successfully complete each fieldwork activity; a short introduction; background information that contextualises student learning; pre-fieldwork activities; and detailed step-by-step instructions on how to complete each fieldwork task.

THE IB MIDDLE YEARS PROGRAM FOR STAGE 4

Source: Wikimedia commons at https://upload.wikimedia.org/wikipedia/commons/8/82/Mont_Blanc%2C_2017.jpg

The MYP: How the IB's inquiry focus supports the teaching and assessing of Landscapes and Landforms

Adrian Harrison, Director of Curriculum Cranbrook School

The IB: International Baccalaureate

The IB Middle Years Program (MYP) is designed for students aged 11 to 16. It provides a framework of learning that emphasises intellectual challenge and encourages connections between studies in traditional subjects and the real world. The MYP focuses on "learning how to learn" through the systematic development of approaches to learning (ATL) skills for communication, collaboration, organisation, self-management, reflection, research, informational literacy, media literacy, creative and critical thinking, and transfer of learning. It also fosters intercultural understanding and global engagement —essential qualities for young people today (International Baccalaureate 2014). One of the significant features of the most recent rewrite of the New South Wales Geography syllabus was the inclusion of the Key Inquiry Questions. These are a way in which teachers and students could frame investigations that facilitated more deep and meaningful learning. The benefits of inquiry-based learning have been known for some time as have the pursuit of critical thinking skills and the capacity to allow students to make their own connections. The shift in education has moved from knowing being centred upon the repetition of information to the ability to find information and to apply it in other contexts.

The MYP: A statement of inquiry

Planning for units in the MYP centres upon a statement of inquiry; this is a way of expressing the relationships between the concepts and context. For the unit on Landscapes & Landforms the statement of inquiry we had adopted was *Landscapes and landforms are shaped by natural and human processes and are used and valued by different people in different ways.* This statement, along with the FOUR Key Inquiry Questions outlined in the syllabus, formed the basis for the entire unit of work.

Along with a focus upon 'learning how to learn' the value of inquiry-based learning is that it leads to transferable conceptual understanding, particularly apparent in the way in which the MYP undertakes assessment. The remainder of this article focuses upon an MYP assessment task for Landscapes and Landforms.

The context: Stage 4 Landscapes and Landforms

Within our school setting we introduce Landscapes & Landforms as the first unit to Year 7 students. For many of them this is the first instance of specific Geography lessons, although many of them have engaged with portions of the subject at primary school, particularly aspects of physical geography.

Stage 4 Landscapes and Landforms

Task Description

Goal: To show your understanding of how landscapes are formed.

Role: You are trying to get a freelance job working for National Geographic as a reporter.

Audience/Scenario: Your editor has asked you to investigate the ways in which landscapes and landforms are transformed by environmental and human processes. You will cover one of the following MOUNTAIN landscapes:

- Mt Vesuvius (you are to select this if you are studying Latin)
- Mont Blanc (you are to select this if you are studying French)

Product:

Complete a 500 word report that investigates the geomorphic process that led to the formation of this landscape. Your article must also discuss the human processes (how humans have/do use it) that have taken place in this landscape over time.

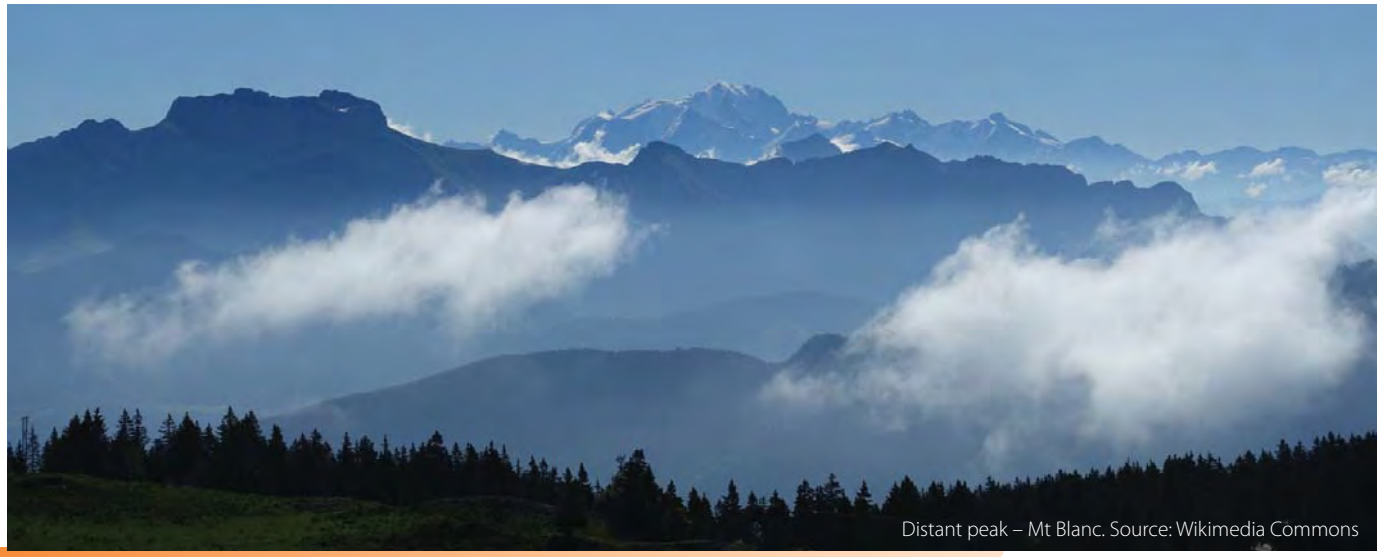
Use the editor's template below to ensure you follow the magazines format. The visual aspect of this is vital and as such your editor has asked for a minimum of 1 image for each section.

Success Criteria

In your report, you must provide information on the following points;

- LOCATION: Describe the location, include a map with BOLTS
- GEOMORPHIC PROCESSES: How the landscape and surrounding landforms were created
- HUMAN PROCESSES: How the landscape and surrounding landforms have been altered

There has been a raft of plagiarism happening in the publishing world. Many writers have had their laptops stolen and articles sold freelance to other publications. As such National Geographic insists that all work belongs to the author. Information may be used if acknowledged correctly (see bibliography guide) but sites such as Wikipedia can NOT be taken from directly.



Distant peak – Mt Blanc. Source: Wikimedia Commons

Assessment Marking Criteria

Level of Learning	A – Knowledge & Understanding	C – Communicating
	The student does not reach a standard described by any of the descriptors below.	The student does not reach a standard described by any of the descriptors below.
	The student: i. makes limited use of terminology ii. demonstrates basic knowledge and understanding of a natural disaster and causes through limited descriptions and/or examples.	The student: i. communicates information and ideas in a way that is not always appropriate for National Geographic ii. makes limited use of headings, subheadings, bullet points and/or paragraphs and correct sentence structure. iii. makes no attempt to format using correct referencing style
	The student: i. uses some terminology accurately ii. demonstrates satisfactory knowledge and understanding of a natural disaster and causes through simple descriptions, explanations and examples.	The student: i. communicates ideas and information in a style that is somewhat clear in report format some images (maps, graphs, diagrams) are included to support key information. ii. communicates ideas and information in a style that is somewhat clear in report format some images (maps, graphs, diagrams) are included to support key information. iii. creates a reference list with 1–2 sources. Some attempt has been made to format using appropriate referencing style
	The student: i. uses considerable and relevant terminology accurately ii. demonstrates substantial knowledge and understanding of a natural disaster and causes through descriptions, explanations and examples.	The student: i. demonstrates clear communication of ideas and information in report format containing headings, subheadings and bullet points. Relevant images (maps, graphs, diagrams) are included to support key information. ii. uses headings, subheadings, bullet points and/or paragraphs and correct sentence structure effectively. Relevant visual sources used to support key information iii. creates a reference list with at least 3–5 sources in an appropriate referencing style, usually cites sources.
	The student: i. consistently uses a range of terminology accurately ii. demonstrates excellent knowledge and understanding of a natural disaster and causes through developed and accurate descriptions, explanations and examples.	The student: i. demonstrates effective communication of ideas and information in report format containing headings, subheadings and bullet points. Relevant images (maps, graphs, diagrams) are included to support key information. ii. structures information and ideas completely according to the task instructions iii. creates a complete reference list containing at least 6 sources in an appropriate referencing style, always cited

Mt Vesuvius viewed from the Pompeii archeological site. Source: Wikimedia Commons

About the assessment criteria

Note that the marking criteria does not have marks assigned to it. The focus for this assessment is to look at two specific criteria, they are Knowledge and Understanding (criteria A) and Communicating (criteria C). The MYP has two other criteria for Geography, Investigating (criteria B) and Critical Thinking (criteria D). We have elected not to assess these specifically with this task although there is obviously a need for a student to apply these skills throughout the task. This allows for the demonstration of learning that has been developed throughout the course. We have removed marks in order to place a focus upon what capabilities students have demonstrated. By directing them to the continuum they can see where progress can be made and how they are capable of improving.

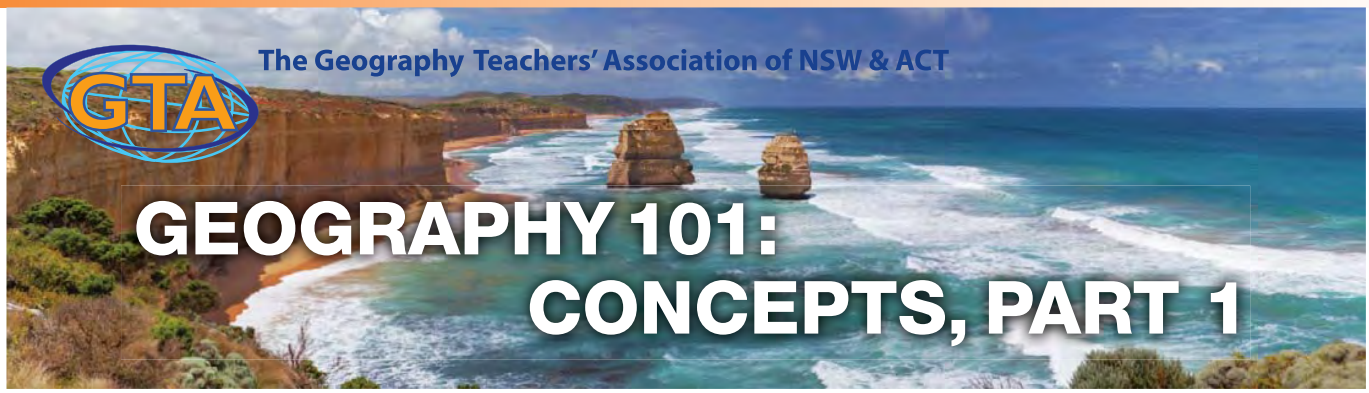
The use of the GRASP (Goal, Role, Audience, Scenario, Product) model for meaningful assessment aligns with not only the IB philosophies but also those key inquiry aspects proffered in Geography. The choice of options of specific landscapes has been directed to align with the student's choice of languages (Latin or French). This supports the 'connection between' subject areas and is a simple way of breaking down the silo's that often occur within departments in schools.

The focus upon inquiry in learning has always been central to the teaching and assessment in Geography. The assessment framework provided by the MYP allows for the targeting of key competencies. The IB desires to offer intellectual challenge and this is supported in Geography through the use of key inquiry questions.

GTA NSW & ACT SCOOP.IT pages

Find contemporary resources on our Scoop.it web curation pages for each topic Geography 7-10 plus HSC, Primary, ICT, Skills, Aboriginal and more.

Go to https://www.scoop.it/u/lorraine-chaffer



A flexible anywhere, any time online learning opportunity through Open Learning

Geographical concepts are a foundation for teaching Geography in NSW. This professional development course, created by Dr. Paul Batten on behalf of the GTA NSW & ACT, examines the seven key concepts from the Australian Curriculum Geography and NESA Geography Syllabus K–10. These concepts are: place, space, environment, interconnection, scale, sustainability and change.

The purpose of the course is to build teachers' understanding of these core concepts. By completing the learning activities participants will demonstrate their capacity to use three of the concepts – place, space and environment – to create engaging Geography lessons.

Skills developed in this course include: applying knowledge of the content and teaching strategies of Geography to develop engaging teaching activities (NESA Standard 2.1.2), providing opportunities for ATSI respect and understanding (NESA Standard 2.4.2) and contributing to collegial discussions to improve professional knowledge and practice (NESA Standard 6.3.2).

The course is designed for flexible delivery, where participants can start, progress and finish at times convenient to them. The collaboration is in a 'pay it forward' style, where participants engage with previous contributions and contribute themselves – learning in the process, but also adding to the galleries of exemplars and case studies for future participants to review.

Cost: $90 Register at https://www.openlearning.com/ptc-nsw/courses/geography-101/
For further information about this course contact – gta.elearning@gmail.com

NSW GOVERNMENT

Geography Teachers Association of NSW & ACT, through the Professional Teachers' Council NSW – is endorsed to provide the NSW Education Standards Authority (NESA) Registered Professional Development for teachers accredited at Proficient, Highly Accomplished, and Lead levels.

Completing the **Geography 101: Concepts, Part 1**, on **29 October 2018 – 29 October 2019** will contribute **3 Hours** of NSW Education Standards Authority (NESA) Registered PD addressing 2.1.2; 2.4.2; 6.3.2 from the Australian Professional Standards for Teachers towards maintaining Proficient Teacher Accreditation in NSW.

TOOLS FOR GEOGRAPHICAL INQUIRY

**Lorraine Chaffer, President GTA NSW & ACT,
Editor Geography Bulletin**

CARTOGRAMS: Ecological footprint

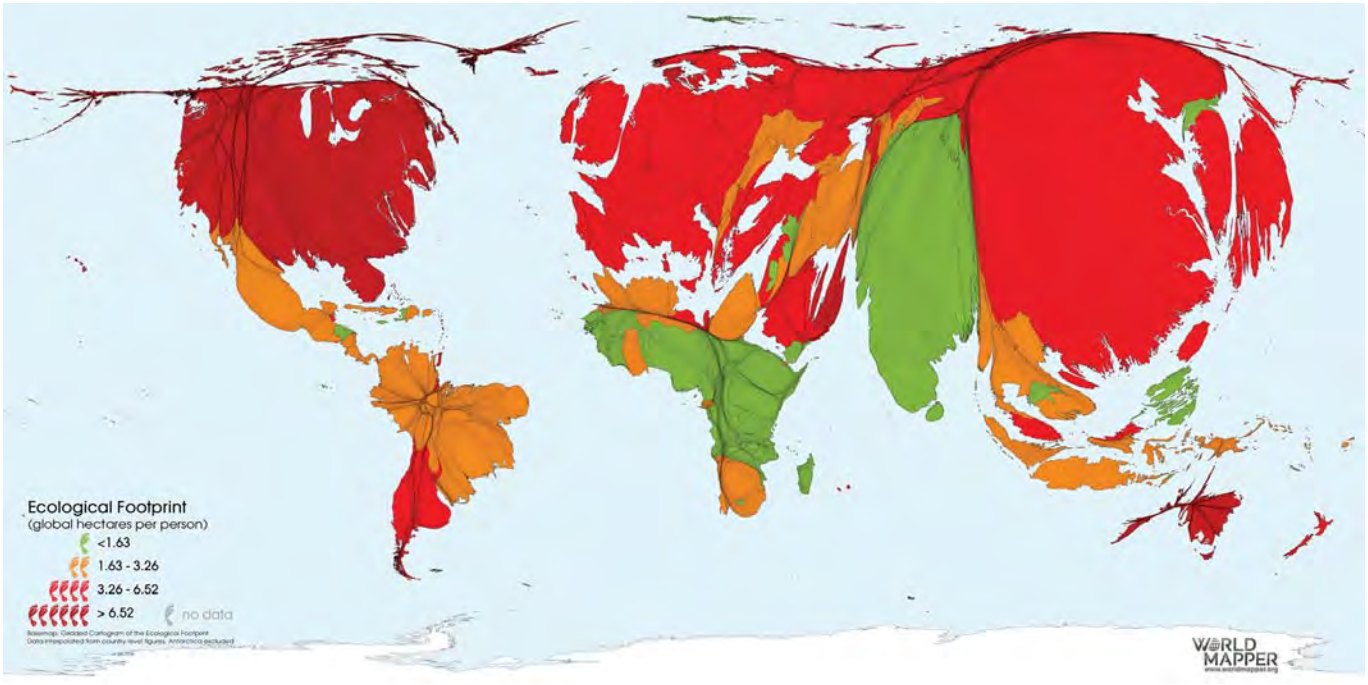
Link: Ecological Footprint. Dr Susan Bliss

Worldmapper cartograms distort our image of the world on purpose and show each country in proportion to a specific variable. Geographers use conventional maps as a reference map to understand the distortion with a more common image of the world based on area.

This cartogram shows land resized by its total ecological footprint. Each grid cell in the map is proportional to the total number of people living in that area multiplied by their national ecological footprint measured in global hectares consumption per capita.

'The Ecological Footprint of Consumption gives a picture of each country's and each person's total ecological footprint. The ecological footprint is a measure to quantify humanity's impact on the natural environment. It is calculated by estimating the carrying capacity of the natural environment and comparing this to the levels of consumption and waste. It is measured in global hectares (gha) for the average biological productivity in a given year.

A sustainable word would need an average ecological footprint of currently 1.63 gha. With changing consumption patterns and population developments, the gap between these two has growing constantly and exceeds the biosphere's regenerative capacity. This map shows the extent to which countries overuse the world's natural resources, colour coded by multiples of the carrying capacity of the planet.'



Data source: Global Footprint Network, National Footprint and Biocapacity Accounts 2019 Edition.– https://worldmapper.org/maps/grid-ecologicalfootprint-2019/

For identifying individual countries use the World Mapper interactive map or an Atlas map of the world.
https://worldmapper.org/region/

INFOGRAPHICS: Changing tundra environments

Link: Subarctic and subantarctic tundra environments. Louise Swanson

Infographics present geographical information in summarised form using images, maps, graphs and text. They are useful tools for stimulating inquiry through questioning and further research. Students can create their own infographics to communicate geographically using tools such as Canva, Piktochart, easel.ly and Vizualise.me.

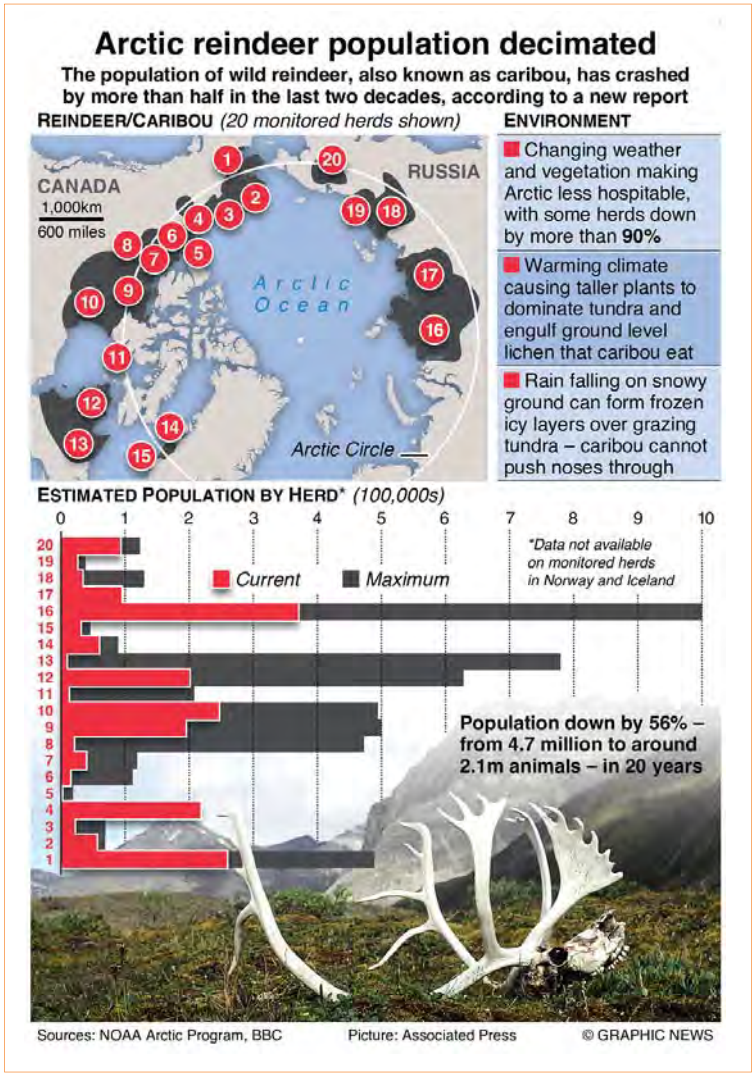
Source: https://commons.wikimedia.org/wiki/File:20070818-0001-strolling_reindeer.jpg"target=

'It's not just the reindeer that are suffering…… Besides seeing caribou and the ecosystems they support disappear or diminish, the report (2018 Arctic Report Card) indicates the air temperature in the region is the highest it's ever been, warming Arctic waters are resulting in harmful algae blooms, Arctic sea ice is thinner and less widespread than ever before and microplastics are beginning to infest Arctic marine ecosystems.'

Source: https://www.smithsonianmag.com/smart-news/reindeer-populations-have-plummeted-among-other-problems-arctic-180971023/

Source: https://upload.wikimedia.org/wikipedia/commons/d/dd/Caribou_herd.jpg

Source:: L. sChaffer



TUNDRA INVESTIGATIVE STUDY

SUBARCTIC AND SUBANTARCTIC TUNDRA

Arctic tundra FloridaStock/Shutterstock
Source: https://theconversation.com/polar-bear-invasion-how-climate-change-is-making-human-wildlife-conflicts-worse-111654

Louise Swanson, Vice President GTA NSW & ACT

This is a comparative study between Heard Island and McDonald Islands Reserve and World Heritage Site, (Australian Territory) and Churchill Wildlife Management Area, (Canada).

