

ANALYSING (BIG) DATA

Module 04

1. Introduction

Environmental SSI and (big) data

Activity 1.1

Global Warming

   	 	Duration: 30-45 minutes
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1.1 Climate change and global warming - background

‘Climate Action’ is one of the sustainable development goals of the UN. The EU adopted these goals and Eurostat (the European bureau of statistics) is monitoring progress towards the SDGs in an EU context.



Climate action is needed because our climate is changing and the global temperature is rising.

1.1 Climate change and global warming – part A

THINK: Answer the following question (individually)



1. In your opinion: is global warming 'real'?
2. In your opinion: what is causing global warming?
3. On what sources do you base your opinions?



PAIR: Compare and discuss your answers with a peer.

- Do you agree on 1 and 2?
- Make a list of sources (you may add extra sources).



1.1 Climate change and global warming – part B



As a group: what can you conclude from the results of the poll?

Make a list of all sources mentioned for question 3.



In a small group, use the questions on worksheet 1.1B to.....

- Find out for one or two of these sources if and how the use of data is made visible in a table, graph(ic), diagram or reference.
- Explore characteristics of these data.



Present (1 minute pitch) and discuss your findings in the whole class.

Activity 1.2

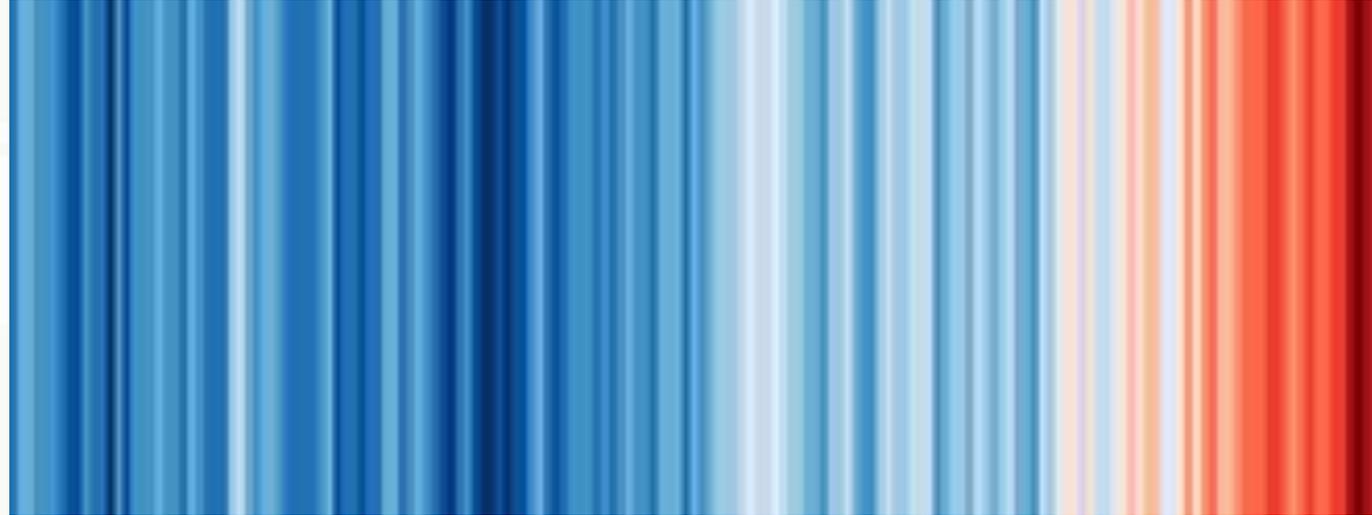
Exploring data and visualisation on global temperature change



Duration: 45 minutes

Data talk

- What do you notice?
- What do you wonder?
- What is going on in this data visualization?



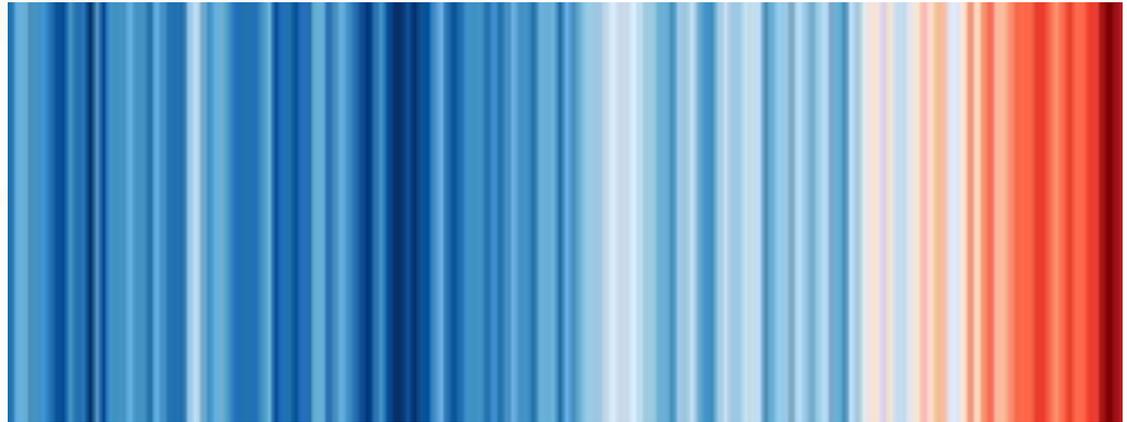
Hawkins, Ed, [2018 visualisation update / Warming stripes for 1850-2018 using the WMO annual global temperature dataset](#). *Climate Lab Book* (4 December 2018).

Archived from [the original](#) on 17 April 2019. "LICENSE / Creative Commons License / These blog pages & images are licensed under a Creative Commons Attribution-ShareAlike 4.0 International License."

Questions to discuss

- What is the (temperature) range of the color scales?
- What story does this graphic tell?
- What feelings does it evoke for you?

Warming stripes of the annual global temperatures from 1850-2018



Hawkins, Ed, [2018 visualisation update / Warming stripes for 1850-2018 using the WMO annual global temperature dataset](#). *Climate Lab Book* (4 December 2018).

Archived from [the original](#) on 17 April 2019. "LICENSE / Creative Commons License / These blog pages & images are licensed under a Creative Commons Attribution-ShareAlike 4.0 International License."

Whole group discussion on the results of worksheet 1.2

- Share the results of worksheet 1.2 for all 3 websites and compare
 - the information on these sites
 - characteristics and source of the data set(s)
 - the way data is visualised
 - strong and weak points
- What would be your own way to present global temperature change?

Graphs under discussion: worksheet 1.2

- Look at the graph on the average annual global temperature from the part “When line graphs ought *not* include zero” on https://www.callingbullshit.org/tools/tools_misleading_axes.html
- Discuss how the choice of scaling on the axes influences the ‘story’ .
- What is your opinion about this way of representing the data?

Activity 1.3

National temperature change compared to