Heard and McDonald Islands are located at approximately 53°S and 73°E.

Subantarctic refers to the region in the Southern Hemisphere which is just north of the Antarctic Circle.

Churchill Wildlife Management Area is located at approximately 58°N and 93°W.

Subarctic refers to the region in the Northern Hemisphere which is just south of the Arctic Circle.

Part A: Biophysical Processes

A range of biophysical processes are essential to the functioning of subarctic and subantarctic tundra environments.

- Lithospheric processes – volcanism, glaciation, erosion and weathering
- Hydrospheric processes – ocean currents, water cycle, sea ice
- Atmospheric processes – climate – air pressure, temperature, humidity, cloud cover, etc.
- Biospheric processes

Heard and McDonald Islands Reserve and World Heritage Site

Lithospheric processes

The subantarctic islands are volcanically active, and allow for the study of volcanic processes and glacial dynamics.

Volcanism

The Heard and McDonald Islands have been formed by the Kerguelen Hotspot, a site of volcanic activity in the Southern Ocean. Big Ben is an active volcanic summit that dominates Heard Island. Volcanoes involve the process of molten rock from the mantle being forced up onto the earth's surface. The magma moves up from the volcano chamber into the cone. When the magma exits the volcano cone it is called lava. Volcanic eruptions can be explosive or gentle. Heard Island experiences a gently oozing of lava, while McDonald Island has had explosive volcanic eruptions. Heard Island has experienced volcanic activity and fresh lava flows in the last few decades. This activity is continuing to shape the island including increasing its size and elevation. A two kilometre wide lava flow moved down Big Ben from the summit in a south-west direction. As a result of volcanic activity all vegetation on the island has been lost. The volcano on McDonald Island, thought to dormant, has erupted several times since 1992. Over the long term volcanic material gradually erodes and adds valuable nutrients to soils including phosphorous, potassium, calcium, magnesium and sulphur. Lava flows create extremely fragmented and irregularly shaped landforms.

Glaciation

Heard Island has twelve major glaciers and several smaller ones. About 70% of the island is covered by glaciers. Glacial processes include abrasion, plucking and freeze-thaw. Abrasion refers to frozen rocks in the side and base of a glacier scraping the bedrock. This creates striations or scratches in the bedrock. Plucking refers to the process where individual pieces of bedrock are picked up and transported by a moving glacier, and deposited in other locations. Freeze-thaw weathering occurs when ice melts, fills cracks in the rocks and then expands when it refreezes. On Heard Island, glacial activity has eroded soft, fragmental volcanic rocks to create rock buttresses. There has been a substantial reduction in glacial cover in the past century, and this is resulting in the creation of lagoons and extra ice-free ground for colonisation of plants and animals. There are no glaciers located on McDonald Islands.

Erosion and weathering

Erosion is the wearing away of materials (soils, rocks, etc) by natural forces such as wind and water. Weathering is when materials (soils, rocks, etc) or broken down or dissolved by environmental factors. There are three types of weathering: physical, chemical and biological. Physical weathering can occur when water freezes and expands. The tundra environment on Heard and MacDonald Islands is particularly affected by strong winds and the erosion caused by it. The removal of this fragile soil is influenced by the limited vegetation in tundra environments.

Hydrospheric processes

Ocean currents

The islands are part of the Southern Indian Ocean Islands Tundra ecoregion. The mid-latitude location of the islands in the Southern Ocean is south of the Antarctic Polar Front, also known as the Antarctic Convergence. Heard Island and the McDonald Islands are located south of the Antarctic Convergence. The Antarctic Convergence is a marine zone where cold waters of the Antarctic sink under the lightly warmer waters of the subantarctic. It is a circumpolar strip (the current creates a ring around the globe) that lies approximately between 45° and 60° South. Its location varies seasonally, and is an approximate boundary for the Southern Ocean. The mixing of the cold and slightly warmer water creates local variations in weather, such as fog. The current is associated with strong, westerly winds.

Water cycle

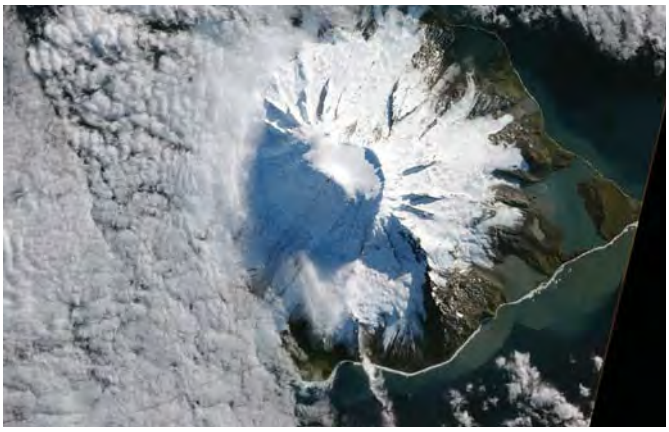
Annual precipitation on Heard Island is between 1.3 –1.9m. Most of this precipitation is in the form of snow. Any rainfall generally soaks into the ground and then freezes becoming permafrost, or is absorbed by plants. Permafrost is a barrier to infiltration and percolation. The water in the uppermost layer of permafrost is stored until it melts in spring and summer. During winter, snow, river and lake ice accumulate, and in summer, meltwater forms many wetland areas, ponds and lakes. River flow increases when snow, river and lake ice melts. Surface and soil water is frozen for most of the year so there is little evaporation and low stores of water in the atmosphere. There is limited transpiration due to the limited amount of vegetation.

Atmospheric processes

Climate

Air temperature

Seasonal and daily temperature ranges are low, and monthly average temperatures range from 0.0 to 4.2°C. The latitude of the Heard and McDonald Islands impacts on the intensity of the light and heat from the sun. Locations in high latitudes receive less intense sunlight and it is spread over a large area of land.



Volcano, Heard Island Source:https://www.nasa.gov/sites/default/files/images/745684main_heard_ali_2013110_geo-full_full.jpg

Air pressure and wind

This is an area of strong, persistent westerly winds, and associated with a deep low pressure system. East moving depressions move across the islands throughout the year creating persistently severe weather such as strong regional, westerly winds, frequent precipitation, and low seasonal and daily temperature ranges.

Humidity

Surface and soil water is frozen for most of the year so there is little evaporation from the land, but water is evaporated over the ocean.

Cloud cover

Cloud cover is persistent, but low due to relatively high humidity, mountainous topography and strong winds.

Precipitation

Annual precipitation on Heard Island is between 1.3 – 1.9m. Most of this precipitation is in the form of snow.

Radiation Fog

Radiation fog is common. It is a type of fog that forms overnight as the air near the ground cools, stabilises and reaches saturation point. Radiation fog will begin to form near the surface and then thickens as the air continues to cool.

Biological processes

Vegetation

Vegetation is impacted by the harsh climate and limited ice-free ground available. Due to the diversity of landscapes on the islands a range of different vegetation communities can be found. Most of the vegetation on the islands occurs is low-lying areas along the coast. Plant diversity is low, and the diversity of flowering plants is particularly low. No trees or ferns are found on Heard and McDonald Islands. In the tundra areas vegetation is minimal and includes low shrubs, mosses and liverworts. Mosses and lichens make up a large proportion of plant communities.

Vegetation covers about 20km^2 of Heard Island. Plant communities on Heard Island include open cushion carpet, mossy feldmark, wet mixed herbfield, coastal biotic, salt spray and closed cushion carpet. A total of 44 moss and 12 liverwort are found on Heard Island. Lichens are also common, with 34 species. There are no known introduced plants species on the islands.

Recent volcanic activity on McDonald Island has altered vegetation.

Animals

Heard Island is considered to be a biological hotspot. There are large colonies of penguins and petrels, and harems of fur seals and elephant seals. There are also high numbers of seabirds and marine mammals. Heard Island contains breeding sites for a large number of seabirds. These include the Heard Island Cormorant, The Heard Island Sheathbill, the South Giant Petrel, Antarctic Tern and Wandering Albatross. There are also four species of penguin and three species of seals that breed on the island. There are some terrestrial invertebrates (animals without backbones for example worms), but no native land mammals on the islands.

McDonald Islands had large numbers of penguins breeding, but recent volcanic activity on McDonald Island may have affected bird populations.

Nitrogen and phosphorous cycle

The nitrogen cycle involves green plants taking in chemicals such as nitrogen and phosphorous from soil. During the growing seasons (spring and summer), plants put carbon-rich litter into the soil. This will be made up of dead leaves, sticks, etc. However, due to low temperatures, the decomposition of the litter will be much slower than in other ecosystems. Guano (bird droppings) is very nitrogen and phosphorous rich. The breeding seabirds and their chicks produce huge amounts of droppings that are able to soak into the ground and provide nutrients for plants.

Macquarie island Source: https://commons.wikimedia.org/w/index.php?curid=7137164

Churchill Wildlife Management Area

Lithospheric processes

Glaciation

The most recent ice age occurred during the Pleistocene, beginning about 2 million years ago and ending around 10,000 years ago. During this time glacial activity shaped the topography around Churchill. Glaciers form when show falling in winter is greater than snow melts the following summer. The following winter, snow weighs down the remaining snow and it turns to ice. Over time, following further accumulation of ice, gravity pulls the ice and it slowly moves downhill. The most extensive Pleistocene ice mass was the Laurentide ice. The Laurentide ice covered Canada and a large part of north east United States.

Bedrock and soils

Churchill is located on the Canadian Shield. The Canadian Shield is a rock structure form hundreds of millions of years ago by mountain-building activity. The Canadian Shield stretches over 8 million square kilometres. It has been shaped by glacial processes. As the ice moved south it scraped the land of weathered rock, and created a landscape that is rocky, with smoother, low hills, basins, lakes and swamps.

Churchill is built on an outcrop of Proterozoic sedimentary bedrock of subgreywacke and conglomerates. Subgreywacke is a dark-coloured sedimentary rock with grains 0.06-2 mm in diameter containing free quartz, a low mud content and high carbonate content. The wider Churchill province contains sedimentary, metamorphic and volcanic rock. Glaciation, marine inundation and weathering have covered these bedrocks with gravel, silt, boulders, sand, clay, and organic materials.

Soil properties and vegetation

Close to the Hudson Bay Coast, salt marshes and mangroves are found, but soil properties are different as you move further inland. Tundra vegetation, bogs and boreal forests are supported by better developed soils inland. Permafrost is widespread and the region also contains ice-related coastal features as a result of sea ice.

Hydrospheric processes

Hydrology

Churchill is located at the mouth of the Churchill River where it feeds into Hudson Bay. The Churchill River flows 487km east to west from Saskatchewan, through Manitoba to where it drains into the Hudson Bay. The river is made up of a large number of lakes joined together by rapids and waterfalls. Hudson Bay completely freezes over in winter. The river is located within a drainage basin called the Canadian Shield. Both sea ice and river water contribute to the region's freshwater budget.

Sea Ice

Churchill Wildlife Management Area is located on the western edge of Hudson Bay. Hudson Bay is seasonally covered in sea ice for 5 to 10 months of the year. Sea ice accumulates between September and December and melts between May and August. The amount and timing of sea ice is determined by atmospheric temperatures, wind, the freshwater and sea water mix, precipitation and currents. It is also impacted by an ice-albedo feedback loop. This is when the heat stored in the water impacts on the accumulation and/or melting of sea ice. The ice can be mobile (shifted by water currents) or landfast (attached to land in some way and immobile).

Atmospheric processes

Climate

The latitude of Churchill is significant because it impacts the climate. Being just south of the Arctic Circle it experiences a Continental Subarctic climate. Hours of daylight vary between 6 hours in December to approximately 18 hours of sunlight in June. These climatic conditions are integral to providing the conditions suitable for polar bears, belugas and arctic foxes, etc.

Air temperatures

Mean monthly temperatures are below zero for six to eight months and on average 50-90 days in a year are frost free. Temperatures can vary from -30°C to 17°C. Winters tend to be long and bitterly cold, while summers are short and mild. The warmest month is July and coolest month is January.

Air pressure and wind

Winds blow continuously over the Hudson Bay into Churchill. High winds occur between September and May, with average wind speeds of about 20 km/hr during this period. Wind mostly comes into Churchill from the north, but Churchill experiences westerly winds during October and March. High winds result in the krummholz effect on any trees in the Churchill Wildlife Area. The krummholz effect results in trees exposed to winds having stunted growth on one side.

Humidity

Humidity in Churchill ranges from 70% to 89%, with higher humidity in November. The average annual humidity Is 82%.

Cloud Cover

There is significant seasonal variation in cloud cover in Churchill. Clearer skies occur from April to November, while the cloudier part of the year is between November to April. At its cloudiest (January), Churchill is overcast or mostly cloudy 87% of the time.

Precipitation

The wettest months occur from April to November.

August is the wettest month. February is the driest month.

The snowy period occurs between September and June.

Aurora Borealis

The latitudinal location of Churchill corresponds with the location of the Aurora Borealis. The Aurora Borealis (also known as the northern lights) is a display of coloured lights in the night sky. The shades of red, green, blue and violet occur above the magnetic pole and are the result of gas particles colliding. The Aurora Borealis is best viewed in locations which are not affected by light pollution in places that are latitudinal relatively close to the magnetic north pole. Churchill's latitude and isolation make it an excellent site for viewing the Aurora Borealis.

Biological processes

Churchill is in close proximity to Wapusk National Park and Caribou River National Park. Organisms found in this area include polar bears, beluga whales, and more than 270 bird species including the snowy owl, gyrfalcon and ptarmigan.

Plants

Plants in tundra of Churchill wildlife Area occur in ground-hugging, dense clumps. In some areas there is considerable bare ground. Permafrost can extend up to 1,500 metres below the ground. Tundra plants are a mix of low plants including dwarf shrubs, mosses, lichens, grasses, and forbs. No trees occur in tundra environments because the summer is so short that the conditions don't allow their growth. However, as Churchill is a convergence of tundra, forest, freshwater and marine ecosystems, there are some trees in close proximity to the tundra environments in Churchill. Plants are perennial, meaning they survive for several years or are long lasting. During the brief summer season, plants quickly complete their annual cycles. They have short reproduction cycles and some plants reproduce asexually. This is enabled by the moisture in the soil during this time. Seeds are dispersed by the strong winds. Many of the plants have small leathery leaves to reduce moisture loss. A variety of fungi can be found amongst the tundra heaths.

Animals

Birds and insects (including mosquitoes and flies) dominate animal life in the tundra during summer. Insects eggs are able to survive the winter. Tundra becomes an important site for nesting in summer, for birds migrating south in winter. While there are very few species of reptiles and amphibians, there are some species of mammals and freshwater fish. Tundra animals in the Churchill region include hares, foxes, polar bears, ringed seals, foxes, birds. There are 75 mammals, 240 bird species, 5 amphibians, 2 reptiles, and 3,300 insect varieties. Many animals migrate to warmer locations in autumn.

Polar bears are attracted to Churchill in the ice free season, in search of food. They are attracted by seasonal berries and often food scraps in rubbish. Polar bears access seasonal ice areas for hunting. As sea ice is melting faster each year, polar bears are spending more time on land, thus increasing human and bear interactions.

For more information and images of tundra environments visit National Geographic – https://www.nationalgeographic.com/environment/habitats/tundra-biome/

SEE APPENDIX 1 for student activity worksheets linked to biophysical processes

Churchill Wildlife Management Area

Photographs by Louise Swanson

Part B: Causes of Change

Heard and McDonald Islands Reserve and World Heritage Site

Climate change

There has been an increase in the average annual air temperature of nearly 1 degree C between 1948 to 1954 and 1997 to 2001. This is resulting in glacial retreat and the creation of lagoon and lakes. Many glaciers at Heard Island have retreated dramatically. Brown Glacier on Heard Island has reduced in size by 33% in the past 50 years. The Southern Ocean is demonstrating a corresponding warming.

This year there has been an occurrence of sudden stratospheric warming above the South Pole during August. This involves temperatures rapidly heating and a reversal of wind direction. This will result in further loss of sea ice between October and January. This is likely to disrupt normal ocean circulation, reduce the albedo effect, and result in more extreme weather.

Natural processes

Natural processes are an ongoing cause of change to Heard and McDonald Islands. Processes such as volcanism, glacial retreat and advance and storms can change the landscape. Animal population change such increase in fur seal populations could lead to changes such as competition over breeding or nesting sites and food sources, vegetation trampling and eutrophication of water.

Human contact

The first recorded visit to Heard Island occurred in 1855. Since that time there have only been about 240 shore-based visits, and only two lists to McDonald Islands. The purpose of visits include sealing (in the past), research and management, private expeditions and surveillance. Visitors must apply to the Australian Antarctic Division for a permit to visit Heard Island. It's vast distance from populated areas, extreme weather and sailing conditions and high cost to visit deter many visitors. No commercial tours operate to Heard Island.

Introduced Species

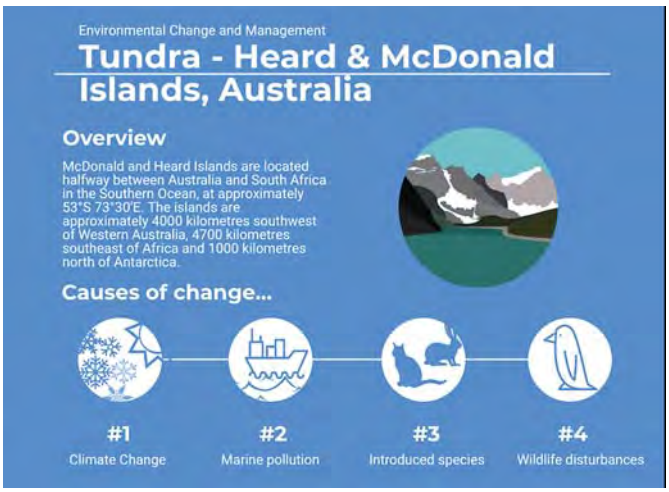
An alien species is an organism that has been introduced to the Heard Island and McDonald Islands as a result of direct or indirect human activity. Many of the Southern Ocean islands have been affected by introduced species such as cats, rabbits, rodents, etc. which can impact on breeding populations of endemic species and result in reductions of biodiversity and local extinctions. McDonald Island has no alien species currently. Heard Island has two plants and two insect species that have been introduced. Heard Island and McDonald Islands are some of the least biologically-disturbed regions on the planet.

Physical disturbance

Physical disturbance could include pathways, soil and vegetation compaction, damage to geological features, buildings or destruction of cultural artefacts. Most of Heard and McDonald Islands are free from physical disturbance as a result of a limited number of recorded visits. This is one of the islands' greatest values.

Wildlife disturbances

In locations where human activity and wildlife habitat overlap, wildlife disturbances such as burrow collapses, changes to wildlife movements or breeding can occur. Wildlife colonies on Heard and McDonald Islands are concentrated in the ice-free coastal areas. These are also the most popular sites for human activities. Wildlife may react to disturbances by relocating or refraining from breeding, or deserting certain locations. It can also result in increased likelihood of mortality rates. In marine environments disturbances may take the form of boat collisions, or interference through noise and lights. Illegal fishing can also impact on population numbers and diversity.

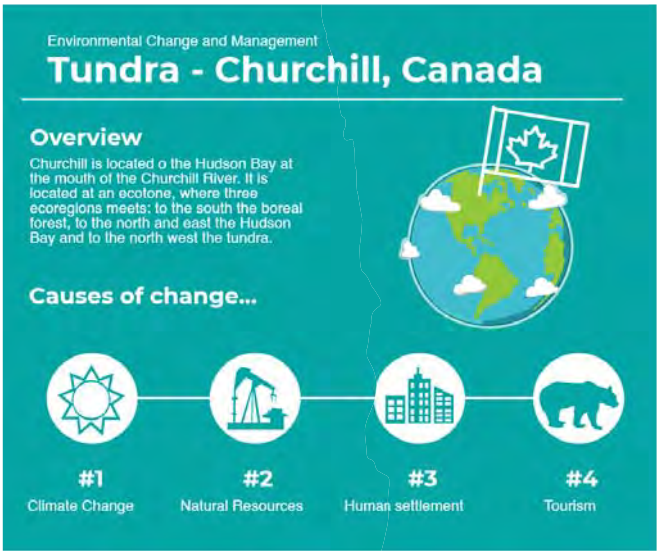


Marine pollution

Fuel spills, discharge of waste water and sewage and rubbish disposal can result from shipping activities. Marine mammals and seabirds can become entangled in floating debris such as discarded fishing nets. This can result in reduced mobility, starvation, amputation, smothering or drowning.

Terrestrial pollution

Pollution on land can include grey water and sewage, which may increase nutrients or risk of disease. Fuel and chemical spills could result in long lasting impacts such as soil contamination, vegetation degradation or harm to wildlife.



Churchill Wildlife Management Area

Climate change

Climate change is resulting in a milder, shorter winter season and longer, warmer summers. Average yearly arctic temperatures are increasing. The shrubs are growing taller on the tundra and the surface temperature of water in Hudson Bay has increased by 3 degrees in the past 20 years. In the long term Churchill is expected to continue experience warming air temperatures. Wetter conditions are resulting from increased annual precipitation, permafrost is thawing and degrading. There has been an increase in the number of natural disasters impacting Churchill.

Climate change is likely to change migratory patterns, population numbers and physical characteristics of species. Organisms are increasingly moving north into the Churchill Wildlife Management Area such as red fox. Migratory birds are changing their movement patterns.

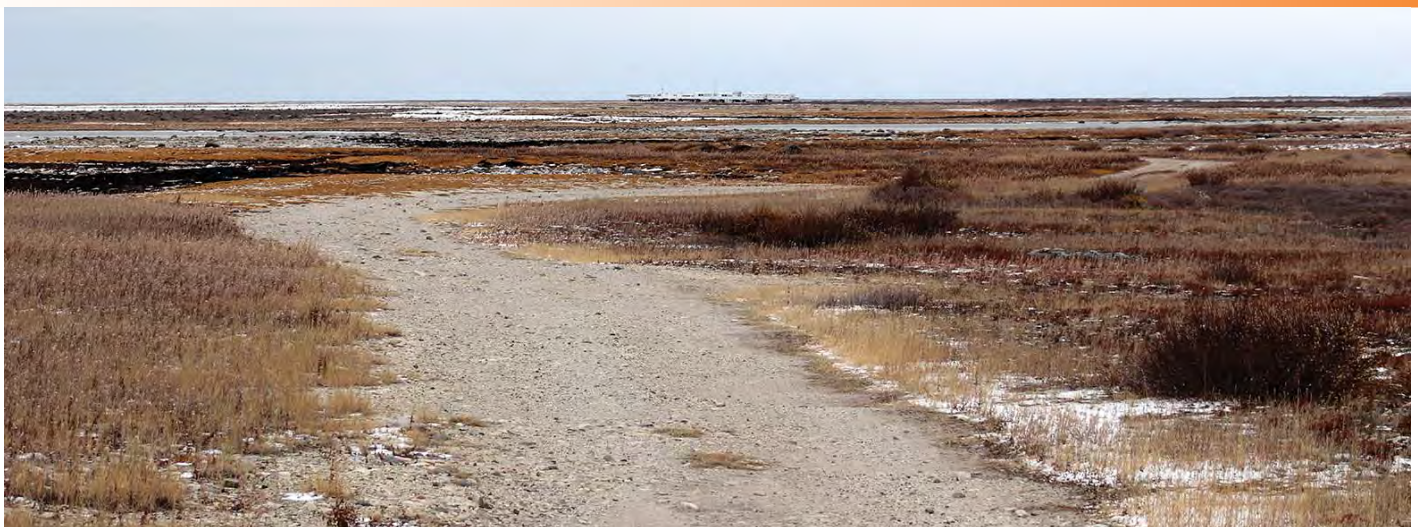
The reduction in the thickness of sea ice, is making it difficult for polar bears to hunt for their primary dietary staple seals. In turn, this is changing polar bear feeding patterns, migration paths and many are experiencing a reduction in body weight. Bears are staying on shore longer to wait for the ice to form. Ice on the Hudson Bay is forming more slowly and melting more quickly, and as a result polar bears are struggling to hunt for food. Polar bears generally hunt seals on the pack ice, and the last of ice is resulting in some bears starving or being underfed, and the survival rates of cubs declining.

Thawing permafrost

Increased temperatures are resulting in sea ice melts and reduced ice cover on Hudson Bay. Permafrost melts are likely to result in increased decomposition and microbiotic activity and release of greenhouse gases like carbon dioxide and methane.

Tourism

Tourism in and around Churchill focuses on polar bears, beluga whales, nature photography and the Aurora Borealis. While activities are intended to minimise human impacts on wildlife, the actions of individuals are difficult to predict and control. In the Churchill Wildlife Management Area two companies are permitted to take visitors for viewing by tundra buggy. The buggies allow access on the difficult terrain, but also provide protection from the polar bears for visitors. Permission has been sought for more permits for vehicles to operate on the tundra.



Some passengers, in trying to attract the attention of bears for better photographs may bang on the side of the tundra buggy, hiss or whistle to encourage the bear to move. Bears are exposed to the tundra vehicles from around 9am to 3pm each day. In periods where there are low polar bear numbers, multiple vehicles will crowd around the one bear or family of bears.

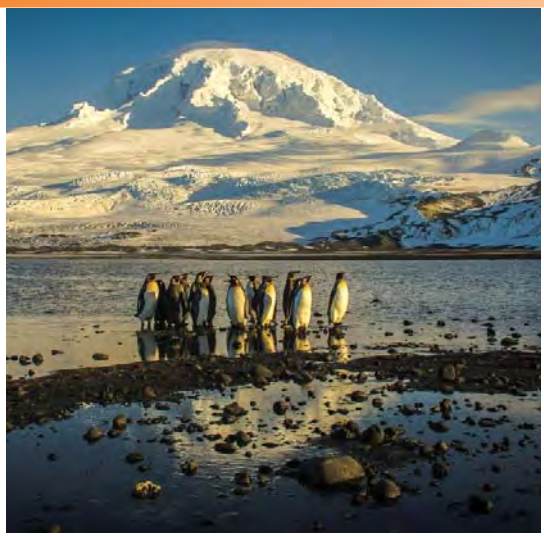
In attempts to ensure polar bear viewing tundra buggies may use any tracks or trails that are available rather than using the roads designed for the purpose. This could result in erosion of tracks or destruction of vegetation.

Some operators have tundra buggy lodges that provide accommodation for tourists and researchers for part of the year. These are mobile structures made up of customised buggies, with sleeping quarters, kitchens and bathrooms. The number, location and disposal of waste and treatment of wastewater are all impacts which must be carefully managed.

Resource extraction and industry

Canada has considerable natural resources, and Manitoba has world-class deposits and large underexplored remote regions of mineral potential. Extensive oil fields are located in northern Manitoba. The coast of Manitoba, along Hudson Bay, has been proposed for an energy corridor (pipeline development) for shipping oil, Alberta bitumen, with Churchill is a possible port location due to its deep water port and railway line.

Natural resource exploration and extraction can impact greatly on tundra environments. Activities can result in the thawing of permafrost, damage to soil and vegetation. There is also increased risk of toxic spills. Climate change and reduced sea ice would make the use of Churchill's port more economically feasible and logistically easier from the water, and less land ice cover may make developments easier on land.



Source: Wikimedia Commons

Part C: Management of environmental change

Heard and McDonald Islands Reserve and World Heritage Site

The Australian Antarctic Division of the Australian Department of Environment and Energy manages Heard Island and McDonald Islands and the HIMI (Heard Island and McDonald Islands) Marine Reserve. A management plan is in place for the HIMI Reserve. The management plan sets out rules and guideline of the Reserve, objectives for managing the area, and specific management strategies including permits, zoning and environmental impact assessments.

Legislation and agreements

The most relevant legislation is:

- Environmental Protection and Biodiversity Conservation Act 1999
- Environmental Protection and Biodiversity Conservation Regulations 2000
- Environmental Protection and Management Ordinance 1987

These provide a national framework for environmental protection.

Click to read about:

EPBC Act and regulations

National agreements

International agreements

World Heritage

Heard and McDonald Islands are listed on the UNESCO World Heritage list. To be listed as a World Heritage Site, a location must meet UNESCO's WHS criteria.

The HIMI Reserve and World Heritage Site provides an opportunity to observe ongoing geomorphic processes, as they are the only volcanically active subantarctic islands. It meets criteria (viii) to be an outstanding example representing major stages of earth's history including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.

The HIMI Reserve and World Heritage Site has no record of introduced species and is is extremely isolated. Its natural processes include glacial dynamics and coastal change. HIMI will be an important place to monitor the impacts of climate change, and as such meets criteria (ix) to be an outstanding example representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.

Click to read more information about World Heritage criteria.

Zoning

Zoning is used to divide areas of the Heard Island and McDonald Islands Marine Reserve into sections where particular activities are allowed. Zoning allows some more susceptible areas of the reserve to be afforded greater protection than others, while more human activities are allowed in less susceptible areas.
The zones are:

Main Use Zone – located at Atlas Cove and Spit Bay. This is where long-term facilities are located and access and support operation can be conducted.

Visitor Access Zone – allows for low impact, short-term, land-based visitor activities, e.g. tourist ships. This zone provides relatively safe landing sites and access to attractions within walking distance, e.g. heritage sites, wildlife colonies, landscape features.

Wilderness Zone – allows for some human activities, but with the purpose to maintain the wilderness qualities of the terrestrial environment. Activities must not cause long-term impacts. Access is primarily for scientific research and monitoring.

Heritage Zone – an area of special protection, this is the location of the Atlas Cove Station site from 1947–1955. It restricts activities that may impact on the heritage value on the site.

Restricted Zone – areas highly sensitive to human activities. Access is highly restricted. This includes areas containing highly unstable lava tubes and sinkholes,

cushion plants, significant numbers of South Georgian diving petrels and breeding sites for Antarctic prions.

Inner Marine Zone – includes areas within 12 nautical miles of the high tide mark on shore. Vessel and small craft use is regulated, to reduce the threats from boat discharges and movements.

Outer Marine Zone – includes areas beyond 12 nautical miles from shore to the edge of the Reserve. Regulations are less strict in this area, but still allow for protection in line with the objectives of the Reserve. A permit is not required into the Outer Marine Zone.

Environmental Approvals

Permits to visit the HIMI Reserve need to be submitted 4 months in advance. Visitors may only enter the Reserve in accordance with the permit. Permits state that people must not take, injure and interfere with organisms, except under very specific circumstances. Permits restrict visitors from interfering with scientific experiments underway and/or introduction of live species to the islands. Permits forbid bringing a diseased organism or live poultry into the Reserve, or mineral extraction and/or fishing. Before a permit is issued an environmental impact report must be submitted. Permit holders also have to be completely self-sufficient while in the Reserve, and must provide a compliance report within 60 days of the permit expiring.

Visitors rules:

- all wastes generated must be removed on departure.
- food must be secured to limit foraging and dispersal by wildlife
- no overnight stays are allowed
- only set numbers of visitors are allowed on site
- foot travel is the only form of transport allowed within the Visitor Access Zone, Main Use Zone and Heritage Zone.
- visitors onshore must be able to maintain two-way communication with their vessels.
- shore landings can only take place in the Main Use Zone and the Visitor Access Zone.
- boats/vessels must minimise lights to avoid disturbance to birds.
- no ballast water can be discharged within 12 nautical miles of the chore.
- vessels entering the Territory must have come directly from an Australian Quarantine Inspections Service and have a deratting certificate.
- all visitors are provided with the Environmental Code of Conduct for Visitors to Heard Island.

Polar Bear Briefing Facility mural.

Churchill Wildlife Management Area

Specific management strategies are employed to limit interactions between humans and the largest tundra animal the polar bear. The most unique of these is the polar bear jail.

Zoning

A set of zones have been set up in the area around Churchill to provide layers of protection for the tundra environments (and associated environments in close proximity). Wapusk National Park is located to the south east of Churchill, and few activities are allowed there. This is an important denning site of female polar bears. Between Wapusk National Park and the town of Churchill is the Churchill Wildlife Management Area which is a buffer zone. In this buffer zone, several tour operators run tundra buggy polar bear tours, aurora borealis tours and photography tours. The site if also the base of a range of conservation organisations such as Polar Bears International. In and around the town of Churchill are natural resource extraction operations, tour businesses, homes and local businesses.

Polar Bear Alert Program

The Polar Bear Alert Program is a multi-pronged approach to raise awareness of polar bears safety and deter polar bears from the town of Churchill. It is made up of:

- Public Awareness campaign – artwork, training and individual precautions
- Signage
- Armed Conservation Officers
- Polar Bear Holding Cells.

Public awareness

Raising public awareness through art or creative endeavours, creates a focal point for the town, and an added tourist attraction for visitors. Sculpture and murals around the town depict key species of the region such as polar bears, beluga whales, etc. Children are trained in polar bear safety and people are encouraged to carry bear spray.

Signage

Signage is an effective strategy to education the general public about the local environments and flora and fauna.

Armed conservation officers

Manitoba Conservation officers carry a range of equipment to scare polar bears away or to shoot them if necessary. Equipment might include scare pistols, paintball guns, air horns, or firecrackers. These extreme options are due to risky behaviour by polar bears, particularly those coming to close to settlements. The aim is to teach the bears to be more scared of humans to discourage them from settlements. Loud noises are used to move them on.

Polar bear holding cells

Polar bears found too close to the town of Churchill are placed in a polar bear jail, where they are held for thirty days before being helicoptered to a more remote location away from humans. This only occurs after attempts are made to scare the bear away from settlements as described above.

Radar and ear-tags

Sophisticated tagging and monitoring strategies help scientists gain a better understanding of where polar bear are located. This provides up-to-date information on polar bear behaviour, feeding and locations. It provides important information about the impact of climate change, pollution and human interactions. At the time of tagging measurements can be taken of fat, hair, blood, etc to provide date on diet, relationships, age, etc.

Arctic Council

The Arctic Council is an inter-governmental forum of Arctic countries. It has established a working group to investigate the spread of introduced species and to work on ways to prevent them. Canada is a member country. The member countries work together on common goals and make recommendations for programs to be implemented in member countries.

Using Twitter to investigate change

Students are very familiar with social media for use in sharing all sorts of details about their personal lives and famous personalities. It can also be a tool that can be used to gain up-to-date information about a research area or topic.

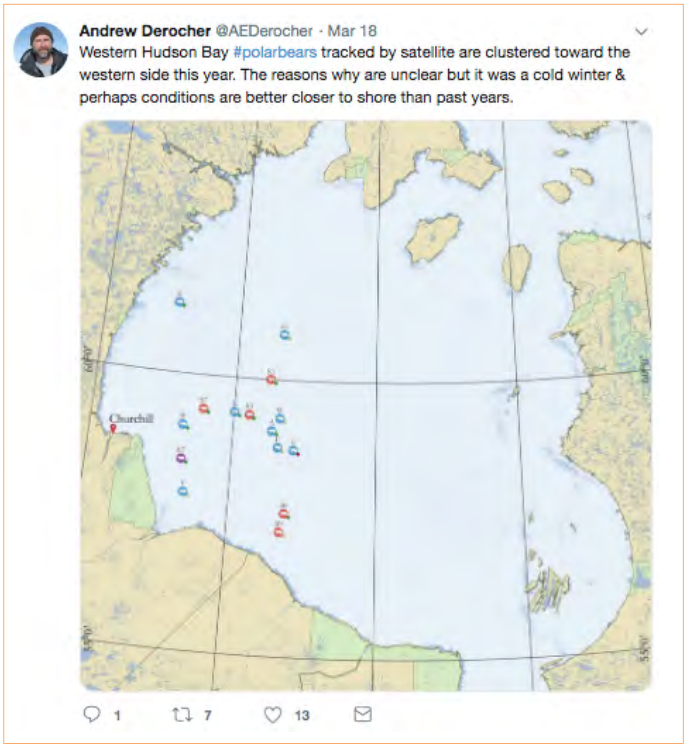
Some examples of experts and organisations to follow on twitter:

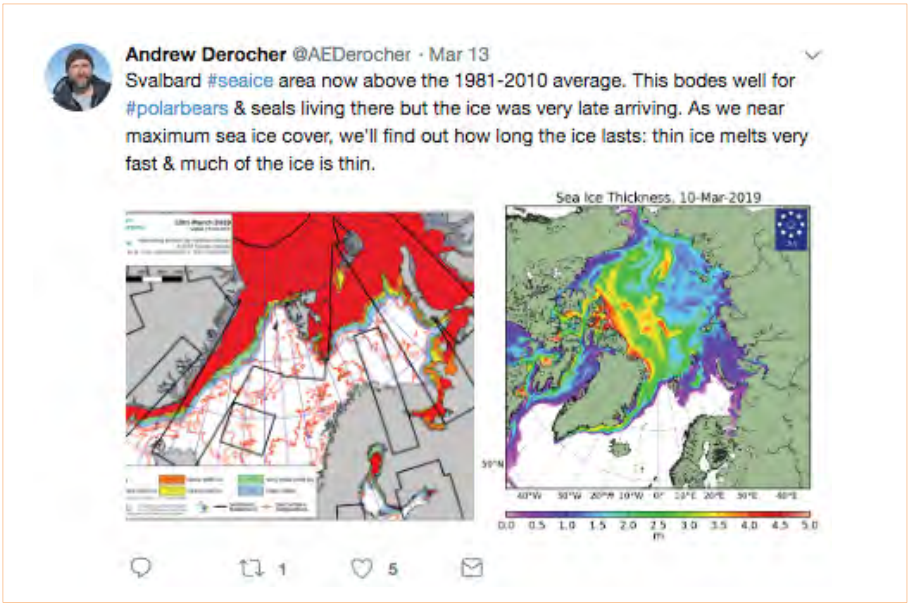
@AEDerocher –
Andrew Derocher, Biological Sciences Professor at University of Alberta

@ArcticBeringia –
Advancing strategies to protect key Arctic areas, developing best practices for industrial activities, and fostering local stewardship of wildlife and habitats

@jackie_dawson –
Applied Scientist – human and policy dimensions of Arctic climate change. Associate Professor at uOttawa

@ArcticBasecamp –
A team of scientists, taking what we know about #Arctic change to the world's most powerful audiences

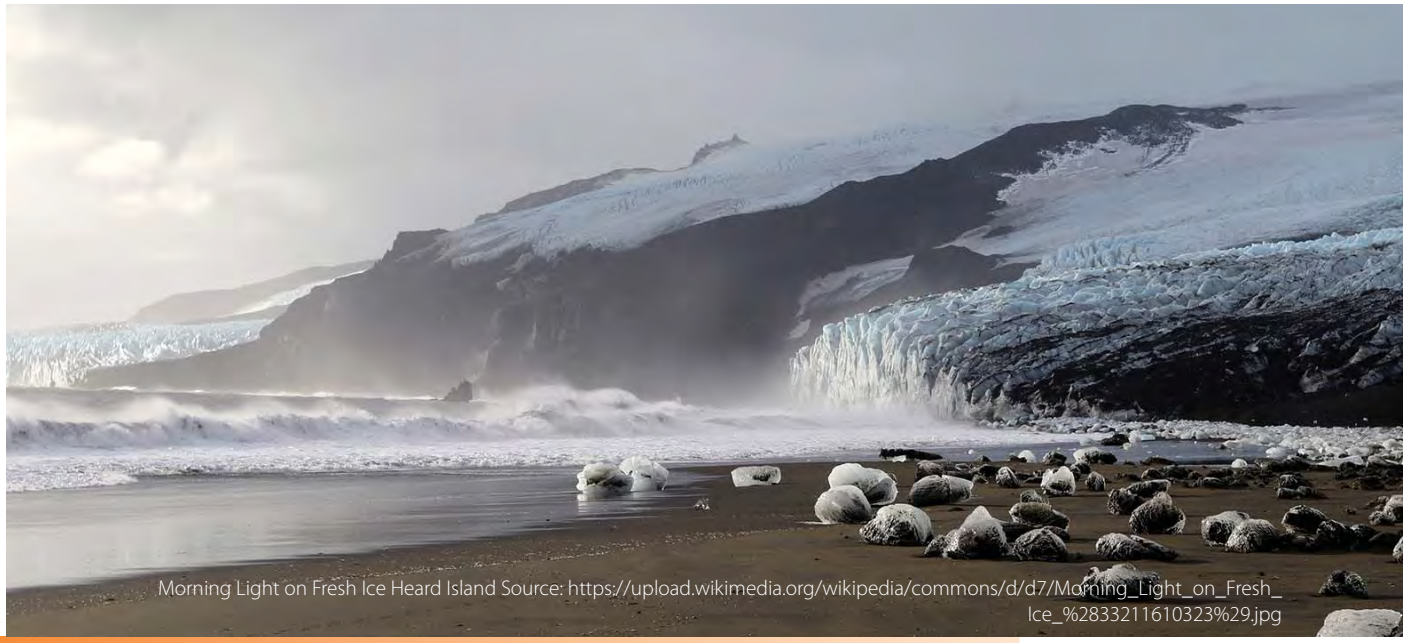




SEE APPENDIX 1 for student activity worksheets

Tundra Glossary

Albedo	The fraction of solar radiation that is reflected back into space.
Antarctic Circle	The parallel of 66.5 degrees south latitude.
Arctic Circle	The parallel of 66.5 degrees north latitude.
Atmosphere	The gaseous envelope surrounding Earth.
Biosphere	The living organisms of Earth
Boreal forest (taiga)	A needle-leaf forest in sub-arctic regions of Eurasia and North America.
Carrying capacity	In the case of tourism, carrying capacity refers to the number of visitors or activities that can take place in an area without environmental degradation occurring.
Climate	Weather conditions of a long period of time.
Evaporation	When liquid water is converted to gaseous water vapour.
Glacier	A large natural accumulation of land ice that flows downhill, or outwards from the point of accumulation.
Hydrosphere	All water on Earth, including lakes, rivers, oceans, groundwater, etc.
Ice Sheet	A blanket of ice that completely covers the underlying terrain.
Lithosphere	The solid, inorganic portion of the Earth's surface.
Polar High	A high pressure system over either polar region.
Subpolar Low	A zone of low pressure situated at about 50–60 degrees latitude (either North or South). Also known as a polar front.
Taiga	See boreal forest.
Tundra	A treeless region, where low growing plants such as moss, heath and lichens grow and where subsoil is permafrost or permanently frozen soil.
Permafrost	Permanently frozen, impermeable ground (upper layers may thaw during summer). It results when ground surface temperatures remain below freezing point for long periods.
Weather	Short-term atmospheric conditions (day-to-day).



Morning Light on Fresh Ice Heard Island Source: https://upload.wikimedia.org/wikipedia/commons/d/d7/Morning_Light_on_Fresh_Ice_%2833211610323%29.jpg

Source: Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/8/83/Minnamurra_Falls.jpg

Regional Conference, Kiama 2019
Andy Grant, Suzanne Johnson, Mark Peters and David Brennan

Syllabus links

Topic: Environmental Change and Management – Stage 5

Geographical Concepts: Place, space, environment, change, interconnection

Geographical Tools: Topographic map, land use map, sketch map, photographs, fieldwork

Key Inquiry Question:

How does the function and management of the Minnamurra River environment change from source to sea?

Geographical Inquiry Skills

- Acquiring geographical information
  Students collect, select, record and organise relevant data and geographical information, using ethical protocols, from a variety of appropriate primary data and secondary information sources
- Communicating geographical information
  Students present findings, arguments and explanations in a range of appropriate communication forms reflect on and evaluate the findings

Expected Learning

Students

- Understand the functioning of natural environments
- Understand the impact of human changes along a river profile
- Investigate different management approaches along a river profile
- Use a spatial technology tool to communicate geographical information

Assessment

- Students create a post fieldwork Google Tour of the Minnamurra River to communicate fieldwork findings

SEE APPENDIX 2 –
Fieldwork Data Collection sheets in PDF and Word formats.

Pre-Fieldwork Activities

Teacher conducts an introductory lesson on the long profile of the Minnamurra River (from source to mouth) using explicit teaching and activities to outline how the function (role, processes, behaviour and uses) of a river changes from the upper to middle and lower courses. http://www.alevelgeography.com/the-long-profile/

Students complete a mapping exercise using a topographic map to create a land use or precis map of the land surrounding the river course. They use colours symbols or shading to identify national park, agricultural land, urban areas, recreational areas.

Note: Use topographic maps printed from six maps to create a long profile of the river. https://maps.six.nsw.gov.au/.

Note: Students could also create a model of the river profile.

Fieldwork Activities

Fieldwork equipment required e.g. clipboard, maps, data collection sheets and / or apps, turbidity tube, anemometer, thermometer, phone/camera, tennis ball, tape measure and stopwatch.

1.Minnamurra Rainforest

At this location teachers may wish to discuss the gradient of the river in the upper course, the presence of only bare rock or large boulders in the riverbed (a result of river velocity), as well as the role of the rainforest in keeping water temps cool. Walk to top of falls to get as close to the source as possible. Above this, the river originates from a swampy spring on the top of the escarpment. Here the river helps support the rainforest and the channel is quite narrow. This is the most heavily managed area of the river and vital to the health of all ecosystems downstream. What sort of management can you identify?

2. Swamp Road – farming

At this location the river has passed through the village of Jamberoo (population around 1700) and several working dairy farms (some of which allow cattle direct access to the river). Note the changing gradient of the river and how this has affected the channel width and the velocity of the river. Run-off from agriculture may lead to an increase in phosphates and nitrates in the river, these can lead to excess nutrients in the water and algal blooms (Note if there are any visible algal blooms. If not, it may be a sign of effective management). Management strategies at this location include signage, fencing to restrict cattle access to the river as well as a well-maintained riparian zone that helps stabilise the bank and reduce erosion.

3. Estuary – mudflats

At this location, teachers may wish to discuss the sediment that has travelled from upstream to create the mudflats, the breadth of the river and biodiversity throughout the estuary. Here, there are opportunities to point our management processes such as the boat ramp, walking bridge, signage, recycling station for fishing wire and fencing.

4. River mouth at Minnamurra

Climb the headland from James Oats Reserve to the Minnamurra Lookout to get a great view of the Minnamurra river estuary. Students take a final photograph to add to their Google tour or complete an annotated field sketch. No are water measurements are completed here but this stop makes a good bookend for the day to complete the river profile. discuss longshore drift and deposition here as well.

Photo: Minnamurra Estuary. Source: https://www.visitnsw.com/destinations/south-coast/kiama-area/kiama/destination-information/minnamurra

Students

- Measure water temperature
- Measure turbidity
- Measure flow rate
- Take photographs
- Observe- land use, biodiversity, management practices
- Complete the data record sheets

Data Collection Sheets – SEE APPENDIX 2a & 2b (Word document) and (PDF)

Assessment / Post-Fieldwork Activity

Create a Google Tour of the Minnamurra River

For each of the four locations visited during fieldwork add the following information to create a Google Tour

- Describe the features and characteristics of the river and surrounding environment using the data collected at each location.
- Identify the different uses of the river at this location e.g. agricultural, recreational, urban
- Identify and describe the management strategies evident and suggest the purpose of each strategy.

Google Tour Builder – https://tourbuilder.withgoogle.com

Source: https://upload.wikimedia.org/wikipedia/commons/5/5a/Minnamurra_NSW_2533%2C_Australia_-_panoramio.jpg

Assessment Marking Guidelines

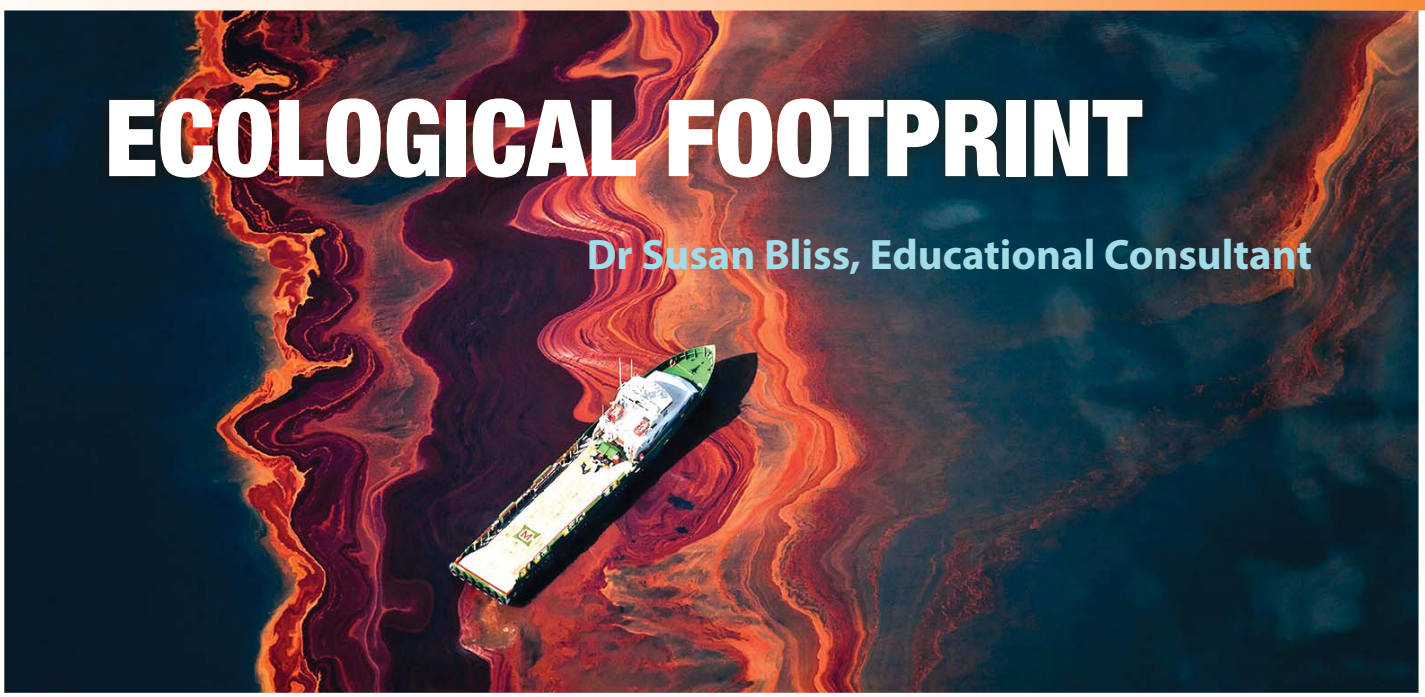
Data collection and communication

A	Clearly and accurately describes the features and characteristics at each location Effectively incorporates all data collected into a relevant and detailed description Demonstrates accurate collection of fieldwork data
B	Clearly describes features and characteristics at each location Incorporates data collected into a relevant description Demonstrates accurate collection of fieldwork data
C	Sketches in general the characteristics at each location Incorporates some of the data collected into a general description Demonstrates a satisfactory level of accuracy in fieldwork data collection
D	Identifies some features at each location

Using a spatial technology tool

A	Demonstrates high level of competency in using a spatial technology tool to communicate geographical information
B	Demonstrates competency in using a spatial technology tool to communicate geographical information
C	Developing competency in using a spatial technology tool to communicate information
D	Developing skills in using a spatial technology tools

Screen capture: Minnamurra River from Google Earth . L Chaffer 2019



Ecological Footprint: *Oil Spill #12* by Daniel Beltrá is an aerial image showing the environmental degradation caused by oil spills. His aim, through his work is to protect the environment from further harm.

Source: https://www.artworksforchange.org/portfolio/daniel-beltra/

SYLLABUS CONNECTIONS

YEAR 7 TO YEAR 12 (STAGES 4, 5 & 6)

STAGE 4

Place and Liveability

- Challenges and strategies to enhance liveability/human wellbeing
- Future liveability-reducing urban ecological footprints
- Sustainable places

Water in the World

- Availability and access to clean water essential for human wellbeing (water footprint)
- Water management-towards sustainability-reducing ecological/water footprint

Interconnections

- Production and consumption

STAGE 5

Sustainable Biomes

- Urbanisation – consequences and sustainable management to improve human wellbeing and reduce the ecological footprint.
- Creating sustainable cities-eco-cities

Environmental Change and Management-Urban

- Urban management –r educe ecological footprint and improve human wellbeing
- Sustainable eco-cities

Human Wellbeing

- Human wellbeing and ecological footprint
- Sustainable wellbeing indexes-SSI, WSI, GPI and IWI.
- Ecological footprint threatens human wellbeing

Urban places

- Sustainability

STAGE 6

Global challenges

- Spatial patterns in distribution and consumption of natural resources (bio-capacity)
- Place and human activity-country; urban/rural; slums versus skyscrapers-human wellbeing and ecological footprint

Senior Geography Project

- Ecological footprint at a variety of scales: personal, local, regional, state, national and global.
- Interactions, challenges, responses
- Proposing individual and collective action

Urban places

- challenges affecting places, and actions for sustainability.
- Study a large city
- Megacities

KEY QUESTIONS

At the end of this article students will acquire knowledge and understanding to answer the following Think, Explore and Puzzle questions.

THINK	EXPLORE	PUZZLE
What is the ecological footprint? How do you measure the ecological footprint? What are the connections between the ecological footprint and sustainability? What are the different measurements used to determine human wellbeing? What are the main influences on human wellbeing in your settlement? What are the differences in human wellbeing between urban and rural settlements in different countries? What are the differences in human wellbeing between and within cities in different countries? What are the links between the ecological footprint and GDP? What are the basic environmental human rights which affect human wellbeing? What are the advantages and disadvantages of shrinking cities on human wellbeing? What is the importance of the City Wellbeing Program? Are sustainable cities 'happy cities'? What is the significance of Sustainable Development Goal 11 (2016) concerning sustainable cities and how can it be implemented?	How does a country or city track how much biocapacity it possesses, and how much it uses? What are the connections between the natural environment and human wellbeing? What is the relationship between high liveability and the ecological footprint in different settlements? What settlements have a small ecological footprint and high human wellbeing? What are eco-cities and eco-villages, and how do they combine the ecological footprint with human wellbeing? What indicators are the most suitable measurements combining human and ecosystem wellbeing? Is there a relationship between large megacities and huge ecological footprints in developed and developing countries? How can the benefits of urbanisation improve human wellbeing? Can benefits be equally shared to ensure access to infrastructure and social services, focusing on the needs of the urban poor and vulnerable groups for housing, education, health care, decent work and a safe environment?	How can responsible citizens, organisations and governments reduce the ecological footprint? What measures can be undertaken to reduce inequality in human wellbeing between settlements-in a country? How can the Human Sustainability Index (HSI) and the Sustainability Society Index (SSI) be useful indexes for measuring environmental and human wellbeing? What were the impacts on liveability and human wellbeing from the following incidents on settlements: • Cancer villages in Yanglingang China? • Fukushima villages and cities in Japan? • Chernobyl nuclear disaster impacting on farming villages and Pripyat? • Disappearing indigenous fishing villages in coastal Asian countries? Some of the fastest-growing cities have fewer than 1 million inhabitants-many of them located in Asia and Africa. What are some effective sustainable management practices that have been implemented in Asian cities? (Green City Index)

SEE APPENDIX 3 & 4 for student activities in PDF and WORD formats, linked to each of the following content sections

TEACHING RESOURCES

YouTube

- The Ecological Footprint Explained https://www.youtube.com/watch?v=fACkb2u1ULY
- What is Human Development? https://www.youtube.com/watch?v=HwgZQ1DqG3w&list=PLH1VK0IdT8whMsE_DdL_-XimRjN7_vOH0
- What does Liveability mean? https://www.youtube.com/watch?v=2n0DUAr_6eI
- How to Make Cities Liveable https://www.youtube.com/watch?v=u-S5TWkLeyk
- What Is Sustainability? https://www.youtube.com/watch?v=rmQby7adocM
- Sustainability explained through animation https://www.youtube.com/watch?v=B5NiTN0chj0
- What is sustainable development? https://www.youtube.com/watch?v=7V8oFI4GYMY

Weblinks

- The environment of human settlements human well-being in cities – https://www.elsevier.com/books/the-environment-of-human-settlements-human-well-being-in-cities/laconte/978-0-08-020978-4
- Are sustainable cities "happy" cities? Associations between sustainable development and human well-being in urban areas of the United States – https://link.springer.com/article/10.1007/s10668-013-9499-0
- Harnessing urbanisation for human wellbeing and planetary health – https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196(17)30005-0.pdf
- Projections suggest cities will swell at an astonishing pace – but whether that means our salvation or an eco-disaster is by no means certain? – https://www.theguardian.com/cities/2018/mar/19/urban-explosion-kinshasa-el-alto-growth-mexico-city-bangalore-lagos

Stomach contents of a Laysan albatross fledgling, Midway Island, by Chris Jordan

Source: https://www.artworksforchange.org/portfolio/earth-day-network-featured-tour-2018/

ARTWORKS FOR CHANGE

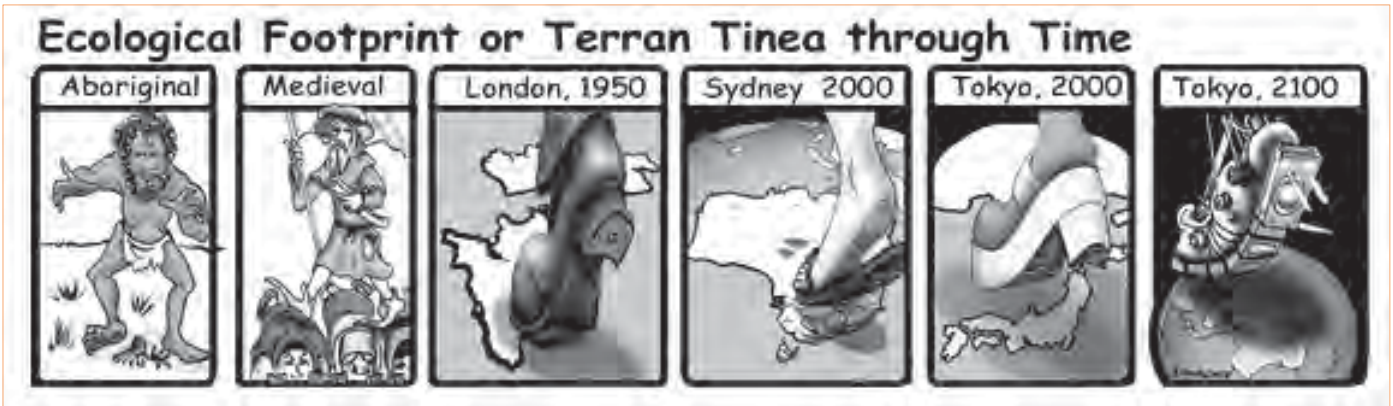
Ecological Footprint: ***Too Too-Much Much*** by Thomas Hirschhorn is a symbol of society's big appetite. In our daily lives, we have the luxury of stashing, hiding and discarding things, but in Hirschhorn's world, we are forced to heed the artist's warning about our collective demands on nature.

Source: https://www.artworksforchange.org/portfolio/thomas-hirschhorn/

A. WHAT IS THE ECOLOGICAL FOOTPRINT (EF)?

The Ecological Footprint (EF), a widely recognised measure of sustainability, is an account-based system of indicators that tracks the use of natural resources, and its impacts on ecosystems. The EF acknowledges that Earth has a finite amount of biological production that supports all life.

Source: https://www.footprintnetwork.org/our-work/ecological-footprint/



Cartoon: Jon Lawrence, Epping Boys' High School (retired)

Archaeologists discovered fossil footprints of humans who walked in the sand near Laetoli in Tanzania Africa, about 3.7 million years ago. These people used rudimentary implements that had a minimal impact on the environment. Their small ecological footprint (EF) was similar to traditional indigenous communities living in the Indonesian, Brazilian and Papua New Guinea rainforests and Namibian deserts, compared to the larger EF of loggers, miners, hunters, agriculturalists and urbanites. Most traditional indigenous communities, demonstrate values that promote conservation and the sustainable use of resources. However the culmination of their nomadic and subsistence lifestyles threatens sustainability.

For at least 60,000 years, traditional Australian Aboriginal and Torres Strait Islander Peoples maintained a special connection to and responsibility for Country, and as a result have a small EF. Their few implements, belongings and clothes were made from rocks, wood, plants and animals. Their intimate knowledge of seasonal patterns secured their ongoing supply of food, medicines and other resources. Scientists and environmental managers increasingly recognise their traditional ecological knowledge and its applications to water resources and land management, as well as their path to low carbon living that meets the global climate challenge.

Humans originally lived by hunting and gathering but major changes occurred that gave humans more energy and new technologies to alter and control more of Earth to meet basic needs and increasing wants. For example:

- Agricultural revolution (about 10,000 –12,000 years ago)
- Industrial revolution (about 275 years ago)
- Information and technology revolution and globalisation (about 50 years ago).

Everything you do from flushing the toilet, buying a mobile phone, watching TV, travelling by car to school and disposing of single use plastic bags – all contribute to your EF.

Over the last century, massive growth in population (83 million a year), high rates of urbanisation, vast technological changes and high consumption of natural resources have increased human's EF, and created an ecological imbalance on Earth, referred to as 'ecological overshoot.'

BELOW: Aboriginal hollow log tombs - National Gallery Canberra

Source: https://upload.wikimedia.org/wikipedia/commons/d/d9/Aboriginal_hollow_log_tombs02.jpg

B. HOW DOES THE EF MEASURE IMPACTS OF HUMANS ON THE ENVIRONMENT?

Ecological Footprint (EF) was defined by (Wackernagel & Rees, 1996) as 'the ecologically productive territory needed to produce the resources used and to assimilate the waste and emissions produced by a population.'

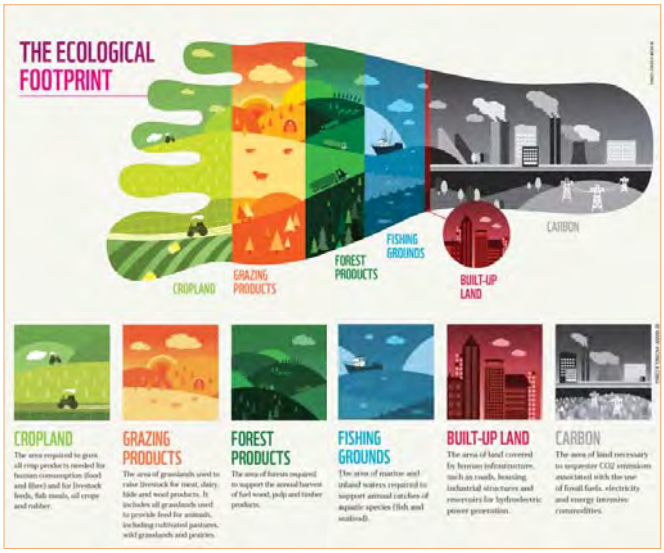
Every human produces an ecological footprint (EF) that is determined largely by their wealth and level of development in the country they live in—more developed countries tend to have a larger footprint but the choices humans make in their daily lives also contribute to the footprint. Running clothes through a dryer and turning on the air conditioning add up to a larger footprint.

Source: https://www.worldwildlife.org/threats/the-human-footprint

Measuring the impact of humans on the natural environment is complex and difficult. One measurement applied is the EF calculated in global hectares (gha), at various scales – individuals, corporations, villages, towns, cities, regions and countries. The EF measures the quantity of natural resources the Earth supplies (biocapacity) and the quantity of natural resources consumed.

The EF tracks the use of six productive surface areas- cropland, grazing land, fishing grounds, built-up land, forest area, and carbon demand on land.

1. Six main components of the Ecological Footprint



Source: https://www.slideshare.net/OliviaSnchezBadini/kefr2016encompressed

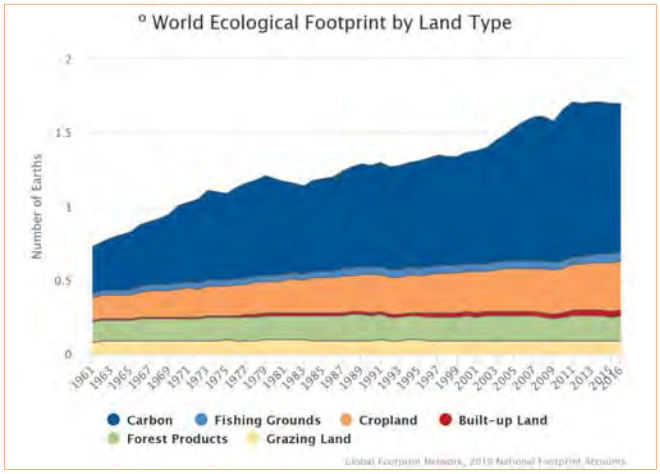
YouTube

- *Mathis Wackernagel: The Ecological Footprint* Source: https://www.youtube.com/watch?v=94tYMWz_Ia4
- *6 Questions on the Ecological Footprint of Cities with Mathis Wackernagel (human wellbeing)* Source: https://www.youtube.com/watch?v=fFf14HFVpAM

2. Growing world EF

The global EF has grown over the past five decades, due to escalating population and consumption per capita. The largest increase was the carbon component of the EF.

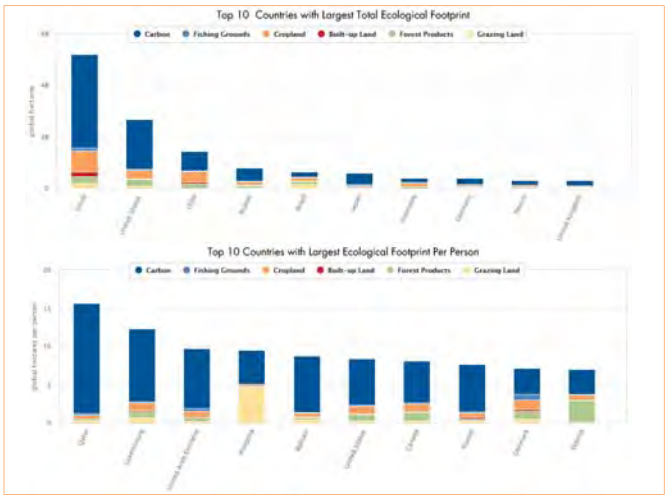
Global EF Trends: Six main categories



Source: https://www.footprintnetwork.org/resources/data/

3. Countries with the largest EF: Six main categories

Of the 25 countries with the largest EF per person, most are located in high-income countries.



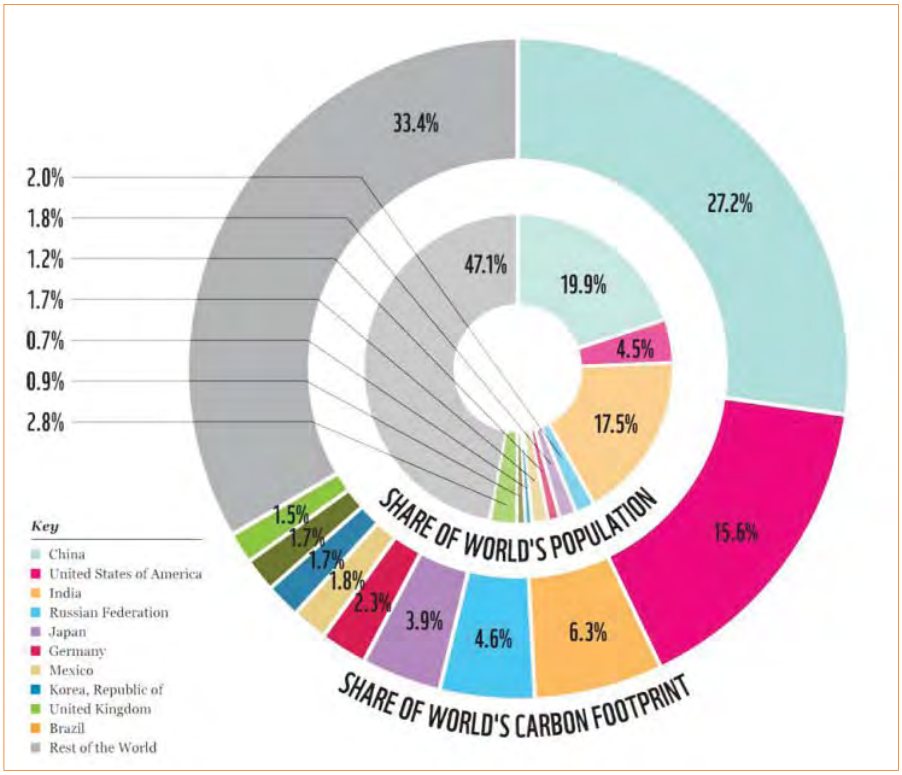
Source: https://www.footprintnetwork.org/2018/04/09/has_humanitys_ecological_footprint_reached_its_peak/

4. Carbon: Main component of EF

The carbon footprint is the amount of carbon dioxide released into the atmosphere as a result of human activities. Where you live (country, urban, rural) and your lifestyle, such as the food you eat, your energy source, and your travel mode, impacts on the size of your carbon footprint.

Carbon is about 60% of the global EF, and the fastest growing component of the EF. In 2018 greenhouse gases (GHG), mainly carbon dioxide CO2, and methane CH4, emissions from all human activities (e.g. use of fossil fuels-energy, industry, transport), rose more than 2%.

5. Share of the world's Carbon Footprint



China with 19.9% of the global population produced 27.2% of the world's carbon footprint compared to US with 4.5% of the global population that produced 15.6% of the world's carbon footprint. This large carbon footprint is followed by countries such as India, Russia, Japan, Japan, Mexico and South Korea.

SEE APPENDIX 3 Activities

Weblinks

- Carbon footprints
  Source: https://www.theguardian.com/environment/carbonfootprints

LEFT: Source: https://www.footprintnetwork.org/our-work/climate-change/

6. Running shoes leave a large Carbon Footprint

A typical pair of synthetic trainers generates 30lbs (13.6 kg) of emissions, equivalent to leaving a 100-watt bulb burning for a week

The MIT researchers tracked the emissions associated with the manufacture of the shoe from extracting the raw materials, manufacturing and assembling the product, and use of detergent to clean it by its eventual owner.

The particular shoe was made from 26 different materials, and required 360 different steps to manufacture and assemble. About 68% of the greenhouse gas emissions generated by the shoes tested by the MIT researchers arose during the manufacturing process – not in sourcing the materials or in their actual use.

More than 25bn pairs of shoes are manufactured every year, most of them in developing countries. Sports apparel companies have been leaders in trying to reduce their environmental impact

Source: https://www.theguardian.com/environment/2013/may/23/running-shoes-carbon-footprint

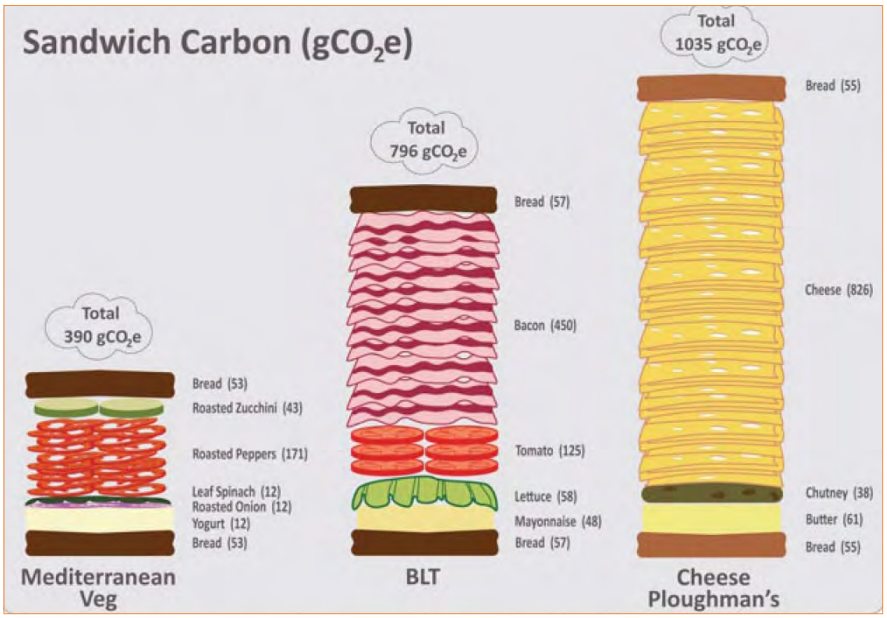
YouTube

- The shoe without a footprint
  Source: https://www.youtube.com/watch?v=a03PbC8UdqQ

ICT

- Running shoes have large carbon footprint: Most of it comes from the manufacturing process.
  Source: https://www.runnersworld.com/gear/a20845278/running-shoes-have-large-carbon-footprint/
- How to rock white sneakers without eco-guilt
  Source: https://sydney.edu.au/news-opinion/news/2017/12/14/how-to-rock-white-sneakers-without-eco-guilt.html

7. Huge Carbon Footprint of a sandwich



Source: http://visual.ly/community/infographic/food/sandwich-counter-your-lunchtime-sandwich-footprint

YouTube

- The carbon footprint of a sandwich
  Source: https://www.youtube.com/watch?v=jRQEi-C5GDg
- Sandwiches have huge carbon footprints
  Source: https://nowthisnews.com/videos/food/sandwiches-have-huge-carbon-footprints
- How your sandwich changed the world
  Source: https://www.youtube.com/watch?v=jRQEi-C5GDg

Weblink

- Scientists calculate carbon emissions of your sandwich
  Source: https://www.theguardian.com/lifeandstyle/2018/jan/25/scientists-calculate-carbon-emissions-of-your-sandwich

C. WHAT IS THE DEMAND SIDE OF THE EF? CONSUMPTION

Source: https://www.artworksforchange.org/portfolio/guerra-de-la-paz/

1. Let's look in your wardrobe!

Humans spend most of their money on housing, food, transport, insurance, entertainment, education, health care, and clothes that have both an ecological footprint (EF) and social footprint (Human Development Index – HDI).

> *Global clothing production doubled from 2000 to 2014. Unfortunately, people keep their clothing for half as long as they did 15 years ago, and as a result generate a huge amount of waste. Australians buy 27kg of textiles each year, with 23kg thrown into landfill or incinerated.*

A cotton shirt uses 2,700 litres of water and 2.1 kg of CO_2. Extra carbon is generated when clothes are transported to distant countries. Additionally, the production of T-shirts sometimes generates a negative social impacts when sweatshop and child labour are used.

Photographs: *Follow the Leader* by Guerra de la Paz, uses repurposed clothing and shoes to emphasise the significance of the human footprint.

2. What do you throw away? Where is the missing plastic?

Source: https://www.artworksforchange.org/portfolio/fred-tomaselli/

Photograph: In *Gyre*, Fred Tomaselli depicts trash ingested by a fish. Plastic harms marine species and increases risks to human health risks by introducing toxins into the seafood we consume.

Around 7 billion kilograms of rubbish such as cardboard, plastic bottles and cans are dumped into the ocean every year. Plastic made from the non-renewable resource petroleum:

- is a major cause of ocean, land, groundwater and air pollution
- upsets food chains
- kills marine species

About 8% of the world's annual oil production is used to produce and manufacture plastic. Due to its low cost and ease of manufacture 33% of plastic is a 'single life product'.However plastic has a large carbon footprint, that is about 6 kg CO_2 per kg of plastic. Humans produce 20 times more plastic than 50 years ago. Asia accounts for 30% of the global consumption followed by North America (26%) and Western Europe (23%).

The Pacific, Atlantic and Indian Oceans, are important environmental resources but are threatened by floating garbage of which 90% is plastic. The Great Pacific Garbage Patch, located in the North Pacific Ocean, was formed by slow swirling ocean currents called gyres. These currents move garbage from the coasts of Asia and North America towards the centre of the Ocean, referred to as the 'patch'. Micro-plastics a major component of the patch are virtually non-biodegradable.

3. What do you do with the waste from consumption?

Photograph: *Mobro – High Seas Drifter* by Scott Greene.

Source: https://www.artworksforchange.org/portfolio/scott-greene/

A barge carried over 3,000 tons of garbage on a 6,000-mile journey that ended where it began. The barge set out in 1987, filled with garbage from New York that was headed for a landfill in North Carolina. The barge was turned away. It travelled to Belize before returning to New York, where its cargo was incinerated. This incident raised awareness about our growing waste problem and propelled the recycling effort throughout the US.

4. Do you think this is over-consumption of natural resources?

Diagram: Average lifetime resource consumption in the USA

Source: http://css.umich.edu/factsheets/us-environmental-footprint-factsheet

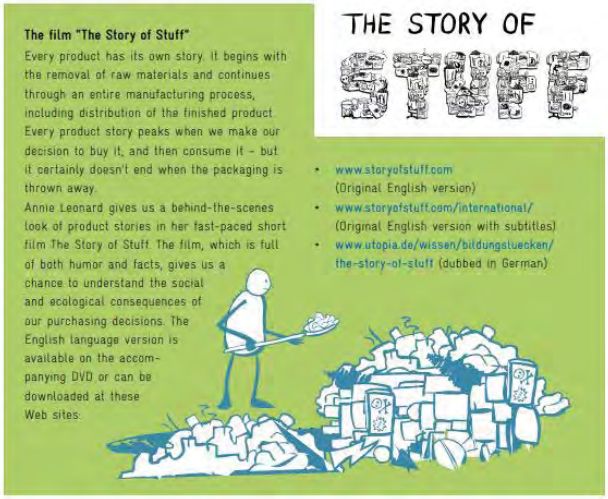
Weblink

- US cult of greed is now a global environmental threat. Source: https://www.theguardian.com/environment/2010/jan/12/climate-change-greed-environment-threat

5. Is over-consumption of 'stuff' causing a sick environment?

The Story of Stuff creator Annie Leonard's book examines the high price of the western world's obsession with all things material

Source: https://www.theguardian.com/environment/2010/jun/21/overconsumption-environment-relationships-annie-leonard



Source: https://conservation-development.net/Projekte/Nachhaltigkeit/DVD_10_Footprint/Material/pdf_Serie_Nachhaltigkeit/10_Footprint_en.pdf

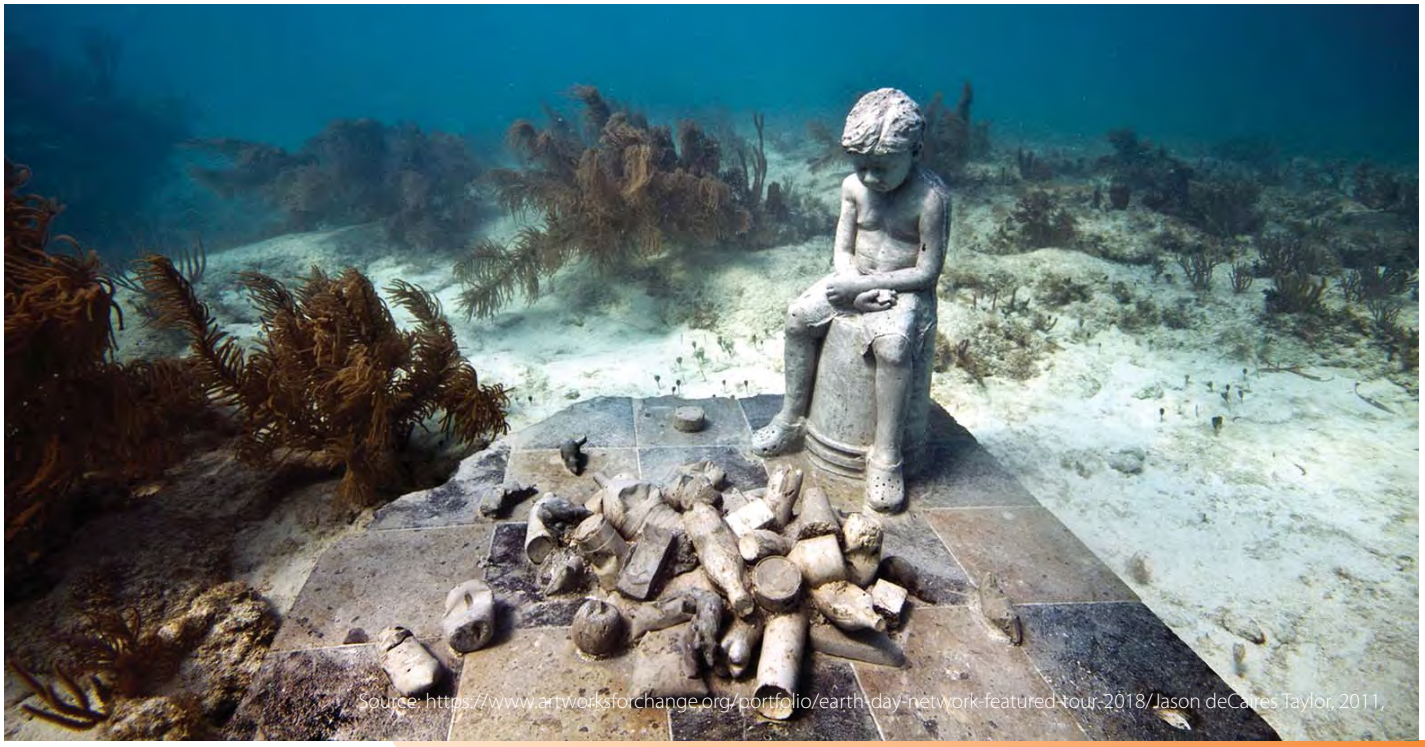
Source: https://upload.wikimedia.org/wikipedia/commons/6/65/Electronic_waste.jpg

Weblink

- Consumption dwarfs population as main environmental threat Source: https://www.theguardian.com/environment/2009/apr/15/consumption-versus-population-environmental-impact

6. Will this be our inheritance if we continue on this unsustainable path?

Photograph: *Inheritance*, an underwater sculpture by Jason deCaires Taylor. Why is it referred to as inheritance?



Source: https://www.artworksforchange.org/portfolio/earth-day-network-featured-tour-2018/Jason deCaires Taylor, 2011,

D. WHAT IS THE SUPPLY SIDE OF THE EF? BIOCAPACITY

We also need to calculate the planet's total biocapacity. In other words, Earth's ability to produce natural resources, provide land for humans to build on, and absorb waste such as carbon emissions.

Biocapacity measured in global hectares (gha), calculates the area of biologically productive land (for crops, grazing, forests and built-up areas) and sea (fishing grounds), that provides the resources a population requires for consumption, and the assimilation of its wastes.

Ecological resources are at the core of a country's long term wealth. However, population growth and high consumption are placing pressure on limited natural resources' (GFN). For example the world's average citizen has an EF of 2.8gha per person but the world's biocapacity is 1.7gha per person. This led to an ecological deficit of 0.11ha per person. About 86% of the world's population lives in countries with an ecological deficit.

Countries are endowed with different resources and consume resources at different rates. In a globalised world, countries meet their demand for resources through trade.

What is the difference between Surplus and Deficit?

BIOCAPACITY SURPLUS

EF is smaller than biocapacity e.g. Suriname, Congo, Bolivia and Namibia. 14% of the world lives in countries with more biocapacity than footprint

BIOCAPACITY DEFICIT

EF is larger than biocapacity e.g. Bermuda, Israel, Bahrain, Saudi Arabia and Qatar. Residents demand more from nature than the country's ecosystems can generate.

BIOCAPACITY DEFICIT COUNTRIES

Percentage that EF exceeds biocapacity:

- Singapore 9,890%
- Bermuda 4,810%
- Réunion 2,820%
- Barbados 2,070%
- Cayman Islands 1,670%
- United Arab Emirates 1,650%
- Israel 1,640%
- Bahrain 1,530%
- Saudi Arabia 1,350%
- Cyprus 1,260%
- Qatar 1,230%
- Kuwait 1,150%

BIOCAPACITY SURPLUS COUNTRIES

Percentage that biocapacity exceeds EF:

- French Guiana 3,860%
- Suriname 2,330%
- Guyana 2,300%
- Gabon 846%
- Congo 763%
- Central African Republic 555%
- Bolivia 436%
- Congo 255%
- Uruguay 246%
- Namibia 212%
- Eritrea 209%
- Timor-Leste 199%

Adapted http://data.footprintnetwork.org/#/

E. WHAT IS THE ENVIRONMENTAL PROBLEM?

Source: https://www.thegef.org/blog/environmental-challenges-need-integrated-solutions

How much nature do we use (DEMAND – ECOLOGICAL FOOTPRINT)?
How much nature do we have (SUPPLY – BIOCAPACITY)?
Demand is greater than supply!

DEMAND
ECOLOGICAL FOOTPRINT

Ecological Footprint measures resource consumption of human activities across the lifecycle of a product or service and converts this to the amount of land required to supply the resources consumed and assimilate the wastes generated.

Source: http://www.foodchoices.com.au/samples/resource%20sheet%2056.pdf

Consumption indicators such as the Ecological Footprint provides a picture of overall resource use. The products we consume, supply chains behind them, materials used and how these are extracted and manufactured, have myriad impacts on Earth.

Source: https://c402277.ssl.cf1.rackcdn.com/publications/1187/files/original/LPR2018_Full_Report_Spreads.pdf?1540487589

ECOLOGICAL FOOTPRINT =

Population X Per capita consumption X Resource intensity

SUPPLY
BIOCAPACITY

Biocapacity refers to the capacity of a given biologically productive area (global hectares) to supply resources and absorb its wastes.

Source: https://www.greenfacts.org/glossary/abc/biocapacity.htm

Ecological resources are at the core of a country's long-term wealth.

Source: https://www.footprintnetwork.org/our-work/countries/

Population, growth and consumption (EF), already exceeds Earth's biocapacity. This is unsustainable

BIOCAPACITY =

Biocapacity X Productive Area

As population and consumption increased, humans have placed greater demands on ecosystems essential for our survival

1. Top Countries – Ecological Demand and Supply

When placing demand and supply together, the problem becomes obvious. It takes a year and a half to generate the resources (supply) that the human population uses (demands) in only a year. This is not a sustainable path for our planet's future.

DEMAND

- 51% of Ecological Footprint is attributed to five countries: China, USA, India, Russia and Japan

SUPPLY

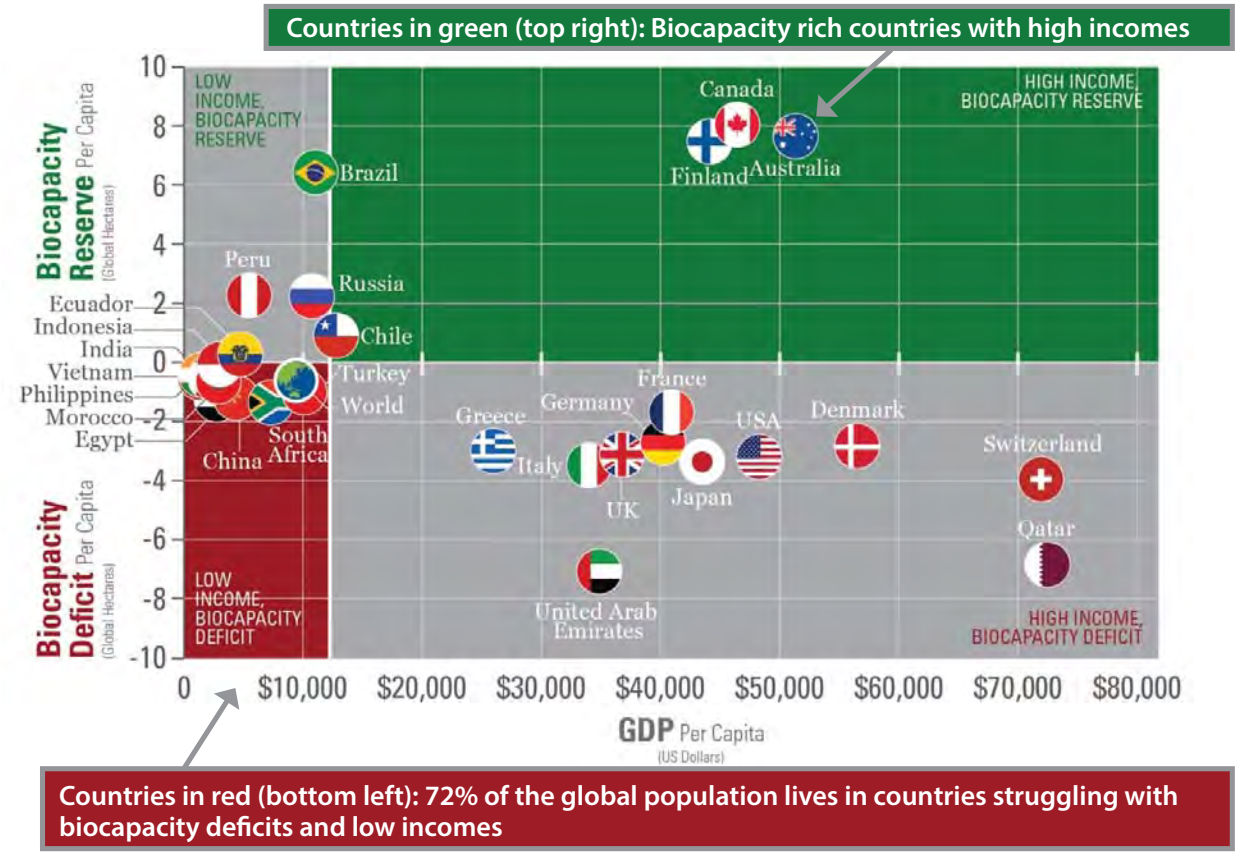
- 62% of the world's biocapacity is located in ten countries. Forests comprise the largest proportion of total biocapacity in Brazil, China, US, Russia, India, Canada, Australia, Indonesia, Argentina and Congo

Photograph: Aerial monitoring of illegal mining in Jamanxim and Rio Novo national parks in Pará, Brazil

Source: https://upload.wikimedia.org/wikipedia/commons/b/bc/Parques_Nacionais_do_Jamanxim_e_do_Rio_Novo%2C_Par%C3%A1_%2831181653127%29.jpg

2. EF and Biocapacity of countries versus GDP per capita

Gross Domestic Product (GDP) per capita is directly connected to the EF. A wealthy country possesses greater opportunities for spending its money, and the use of more natural resources.



https://www.eco-business.com/news/earths-annual-ecological-budget-blown-just-8-months/

Wealthy countries such as UAE and Qatar have the highest ecological deficits, while Brazil, Canada, Finland and Australia have the highest biocapacity reserves.

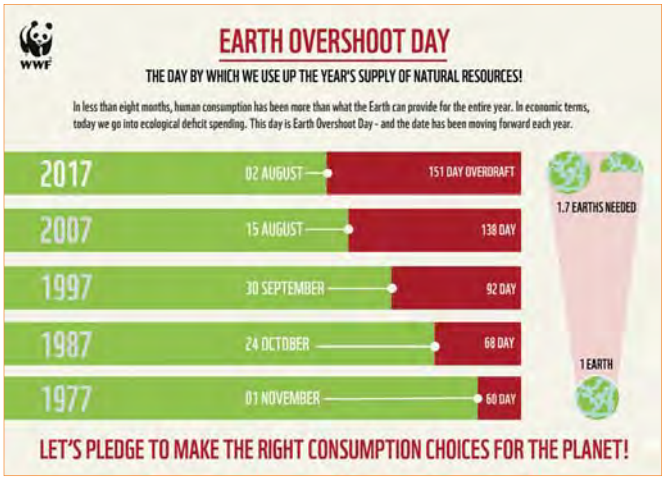
F. WHAT IS MEANT BY ECOLOGICAL OVERSHOOT? IS THIS A PROBLEM?

Ecological Overshoot is the shortfall in Earth's biological capacity to meet humanity's consumption demands.

'The costs of this global ecological overspending are evident around the world, in the form of deforestation; scarce fresh-water; soil erosion; biodiversity loss; and the build-up of carbon dioxide in the atmosphere, leading to climate change and more severe droughts, wildfires and cyclones.'

Source: https://www.footprintnetwork.org/2018/06/13/earth-overshoot-day-2018-is-august-1-the-earliest-date-since-ecological-overshoot-started-in-the-early-1970s/

Since the 1970s, humans are consuming more energy and other resources than nature can provide, as well as produce more wastes than nature can assimilate, in a year. This referred to as "ecological overshoot", has continued to grow. By August 1 2018, more of the Earth's resources had been consumed than it could regenerate in one year. In fact humans had used a year's worth of resources in only seven months.



Source: https://www.wwfindia.org/?16661/Earth-Overshoot-Day-2017-is-August-2

In a globalised world, countries meet their population's demand for resources by firstly using their own biocapacity, then secondly using the biocapacity of other countries via trade, and so called land grabs in other countries, such as Saudi Arabia in Ethiopia.

As wealth grows and consumption patterns change humans need to adopt innovative technology and sustainable lifestyles to preserve this planet. *'All hope is not lost if we can reverse the trend. Living within the means of one planet is technologically possible, financially beneficial, and our only chance for a prosperous future,"* said Wackernagel

Source: https://www.wwfindia.org/?16661/Earth-Overshoot-Day-2017-is-August-2

1. Why should we be concerned with overshoot?

A digression: Looking back – an example of overshoot in early civilisation

The first evidence of the destruction of an ecosystem comes from the Sumerians about 2400 BCE. The geology of the valley between the Tigris and Euphrates made food production especially difficult. In spring both rivers were swollen with large amounts of water; between August and October, the period when farms most need water, the rivers shrank into tiny rivulets. The Sumerians developed one of the world's first artificial irrigation systems. The productivity of the ecosystems rose as did grain harvests. During summer it is extremely hot in this latitude, around 40 ºC. The irrigation water quickly evaporated on the fields, leaving deposits of salt behind. Beginning in 2000 BCE reports grew of the earth "turning white". Ultimately, grain production collapsed due to salinisation of the soil – a chief problem with irrigation even today. The case of the Sumerians reveals the basic pattern of overshoot:

- Growth occurs and events accelerate (artificial irrigation increases the productivity in the Tigris and Euphrates valley).
- Limits are exceeded whereby the system is decisively destroyed (after a certain degree of soil salinisation, plants reacted negatively and yields sank).
- Learning processes start too late to correct the problem (the Sumerians were unaware of the problem of salinisation and may have never fully understood what caused the collapse).

This example shows how overshoot is a problem that often creeps up slowly; this is what makes it so dangerous. The fate of the Sumerians as a result of their unintentional mismanagement and overuse of ecosystems has repeated itself innumerable times, be it in Biblical times with the destruction of the forests on the hills of Lebanon, Roman times with extensive erosion around the Mediterranean, right up to the present day. Ecosystems are sensitive; when they lose their balance, a collapse is often not far away.

Ponting, C. (2007): A New Green History of the World. The Environment and the Collapse of Great Civilisations. Source: https://conservation-development.net/Projekte/Nachhaltigkeit/DVD_10_Footprint/Material/pdf_Serie_Nachhaltigkeit/10_Footprint_en.pdf

Do you understand the importance of overshoot?

Suggestions for further work: Have you understood the principle of overshoot?

Imagine, for example, you take a second job in a bakery. You must get up every morning at 3 am. After a certain amount of time, your ability to perform your day job really begins to suffer, probably because you are much too tired. Is this overshoot?

Consider other situations from your everyday life, your family, your community, or on a global level in which overshoot can occur (even when we don't call it that in everyday conversation).

Let's look a bit into the future: humankind realies that it cannot overdraw its natural capital account any longer because it is endangering its own basis for survival. Imagine that you are a minister of the environment, a mayor, or an automobile manufacturer – what do you think the basic approaches for solutions would look like in order to encourage better, more intelligent and fairer dealings with natural resources? What ideas occur to you in the face of such complex challenges? What would the different arguments look like from the perspectives of the interested parties mentioned above (or others)? For example:

- What if every person, every city, every country or business could buy or sell their "personal consumption units" similar to the trading of greenhouse gas emissions? How would this impact people's daily lives? Do you think that this approach would reduce consumption? Why, or why not? Who would likely oppose such an idea and who would support it? How could such an idea be implemented – which institution or organisation would have the capability to handle such a challenging task? Where do you see risks and / or potential negative consequences?
- Some suggest that we should consider giving everybody equal access rights to global biocapacity – Is this fair? Or does biocapacity belong to the various countries? Or should we get access according to our purchasing power?
- If we lived within the means of the planet, would we all go hungry from October onwards, after the annual Overshoot Day because we had already used up our resources for the year?
- Germany's "green tax" (which, among other things, contains electricity taxes and leads to an increase in petroleum taxes) makes environmentally damaging behavior more expensive. Should this regulatory instrument be extended to other consumption sectors? Do you see ways of expand it to include biocapacity? Might it be a good model for other countries?
- What other solutions can you think of?

Sustainability Has Many Faces. A big foot on a small planet? A brochure series with accompanying materials on development cooperation for the UN Decade of Education for Sustainable Development

Source: https://conservation-development.net/Projekte/Nachhaltigkeit/DVD_10_Footprint/Material/pdf_Serie_Nachhaltigkeit/10_Footprint_en.pdf

SEE APPENDIX 3 and 4 activities

G. WHAT ARE THE INEQUALITIES BETWEEN EF AT A VARIETY OF SCALES?

The world's 7.7 billion people consume varying amounts of the planet's resources and production of wastes. Consumption varies between and within:

a. REGIONS (Asia, Europe, North America, Africa and South America)
b. COUNTRIES (developed and developing)
c. SETTLEMENTS (rural – urban)
d. PEOPLE (rich and poor)

a. REGIONS

EF per person: North America has the highest EF per person, followed by Europe. The most rapid increase in EF is in the Asia region which is primarily driven by China. The EF of Africa and West Asia/ Central Asia region are increasing. All other regions are characterised by relatively minor increases in per capita EF (8% Africa, 16% South America)

Source: https://www.mdpi.com/2079-9276/7/3/58/htm

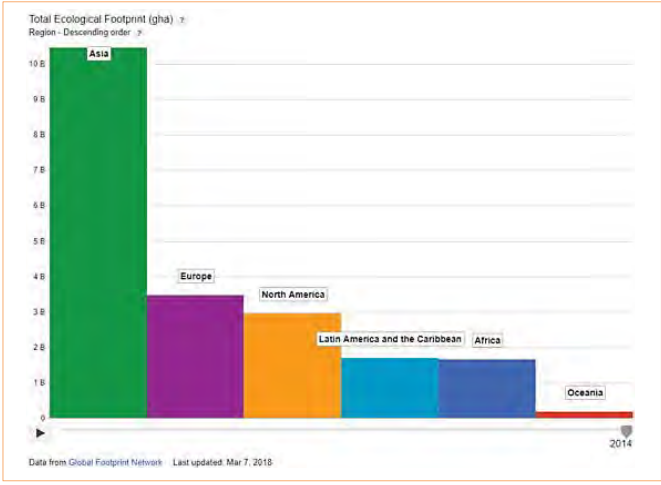
Total EF: However, the story differs when measuring the total EF. Asia has the highest with large populations, followed by Europe and North America. Asia's large population (60% of global population) creates 40% of the world's EF.

From 1961 to 2007 Asia's population doubled, total EF increased 340% to about 5.1 billion gha, and per capita EF increased by 30%.

Within Asia there are variations: For example, the United Arab Emirates (UAE) has a per capita EF of 10.3gha, the highest in the world, whilst Pakistan's per capita EF is only 0.75gha.

Currently, Asia's EF is around 2.5 times that of its biocapacity.

Comparative column graph: EF of Regions: EF of Regions



Source: https://www.footprintnetwork.org/our-work/climate-change/

b. COUNTRIES

Countries demand and supply of natural resources varies over time. Generally richer more developed countries have a higher EF per person than poorer less developed countries. For example developed Luxembourg (15.82) in contrast to developing Pakistan (0.79) and India (1.16).

Inequalities in EF per person in some Asian countires

Rank	Country	EF per person
8	Singapore	7.97
20	Mongolia	6.08
27	South Korea	5.69
42	Japan	5.02
64	Malaysia	3.71
71	China	3.38
98	Thailand	2.66
133	Vietnam	1.65
135	Indonesia	1.58
143	Myanmar	1.43
163	North Korea	1.17
164	India	1.16
167	Phillipines	1.10
175	Nepal	0.98
184	Pakistan	0.79
185	Bangladesh	0.72

Adapted: https://en.wikipedia.org/wiki/List_of_countries_by_ecological_footprint

Bangladesh

Bangladesh is a poor developing country, with a small population than lives without many luxuries. Hence, the EF per person of a Bangladeshi is small. This is mainly due to low per capita income which means Bangladesh does not possess a large consumer society. Moreover, it has a low carbon footprint as it possesses few industries resulting in emitting only 0.44 tonnes of CO_2 per person compared to 14.4 tonnes of CO_2 per person in the US.

Producer:

- Less production in Bangladesh means less ecological damage – reduced consumption of biocapacity and the productio of waste.

Consumer:

- Lower incomes in Bangladesh means les consumption of resources that leads to smaller EF.

This contrasts with United Arab Emirates (UAE) that has a very large EF because it is the world's third-largest oil exporter country. As a result, this country has one of the highest per capita carbon footprints in the world.

India

India's EF has doubled since 1961 with India now demanding the biocapacity of two India's to provide for its consumption and absorb its wastes. While India demands a significant percent of the world's biocapacity, its per-capita EF of 0.8 gha, is well below the world average of 2.2 global hectares

On a global scale, India has the fourth-largest carbon footprint from tourism in the world. *Have you ever wondered if your vacation to exotic India may have played a role in global carbon pollution?*

c. SETTLEMENTS WITHIN COUNTRIES

The wellbeing of a subsistence farmer living in an isolated village in a developing country contrasts with a wealthy city-dweller in a developed country. More land is required to grow the city dweller's food, more materials are used to build the city dweller's home and workplace, and more energy is required for transport, heating and cooling.

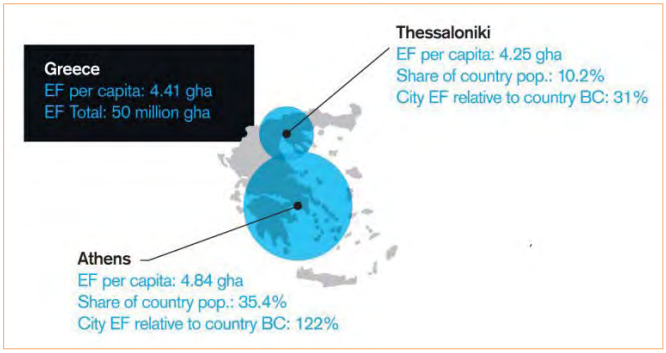
Source: https://www.bbc.com/news/magazine-33133712

In many countries, one or two major urban centres are major contributors to the country's EF and also runs higher per capita EF than the average for their country. For instance, the resource demands of citizens in Athens exceeds the biocapacity of all of Greece.

Source: https://www.footprintnetwork.org/our-work/cities/

Greece compared to its two cities – Athens and Thessaloniki

Both cities have a larger EF per person than Greece



Source: https://www.footprintnetwork.org/our-work/cities/

Two per cent (2%) of the world's land surface, which the cities currently occupy, consumes 75% of the world's natural resources and discharges an equal amount of waste, causing huge EF.

- *Will we have enough resources to consume and survive if 60% of the world's population becomes urbanised by 2030?*
- *Are our cities self-sufficient entities?*
- *How are we going to satisfy the huge appetite of the growing cities and still be able the leave a liveable world for our future?*

Source: ***https://www.smartcitiesdive.com/ex/sustainablecitiescollective/ecological-footprint-and-livable-future/118866/***

In a globalised world, cities regions and countries, depend on resources and ecological services from distant ecosystems. The wellbeing of residents is affected by both the health and availability of diverse ecosystems, and that the supply of natural capital meets human demand.

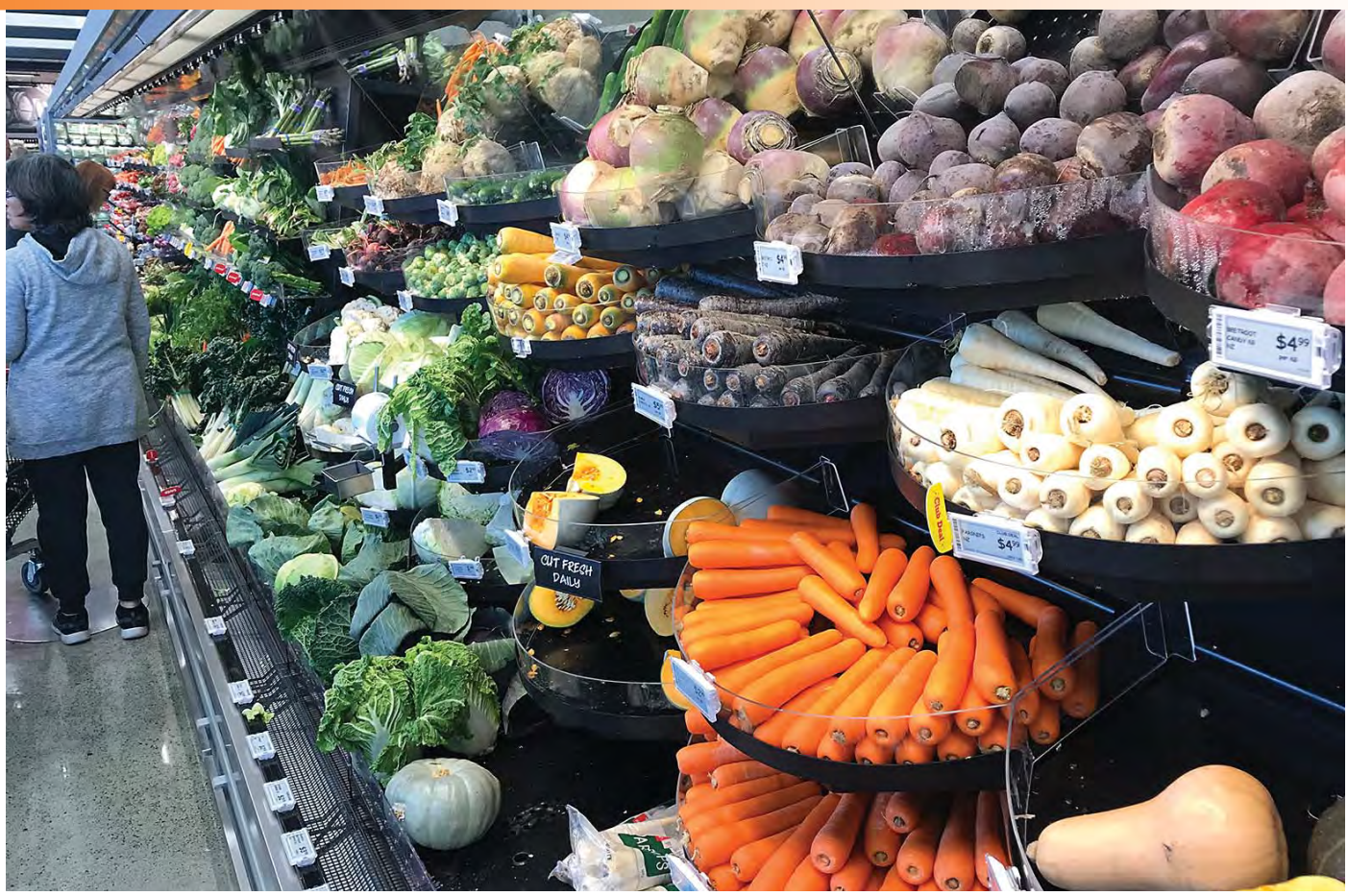
d. PEOPLE

Every person on Earth from birth to death is responsible for the EF. However, the size of a person's EF depends on what country they live in, where they live in that country, and their wealth (income and assets).

- A person's per-capita share of the country's services and infrastructure such as hospitals, roads and schools, tends to be higher in urban compared to rural settlements.
- The size of a person's EF depends on income, assets and lifestyle such as the choices individuals make on what they eat, what products they purchase and how they travel.
- Wealthier people tend to have a larger EF produce more carbon pollution, and waste more energy e.g. heat homes, drive cars, take more flights and require more cement to construct their large homes, while buying and throwing away more items.

Decisions undertaken by governments and businesses have a substantial influence on the EF. For example, individuals generally have no direct control over the size of the built-up land footprint. The same is true for the way in which a country produces its electricity or the intensity of its agricultural production. Governments and businesses therefore play an important role in increasing or reducing the EF of each person.

Source: https://wwf.panda.org/knowledge_hub/all_publications/living_planet_report_timeline/lpr_2012/demands_on_our_planet/footprint_income/



Source: https://upload.wikimedia.org/wikipedia/commons/c/c1/Naked_food_279.jpg

1. Comparing people who live in USA with those living in India

Globally, half the CO_2 emissions associated with individual lifestyles are due to the actions of the richest 10% of humanity, who live in the world's most affluent 25 countries.

Source: https://newint.org/features/2017/07/01-equality-environment

CATEGORIES	AVERAGE US/INDIAN PERSON
Average per capita consumption expenditure	US: US$33,469; India: US$900
Consumption of: – food and beverages – housing and household goods and services – recreation – health	US consumes more than India by: 15 times 50 times 6,000 times 200 times
The richest 5% of Indians consume less than the poorest 20% of people living in US.	

Adapted: https://www.downtoearth.org.in/news/climate-change/consumption-and-emissions-rich-indians-v-s-rich-and-poor-americans-61805

The Human Development Report stated that the richest one-fifth of the world's people consume/possess:

- 45% of fish and meat (poorest fifth 5%)
- 58% of world's energy (poorest fifth 4%)
- 74% of telephone lines (poorest fifth 1.1%).

Developed countries have 25% of the world's population but consume 75% of energy, 85% of wood products and 72% of steel products, and are able to use 84% of all manufactured products.

Is this fair? Who should pay?

Egalitarianism:
All humans should be entitled to an equal share of the global commons (air, water, land and resources).

Historical Responsibility:
Those who caused global warming and environmental degradation, should bear the burden (ecological debt).

H. HOW CAN YOU REDUCE THE EF? ACTIVE CITIZENSHIP

'How shall we learn to tread more lightly on the face of the Earth? One answer is to calculate our "ecological footprint", being the impact that each and every one of us makes through our daily lifestyles.'

Professor Norman Myers

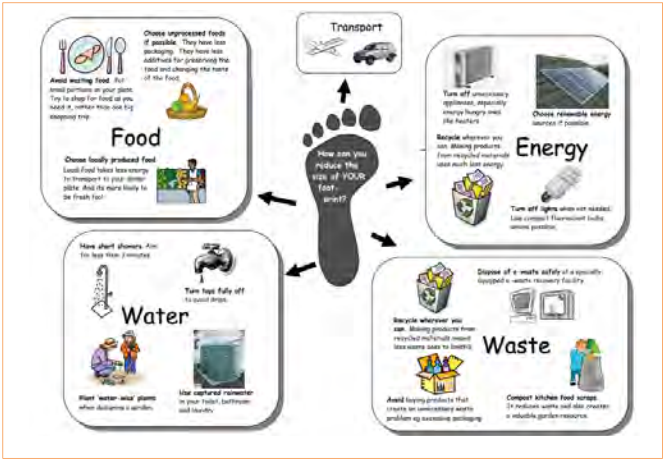
Today the EF is 30% larger than what the world possesses as we are overusing and misusing the Earth's resources leading to deforestation, disappearing species, global warming, air pollution, declining water quality and quantity, and soil degradation. If the global population continues to grow and the emerging middle class, demand more goods and services, it will impact adversely on human wellbeing, and threaten the sustainability of our civilisation. As informed, responsible active local-global citizens the stewardship of the world and the wellbeing of its people are our collective responsibility.

Sustainability is creeping into our lives. Olympic Games and World Cups are becoming more environmentally aware in the design of buildings and products. Ecuador requested the international community pledge $3.6 billion to a United Nations Development Fund (UNDF) instead of mining 850 million barrels of oil in the Yasuni National Park which is one of the most biologically biodiverse regions on Earth. The fashion industry uses organic fibres, recycles plastic into clothes and eco-friendly upcycled clothing is creative.

WHAT CAN YOU DO AS AN INFORMED, RESPONSIBLE ACTIVE CITIZEN?

1. Plant native species
2. Mulch the garden
3. Use less water e.g. turn off tap while brushing teeth
4. Avoid using plastic bags.
5. Choose cleaning products that are environmentally friendly.
6. Use energy smart light globes and whitegoods
7. When buying food:
   - buy local: saves cost on transport
   - Buy organic: saves costs of pesticides and fertilisers on the land and bioaccumulation in the body.
   - preserve biological diversity
   - buy bulk or in large quantities: saves cost of packaging and reduces landfill
   - buy food in season: saves costs of transport, glasshouses and cool stores
8. Recycle and reuse resources
9. Turn off computer, lights and equipment not in use.
10. Cycle to school, utilise public transport or car pool
11. Purchase products that support fair and ethical trade, and recycled
12. Visit parks and gardens: take nothing but photographs
13. Obtain permission from traditional landowners or land manager to visit sensitive areas.

Suggested solutions – Food, water, energy, waste



Source: http://www.arburypark.sa.edu.au/docs/ecological_footprint_poster.pdf

Suggested solutions – Recycle, green waste, trash

Source: http://shopannies.blogspot.com/2016/11/america-recycles-day.html

I. IS THERE PROGRESS TOWARDS A LIVEABLE FUTURE?

Source: https://www.outlookindia.com/outlooktraveller/explore/story/68010/mahim-nature-park-mumbai

Interior of the Mahim N

Has the world reached peak EF? Interestingly the EF for some high incomes countries have declined since 2000 (e.g. Singapore and Denmark). Mathis Wackernagel, the network's founder and chief executive, said *"We may have reached peak eco-footprint, after years of expansion. For example, China underwent a rapid expansion of its footprint, and now it has flattened. This could be a real trend."*

Source: https://www.thefifthestate.com.au/urbanism/climate-change-news/has-the-world-reached-peak-ecological-footprint/

1. Mahim Nature Park in Mumbai

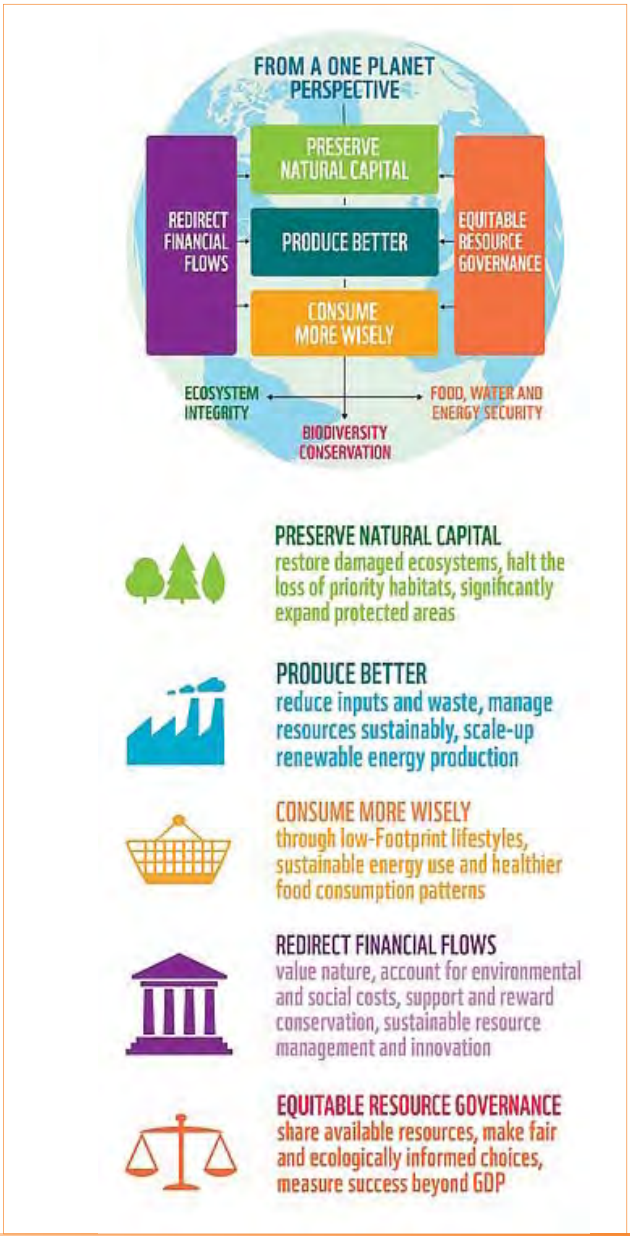
India covers an area of 37 acres. The park is situated next to India's largest slum, Dharavi. Over time the slum has been transformed into a green lung for the city, by the Mumbai Metropolitan Region Development Authority (MMRDA) and World Wildlife Fund (WWF India). The lush green forest replaced the five-metre deep garbage dump. The area now boasts 18,000 trees that attracts thousands of varieties of species-butterflies, birds, insects, reptiles and amphibians. Instead of shifting all the garbage to another city or place and damaging more ecosystems, the project improved the biocapacity of Mumbai.

2. WWF 'One Planet Perspective'

This project outlines better choices for managing, using and sharing natural resources within the planet's capacity.

Source: https://www.footprintnetwork.org/content/documents/2016_Korea_EF_

The One Planet Perspective Goals



J. QUOTATIONS

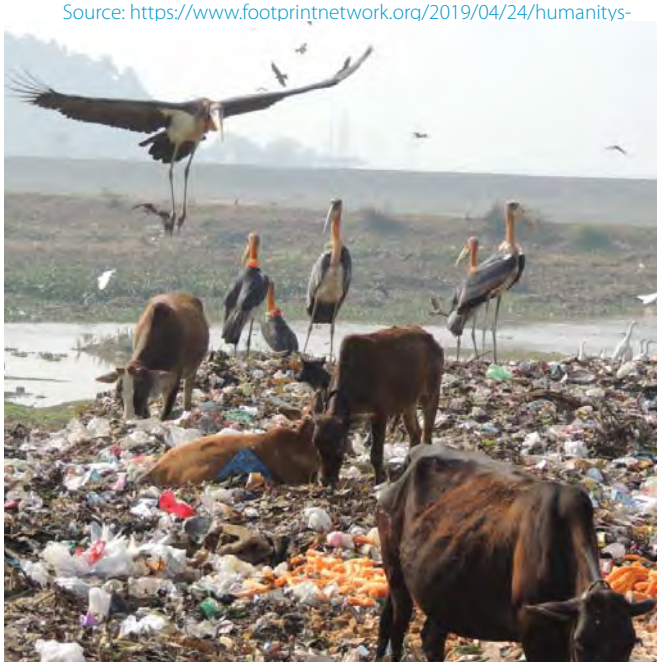
The Global Footprint Network (GFN) predicts that if we continue with business as usual, by 2050 humanity's EF will be 100% larger than the planet's biocapacity – that is, it would take two years for the planet to regenerate what we use in one year.

The GFN finds that almost no country today meets the sustainable development challenge—to have both a high quality of life (wellbeing), defined here by the United Nations Human Development Index (HDI), and an average Footprint (EF) that doesn't exceed the biological capacity available per person on the planet. It also shows that ending overshoot does not condemn us to a low standard of living or low human wellbeing standards

Source: https://www.footprintnetwork.org/content/documents/LPR06_media_Backgrounder.pdf

"Our data shows that we use as much from nature as if we lived on 1.75 Earths, yet we only have one. This is not a judgement, just a measurement. In this context, bringing human activity back within the ecological budget of our one planet is not about doing the noble thing or easing our guilty conscience. It is about choosing self-interest and what works. We will move out of ecological overshoot. Why choose to get there by disaster rather than by design?"

Mathis Wackernagel, Founder and President of Global Footprint Network
Source: https://www.footprintnetwork.org/2019/04/24/humanitys-ecological-footprint-contracted-between-2014-and-2016/



Source: https://upload.wikimedia.org/wikipedia/commons/9/94/Greater_adjutant_stork_garbage_dump_Guwahati_AJTJ_DSCN7659.JPG

https://upload.wikimedia.org/wikipedia/commons/d/d4/Trash_in_Venice_%2833966463004%29.jpg

ecological-footprint-contracted-between-2014-and-2016/

``We are in serious ecological overshoot, consuming resources faster than the Earth can replace them. The consequences of this are predictable and dire. It is time to make some vital choices. Change that improves living standards while reducing our impact on the natural world will not be easy. The cities, power plants and homes we build today will either lock society into damaging over consumption beyond our lifetimes, or begin to propel this and future generations towards sustainable living."

James Leape, Director General, WWF
Source: https://www.footprintnetwork.org/2019/04/24/humanitys-ecological-footprint-contracted-between-2014-and-2016/

"For twenty years we've lived our lives in a way that far exceeds the carrying capacity of the Earth. The choices we make today will shape the possibilities for the generations which follow us. The fact that we live beyond our means in our use of natural resources will surely limit opportunities for future generations that follow."

Carter Roberts, President and CEO of WWF US

"The most precious resources in the 21st century will be natural resources, particularly in a finite world with rapidly growing populations and consumption. Every day we make decisions about where to invest our money, what kind of policies we demand from our political system and how we live our lives. These decisions will determine our resource demand into the future, and whether or not there will be natural resources to meet it."

Carter Roberts, President and CEO of WWF US

But we only have one Earth. The only thing we can do is create more sustainable consumption models and lifestyles and, as a result, enable humans and nature to live in harmony.

Source: https://www.footprintnetwork.org/content/images/article_uploads/China_EF_Sustainable_Consumption_2014_English.pdf

THE WORLD ENERGY MARKET AND AUSTRALIAN ENERGY: ECONOMIC AND BUSINESS PERSPECTIVES

Martin Pluss, GTA NSW & ACT Director

This article is a selective treatment of the world global market and Australian policy scenarios/trends in the energy discussion. Even though emissions of carbon dioxide (CO2) are mainly derived from the combustion of fossil fuels to produce energy, the focus of this article is energy from an economic and business perspective. As such, this article does not address the climate change debate.

World Energy Market

What does the world energy market look like from 2016 to 2040?

The U.S. Energy Information Administration (2016) *International Energy Outlook 2016* identifies the following fuel types: liquid fuels, natural gas, coal and electricity. The total world energy consumption is set to rise from 549 quadrillion British Thermal Units (Btu) in 2012 to 815 quadrillion Btu in 2040, an increase of 48%.

Renewables are the world's fastest-growing energy source growing by an average 2.6%/year between 2012 and 2040. Nuclear power is the world's second fastest-growing energy source, with consumption increasing by 2.3%/year over that period. Non Fossil fuel is expected to grow faster than consumption of fossil fuels, fossil fuels accounting for 78% of energy use in 2040.

Liquid Fuels

World use of petroleum and other liquid fuels grows from 90 million barrels per day (b/d) in 2012 to 100 million b/d in 2020 and to 121 million b/d in 2040. Most of the growth in liquid fuels consumption is in the transportation and industrial sectors.

Natural Gas

Worldwide natural gas consumption is projected to increase from 120 trillion cubic feet (Tcf) in 2012 to 203 Tcf. By energy source, natural gas accounts for the largest increase in world primary energy consumption. Natural gas remains a main fuel in the electric power sector and in the industrial sector.

Coal

Coal is the world's slowest-growing energy, rising by an average 0.6%/year, from 153 quadrillion Btu in 2012 to 180 quadrillion Btu in 2040. Throughout the projection, the top three coal-consuming countries are China, the United States, and India, which together account for more than 70% of world coal use.

Electricity

World net electricity generation is projected to increase by 69% from 21.6 trillion kilowatt hours (kWh) in 2012 to 25.8 trillion kWh in 2020 and to 36.5 trillion kWh in 2040.

While coal continues to be the fuel most widely used in electricity generation, renewables are the fastest-growing source of energy for electricity generation, followed by natural gas and nuclear power. Electricity generation from nuclear power worldwide increases from 2.3 trillion kWh in 2012 to 3.1 trillion kWh in 2020 and to 4.5 trillion kWh in 2040 as concerns about energy security and greenhouse gas emissions support the development of new nuclear generating capacity.

Energy related C02 Emissions

The report includes a factual outline of world carbon emissions. Figure 1 indicates the regional and country trends. World energy-related CO2 emissions are expected to rise from 32.2 billion metric tons in 2012 to 35.6 billion metric tons in 2020 and 43.2 billion metric tons in 2040. Growth in emissions is attributed to developing Non- OECD nations, many of which continue to rely heavily on fossil fuels to meet the fast-paced growth of energy demand.

Coal became the leading source of world energy-related CO2 emissions in 2006, and it remains the leading source through 2040. Although coal accounted for 39% of total emissions in 1990 and 43% in 2012, its share is projected to stabilize and then decline to 38% in 2040, only slightly higher than the liquids share.

The natural gas share of CO2 emissions, which was a relatively small 19% of total energy-related CO2 emissions in 1990 and 20% in 2012, increases over the projection to 26% of total fossil fuel emissions in 2040.

In 1990, CO2 emissions associated with the consumption of liquid fuels accounted for the largest portion (43%) of global emissions. In 2012, they had fallen to 36% of total emissions, and they remain at that level through 2040.

The net result of both the reduced share of fossil-fuel energy and the shift in the fossil-fuel mix is that projected energy-related CO2 emissions in 2040 are 10% lower in 2040 than they would have been without the changes.

Figure 1 World Energy related Co2 emissions by region figures without US Clean Power Plan

Region Country	1990 (%)	2012 (%)	2020 (%)	2030 (%)	2040 (%)
OECD	11.6	12.8	13	13.3	13.8
USA	5.0	5.3	5.5	5.5	5.5
Australia & NZ	0.3	0.4	0.5	0.5	0.6
Non-OECD	9.9	19.5	22.6	25.8	29.4
China	2.3	8.5	9.9	10.8	11.1

U.S. Energy Information Administration (2016) *International Energy Outlook 2016*

Australian Energy Market

To gather evidence, I have limited the scope of data collection to the business and economic articles in *The Australian* newspaper and a report on electricity policy scenarios. I have done this because, from my experience, the go to resources in the geography classroom are often from sources like *The Sydney Morning Herald, The Guardian* and *The Conversation.*

The Australian articles are behind a paywall and as such not everyone would have access to them. There is a potential inherent bias in this approach, however, I aim to provide my students another perspective from which they can build their arguments and potentially refute with evidence counter arguments to their viewpoints.

My methodology was to collect articles in 2018. I collected and processed dozens of articles on the energy, specifically the National Energy Guarantee (NEG) in 2018 which I used as the basis of early drafts and were quickly shelved as soon as the NEG was put on the back burner.

So, I decided to wait till after the 2019 elections and only collected articles for 2019. I specifically sourced articles relevant to energy demand in January and the resultant impact on supply with high summer temperatures and then monitored articles up to and just after the 2019 elections.

Policy Scenarios and Electricity

Where does the Australian energy market fit into the worldwide picture?

Brian Fisher (2019) authored the report on *Economic Consequences of Alternative Australian Climate Policy Approaches* which in part give indications of trends for electricity generation in Australia in relation to six policy positions.Scenarios 1–3 impose an emission target representing a 27 per cent reduction off 2005 levels consistent with the countries announced Paris contribution of a reduction in emissions to 26 to 28 per cent by 2030. Scenarios 4–6 impose a more stringent emissions target representing a reduction of 45 per cent compared to 2005 levels.

To break down the scenarios further:

- Scenario 1: -27% from 2005 by 2030
- Scenario 2: -27% from 2005 by 2030 with use of Kyoto carryover

- Scenario 3: -27% from 2005 by 2030 with use of carryover and permit trading
- Scenario 4: -45% from 2005 by 2030 and 50% renewables
- Scenario 5: -45% from 2005 by 2030 and 50% renewables with use of carryover
- Scenario 6: -45% from 2005 by 2030 and 50% renewables with carryover and trading

Fisher, B.S. (2019) *Economic Consequences of Alternative Australian Climate Policy Approaches.*

Here we examine the electricity section of the report in the context of electricity generation in Australia and the different policy scenarios.

Electricity generation in Australia is projected to reach around 300 TWh by 2030. This is equivalent to a growth rate from 2021 to 2030 of around 1.6 per cent a year, accompanied by projected higher consumption by electric vehicles. The share of renewable energy, including hydroelectricity, is projected to increase from around 13 per cent in 2013 to around 36 per cent by 2030.

The report investigates six policy scenarios in which a significant amount of coal is removed from the fuel mix. Results for other fuel types vary substantially depending on the scenario under consideration. The projected electricity generation mix in 2030 is summarised in Figure 2. The first column indicates the reference point and the numbers of the different fuel types for the different scenarios need to be read in the context of the reference point.

For example, in Scenario 1 in 2030 there is a near halving of the use of coal in relation to the reference point with Scenario 1 at 23 and reference point 40. There is a rapid uptake in natural gas with S1 at 38 compared to reference point of 23. Also, it seems that 75% coal fire generation must be retired by 2030 and gas penetration needs to increase by 15%. Also note electricity demand is less for S4–6 compared to S1–3.

Figure 2 Scenario and Electricity Generation Mix in 2030, Australia (%)

	Reference	S1	S2	S3	S4	S5	S6
Coal	40	23	32	34	12	18	26
Gas	23	38	30	29	37	31	22
Renewables	36	36	36	36	50	50	50
Other	2	1	2	2	1	1	2
Total	100	100	100	100	100	100	100

Fisher, B.S. (2019) *Economic Consequences of Alternative Australian Climate Policy Approaches.*

Another factor that plays into the energy discussion in Australia is the price of energy. The wholesale price is impacted upon by existing generation capacity, intermittency, the integration costs of wind and solar technologies and the supply and demand of electricity. Figure 3 indicates how the price factor is related to the scenarios.

At right: Transporting a wind turbine blade, Atherton QLD

Figure 3 Impacts on the wholesale Electricity price in Australia in 2030, $/month Wh

	References	S1	S2	S3	S4	S5	S6
Wholesale Electricity Price	81	112	93	91	157	128	111

Fisher, B.S. (2019) *Economic Consequences of Alternative Australian Climate Policy Approaches.*

A final factor to examine is the electricity industry output projections for a whole range of industries. These industries include crops, livestock, forestry, fishing, thermal coal, metallurgical coal, oil and gas, oil refinery, iron ore, food processing, chemical rubber and plastic, non-metallic mining products, iron and steel, non-ferrous metal electricity, land transport, construction, water and air transport and services.

Some of these industries are compared to the scenarios in Figure 4. Though the sample in Figure 4 is selective all other industries mentioned above were in the negative territory as well. Scenario 4 and 5 appears to have the greatest impact on price.

ESA's deep-space ground station at New Norcia, Western Australia, is now powered in part by sunlight, from a new solar power 'farm' completed in August 2017. The farm has 840 photovoltaic panels arranged in five double rows with a rated capacity of 250 kW. Source: https://commons.wikimedia.org/wiki/File:New_Norcia_solar_ESA387214.jpg

Figure 4 Industry output projection, percentage variation from reference case, 2030.

	S1	S2	S3	S4	S5	S6
Thermal Coal	-37.3	-21.2	-19.0	-63.8	-44.0	-26.4
Oil refinery	-13.1	-4.3	-3.4	-36.7	-17.0	-5.2
Electricity	-11.3	-3.9	-3.0	-23.8	-14	-7.7
Land Transport	-6.2	-1.4	-1.0	-20.5	-9.1	-2.8

Fisher, B.S. (2019) *Economic Consequences of Alternative Australian Climate Policy Approaches.*

By necessity this examination of global and Australian trends is from two sources and can be complemented with references and cross checking. Notwithstanding the material should provide teachers a good foundation to work with students in developing evidence-based knowledge for their decision making and future actions

Australian Energy: classroom discussion points and ideas for resource collation

These different Australian energy situations can be unpacked in the classroom through group work, individual research, interviews and even worksheets. As much as possible the intention is to steer a middle path based on evidence collected from the sources identified. Below I have pooled together issues which could be used to generate classroom discussion, activities and resource development. The reference for each issue is in the body of the article.

1. There is evidence of a lack of power supply in January for the past couple of years.

One of the key issues at the beginning of each year is the reliability of the energy supply in summer when hundreds of thousands of people turn on their air conditioner units.

In the week before 28 January 2019, the wind generators in Victoria and South Australia worked at around 20 percent of capacity in the crisis periods because the "wind didn't blow enough". It was a repeat of the events on February 10, 2017 when the NSW system had 2080MW in renewable capacity, excluding the Snowy, but only generated 707MW from that capacity at the peak demand time because the wind did not blow and at 5pm the sun had lost the capacity to generate power. In 2016, South Australia was not as lucky and suffered a week-long blackout made worse by cable failures.

Gottliebsen, R (2019) "Close shave as southern states once again spin climate roulette" *The Australian* 28 January.

2. Is there an impact of closing down on coal fired power plants while renewable energy is still building capacity to meet the demand for electricity?

For example, the Snowy Hydro Snowy Hydro has called for urgent investment in NSW's electricity transmission network to unlock an extra 1000 megawatts of generation and dodge a supply shortfall when AGL's ageing Liddell coal plant retires in 2022. AGL plans to replace the lost capacity with a mixture of solar, wind, gas, pumped hydro and battery power.

Williams, P (2019) "Invest Now to Unlock Power" *The Australian* 28 January.

3. The capacity of the transmission lines even if the nation had the energy supply.

For example:

"Transmission upgrades would integrate future renewables into the shared network and unlock

up to 1000MW of existing capacity from the Snowy Scheme which we can't get into the market due to constraints on the transmission lines."

This can be achieved by boosting the state's inter-connections with Victoria, South Australia and Queensland in a bid to unlock more power from the Snowy scheme and better manage peak demand on hot days.

Williams, P (2019) Call for new coal plants as grid feels the heat" ***The Australian*** 21 January.

4. The creation of new thermal coal/gas fired power stations or suitable alternatives.

For example, firstly, Australia's big three "gentailers" — AGL Energy, Origin Energy and Energy Australia — operate the nation's biggest coal power stations. All three have ruled out building new plants given high construction costs and cheaper renewable alternatives. Secondly, in NSW a $2 billion high efficiency, low emission (HELE) coal plant with 660MW is planned. This could either be built at AGL's Liddell facility in the Hunter Valley or at the site of the old Vales Point A power station.

5. What can we do with the closed down fire powered coal power stations?

For example, a Chinese businessman and sole shareholder of privately-owned CU- River Mining, wants to transform the site of South Australia's last coal-fired power station into a bulk commodity port facility that ships high-grade iron ore from his company's local mining operations to China. This involves a 1068-hectare Spencer Gulf site in Port Augusta, 310km north of Adelaide. This would not progress until rehabilitation works have been finalised by current owner Flinders Power, an offshoot of Alinta Energy, in April.

Williams, (2019) "Gas guru stays ahead of the game" *The Australian* 21 January.

6. What is the impact of high level corporate and government decision making?

For example, Glencore is to abandon large coal acquisitions, freeze production over investor climate change concerns.

The Swiss-based resources giant will cap its global thermal and coking coal production at the current level of about 145 million tonnes after holding talks with the Climate Action 100+ initiative. Glencore's Australian mines account for nearly 100m tonnes of its global volumes, underlining the impact it may have on Queensland and NSW. Such decisions are taken seriously by Climate Action 100+ members in Australia including Australian Super, AMP Capital, Cbus, IFM Investors, QSuper and BT Financial Group reflecting ethical investment decision making.

Further examples include RioTinto exiting from NSW thermal coal mines due to climate change concerns, stating the decision was influenced by the implications of climate change on coal supply and demand and because it had better investment options in iron ore and copper.

In addition, the NSW Land and Environment Court earlier this month upheld a decision by the NSW government to block the development of Gloucester Coal's proposed Rocky Hill coking coal mine, with judge Brian Preston citing the mine's potential contribution to climate change as a reason for the decision.

Williams, P (2019) "Glencore to abandon large coal acquisitions, freeze production over investor climate change concerns" *The Australian* February 20.

7. The relationship between Federal and State Governments

Policy decisions are made at a federal government level for implementation at the state level

On February 1 2019 the government indicated it will consider 10 new power generation projects. Including coal after energy was cut to 200 000 homes in Victoria in the week prior to when the article was written. Outage cost VIC and SA 1.1b in less than 48 hours. Seventy investors "seized on the chance to compete for federal government backing". Including two clean coal plants (HELE) aiming to reduce power bills and shore up their reliability. The breakdown of the 66 submissions include projects in NSW (26), VIC (17), SA (15), QLD (12), TAS (3) and WA (3).

Kelly, J (2019) "New coal projects to secure power supply" *The Australian* February 1.

Below: Murujuga National Park, WA. The bright flame tower of the North West Shelf LNG gas plant lights the night time landscape, as the moon rises over the rocky terrain Source: https://commons.wikimedia.org/wiki/File:LNG_Flare_turns_night_into_day.jpg

Coal freight train travels through the northern Sydney suburb of Pennant Hills

8. What is the story with batteries?

Tesla recently said SA's giant Hornsdale battery bringing worldwide interest. In 2018 it deployed 1.04 GWh (gigawatt hours) of energy storage and 2GWh in 2019 providing $US 140m profit in last quarter in 2018. SA Virtual Power Plant Program aims to install 50 000 interconnected Powerwall units. The Hornsdale battery project is located at Hornsdale wind farm near Jamestown run by French group Neoen

Jenkins, C (2019) "Tesla says SA's giant Hornsdale battery bringing worldwide interest" *The Australian* 31 January.

9. Supplies of some energy resources will eventually run out.

For example, AGL chief executive Brett Redman suggested gas on the east coast is going to go into shortage over the next few years.

"We're not seeing development coming on quickly and the new drilling going on in the Bass Strait is coming up dry so we're not seeing big, new reserves necessarily poised to enter the market."

Williams, P (2019) "AGL signals full steam ahead with LNG terminal plan" *The Australian* 15 February.

10. Impact of government changing policy and indecision.

For example, businesses have threatened to pull $2 billion of planned investments from NSW as frustrations mount that delays approving Santos's Narrabri project will cripple the viability of their operations.

Indian-Australian industrial company Perdaman Group, Australia's largest brickmaker Brickworks and gas wholesaler Weston Energy are calling on the Berejiklian government to make a final decision on Santos's project this year. Perdaman is considering developing a $US1bn ($1.44bn) ammonium nitrate plant near the town, 520km northwest of Sydney, which could supply fertiliser for agribusiness or explosives for the state's mining industry.

Unless a decision is made the company could redirect the investment to other international destinations including New Zealand, Indonesia or the Middle East, and drew a comparison with a $4bn urea project on the Burrup Peninsula in the Pilbara where it is working with Woodside Petroleum and the state government.

Williams, P (2019) "Investment to walk out the door over gas delays" *The Australian* May 28.

11. The links between energy providers and retail distributors of energy.

Andrew Forrest's planned LNG terminal in NSW has struck a five-year, $500 million-plus supply deal with Energy Australia as it works to lock in customers for the nation's first gas import plant. Energy Australia, one of Australia's big three power retailers, reached a preliminary agreement to buy 15 petajoules of gas from January 1, 2021. Gas from the Port Kembla terminal will be supplied to Energy Australia's residential and industrial customers on the east coast.

Utility AGL Energy and big gas producer ExxonMobil have flagged potential import terminals in Victoria while Japanese conglomerate Mitsubishi is backing a plan to import LNG at Pelican Point in South Australia.

William, P (2019) "Port Kembla LNG terminal strikes $500m deal with Energy Australia" *The Australian* May 23.

This scenario is best summed up by the following quote:

The big three generator retailers — AGL Energy, Origin Energy and Energy Australia — may still lack sufficient certainty to proceed with looming investment decisions.

Williams, P (2019) "Power players push for certainty" *The Australian* May 21.

12. There is a need for visionary strategy

A commodity tycoon, who rescued South Australia's Whyalla steelworks from administration, believes the government could play a critical role in backing the development of cheap but intermittent solar and wind supplies supported by firming up generation sources like pumped hydro or gas.

Solar is wonderful but it is not a 24/7 solution. You need pumped hydro and gas to smooth the supply curve and they require substantial investment.

While power plants could run for 30 years or even 50 or 60 years if they were hydro- powered, they cannot be financed at normal market rates and may require additional government assistance to get off the ground:

We know renewables is economically viable, but the security of supply is even more important. So, with that in mind, we need to ensure the transition occurs in an orderly manner.

Coal continues to prop up about 70 percent of the national power grid but with many of the east coast's ageing plants nearing the end of their life the government faces a test to ensure the grid can handle a boom of renewable supply into the system.

Williams, P (2019) "Sanjeev Gupta's powerful vision for reliable energy" *The Australian* 22 May.

13. The nuclear option

It's embarrassing to tell people in the US that nuclear energy is banned in Australia. "But don't you export uranium?"

Australia could learn for overseas projects. As part of its "carbon-free power project", Oregon-based Nuscale is already building a set of small modular reactors for the state of Utah, which should be operational by the mid-2020s. The new designs eliminate two-thirds of previously required safety systems and components found in today's large reactors. Three of these, at about $US250 million ($350m) each, would provide more energy than Australia's biggest wind farm.

It is argued that nuclear power should be a natural complement to wind and solar as the world moves away from fossil fuels.

The development of massive storage capacity at low cost is of benefit to nuclear too, because when there is abundant wind, for example, you don't need all (of a) nuclear plant's production, so you can store it and release it later."

There is a cost advantage for example, in Illinois, with just under 13 million people, there are six nuclear power stations. In Chicago the average price of electricity in January was around US12c a kW/H. Energy Australia charges me 29.4c a kW/H for electricity in Sydney. In nearby Ontario, where nuclear energy provides 60 per cent of the electricity needs of Canada's biggest province, it was less than C13c a kW/h.

It has two major benefits — low operating costs and virtually none of the emissions that lead to smog, acid rain or global warming," says Ontario Power Generation. "These benefits make nuclear a very attractive option for meeting the province's electricity needs well into the future.

Adam Creighton suggests Australia offers a safer geography for nuclear power. As the closure of the giant Liddell coal power station nears in 2022, small modular imported nuclear reactors might be one option worth investigating, providing reliable, carbon-free power cheaply.

Creighton, A (2019) "No logic in our nuclear allergy" ***The Australian*** 23 April.

Conclusion

Although this article is focused economic and business perspectives it should provide useful insights and ideas for classroom application and lead to the development of resources which may be of used for a balanced discussion, when used with other resources. Most probably, by the time of publication, of the article there will be further developments in this evolving global and national issue.

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Wind Farm, Challicum Hills Vic. Source: https://www.flickr.com/photos/jlascar/4613875666/in/photostream/

Geography Teachers' Association of NSW & ACT

ARTHUR PHILLIP GEOGRAPHY FIELDWORK COMPETITION 2019

The Geography Teachers' Association of NSW & ACT (GTA NSW & ACT) organises an annual competition for students and schools to foster an enthusiasm for Geography through engagement and awards. The emphasis of the competition is the use of fieldwork and the gathering of primary and secondary data as core skills in students' study of Geography. Teachers are encouraged to use the competition as a form of authentic assessment for their teaching and learning programmes. The competition is open to all primary and secondary schools in NSW and ACT. Entries are welcome from both members and non-members of GTA NSW & ACT.

The submission of entries and the prize categories have been updated to better reflect the requirements of the new Australian K–10 Geography Curriculum and the central place that inquiry holds within Geography. The categories have been modified to reflect the Australian K–10 Geography content now used in both NSW and ACT. The Brock Rowe Senior Geography Fieldwork Competition is open to entries of HSC Senior Geography Projects, International Baccalaureate Diploma Geography Internal Assessments or fieldwork based Depth Studies for ACT participants. There is a form available on the GTA NSW & ACT website to submit digital entries. Entries must be submitted either by mail or online by Wednesday 20 November 2019.

Please complete and return a student entry form either by mail or online with all student entries by Wednesday 20 November 2019.

NATURE OF THE COMPETITIONS

1. **The "Investigating Places" Primary Fieldwork Competition**
   Three subcategories: Years K-2, Year 3-4, Years 5-6

   This section is open to Primary Students across NSW and ACT. Entries can be made by individuals, groups or classes.

   - Identify a Geographical inquiry that demonstrates the interaction of People, Places and Environments
   - Undertake fieldwork to gather primary data
   - Support fieldwork with secondary data if required
   - Present research findings

2. **The Geographical Fieldwork and Research Competition:**
   Five subcategories: Years 5-6, Year 7-8, Year 9-10, Life Skills and Year 11-12

   This section is open to all Geography students across NSW and ACT. Entries can be made by individuals or groups. Inquiry topics must be clearly relevant to the Australian K–10 Geography Curriculum, the NSW Elective Geography Syllabus or the IB Geography courses at any level. There is an expectation that geospatial technologies will play a role in either the gathering, organising or presentation of student research.

   - Identify a Geographical inquiry topic relevant to any of the Geographical concepts (Place, Space, Environment, Interconnections, Scale, Sustainability, Change) or the Australian cross-curricular priorities (Aboriginal and Torres Strait Islander histories and cultures, Asia and Australia's engagement with Asia or Sustainability)
   - Undertake research using both secondary data and primary fieldwork such as that obtained during interviews, questionnaires or other fieldwork methods
   - Analyse data gathered
   - Present research findings

ARTHUR PHILLIP GEOGRAPHY FIELDWORK COMPETITION 2019

NATURE OF THE COMPETITIONS

3. **The Dr Don Biddle Places and Environments Study (Year 9 and 10 only)**

   Entries are open to NSW or ACT schools teaching the Australian K–10 Geography Curriculum content. Inquiry topics must be relevant to the Year 9 and 10 syllabus. There is an expectation that geospatial technologies will play a role in either the gathering, organising or presentation of student research.

   - Undertake research into a place or environment relevant to the Year 9 and 10 Australian Geography Curriculum
   - Undertake fieldwork to gather primary data
   - Support fieldwork with secondary data if required
   - Organise and analyse the data gathered
   - Present research findings

4. **The Brock Rowe Senior Geography Fieldwork Competition**

   This section is open to Senior Geography Students across NSW and ACT. Only individual entries will be accepted. The competition is open to either Senior Geography Projects, International Baccalaureate Geography Internal Assessments or a Depth Study for ACT participants.

   - Undertake an HSC Senior Geography Project, International Baccalaureate Internal Assessment for Geography or ACT Depth Study that uses fieldwork to gather primary data
   - Support fieldwork with secondary data if required
   - Analyse data gathered
   - Present research findings
   - Evaluate the research methodologies used and the ethical aspects of research undertaken

5. **The Dr Susan Bliss Cross-Curricular Priority Awards**

   The Dr Susan Bliss Awards are available for entries from any category or subcategory that demonstrates significant achievement or development of understanding in any of the three Australian K–10 Geography Curriculum cross curricular priority areas; Aboriginal and Torres Strait Islander histories and cultures, Asia and Australia's engagement with Asia or Sustainability.

6. **The Dr Maurine Goldston-Morris Civic and Citizenship Awards**

   The Dr Maurine Goldston-Morris Civic and Citizenship Awards are available for entries from any category or subcategory that demonstrate civic action has occurred at either the individual or group level, as a result of the research/fieldwork activity.

7. **The Dr Maurine Goldston-Morris Teacher Awards**

   The Dr Maurine Goldston-Morris Teacher Awards will be allocated to teachers for outstanding involvement in the Geography Fieldwork Competition during 2019.

ARTHUR PHILLIP GEOGRAPHY FIELDWORK COMPETITION 2019

ENTRY INFORMATION

A competition entry fee of $20 per school, regardless of the total number of entries submitted.

Each school can submit a maximum of FOUR (4) entries in each competition category.

To enter the 2019 Arthur Phillip Fieldwork Competition CLICK HERE

Final date for competition entries to be received
Wednesday 20 November 2019

All **postal entries** MUST be clearly marked as **Geography Fieldwork Competition.**
Entries can be mailed to:

GTA NSW & ACT Office (PO Box 699 Lidcombe 1825)

Please contact our office on **9716 0378** prior to delivering entries to the following location:

PTC NSW Office and Training Rooms
Ground Floor, Community First Credit Union Building
Cnr. Hall and Percy Streets, Auburn

Enquiries via email to the GTA NSW & ACT office – gta.admin@ptc.nsw.edu.au

Hardcopy entries may be in a book, as loose leaves (with reinforced rings) or mounted on cardboard (limit 2 sheets of 65 x 55cm).

All digital entries MUST be submitted as a hyperlink through the online entry form available on the GTA NSW & ACT website. All digital presentation formats, such as videos, web pages and podcasts are welcome. Slide presentations (such as PowerPoint, Slides or Pages) will have a maximum slide number of 20. It is the responsibility of the student and supervising teacher to ensure hyperlinks are functional and able to be accessed by markers.

No models will be accepted.

All entries will be available for collection at the end of the Arthur Phillip Award ceremony. GTA NSW & ACT is unable to return uncollected entries to schools.

PRIZES:

Prizes will be awarded for the first, second, third and highly commended place entries in each competition category or subcategory where available.

AWARDS:

Awards will be allocated to each category according to marking criteria. The presentation of awards will take place at the Arthur Phillip Awards ceremony in early 2020. Award recipients, their parents and teachers will receive invitations to the event.

ADVICE TO CONTRIBUTORS

Geography Bulletin guidelines

1. ***Objective:*** The Geography Bulletin is the quarterly journal of The Geography Teachers' Association of NSW & ACT Inc. The role of the Geography Bulletin is to disseminate up-to-date geographical information and to widen access to new geographic teaching ideas, methods and content. Articles of interest to teachers and students of geography in both secondary and tertiary institutions are invited, and contributions of factually correct, informed analyses, and case studies suitable for use in secondary schools are particularly welcomed.
2. ***Content:*** Articles, not normally exceeding 5000 words, should be submitted to the GTA NSW & ACT Office by email gta.admin@ptc.nsw.edu.au

   Submissions can also be sent directly to the editors: Lorraine Chaffer (lchaffer@tpg.com.au)

   Articles are welcomed from tertiary and secondary teachers, students, business and government representatives. Articles may also be solicited from time to time. Articles submitted will be evaluated according to their ability to meet the objectives outlined above.
3. ***Format:*** Digital submission in Word format.

- Tables should be on separate pages, one per page, and figures should be clearly drawn, one per page, in black on opaque coloured background, suitable for reproduction.
- Photographs should be in high resolution digital format. An indication should be given in the text of approximate location of tables, figures and photographs.
- Every illustration needs a caption.
- Photographs, tables and illustrations sourced from the internet must acknowledge the source and have a URL link to the original context.

Note: Please try to limit the number of images per page to facilitate ease of reproduction by teachers.

Diagrams created using templates should be saved as an image for ease of incorporation into the bulletin.

All assessment or skills tasks should have an introduction explaining links to syllabus content and outcomes. A Marking Guideline for this type of article is encouraged.

4. ***Title:*** The title should be short, yet clear and descriptive. The author's name should appear in full, together with a full title of position held and location of employment.
5. ***Covering Letter:*** As email with submitted articles. If the manuscript has been submitted to another journal, this should be stated clearly.
6. ***Photo of Contributor:*** Contributors may enclose a passport-type photograph and a brief biographical statement as part of their article.
7. ***References:*** References should follow the conventional author-date format:

   Abbott, B. K. (1980) ***The Historical and Geographical Development of Muswellbrook*** Newcastle: Hunter Valley Press.

   Harrison, T. L. (1973a) ***Railway to Jugiong*** Adelaide: The Rosebud Press. ***(2nd Ed.)***

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All suitable manuscripts submitted to the Geography Bulletin are subject to the process of review. The authors and contributors alone are responsible for the opinions expressed in their articles and while reasonable checks are made to ensure the accuracy of all statements, neither the editor nor the Geography Teachers' Association of NSW & ACT Inc accepts responsibility for statements or opinions expressed herein.

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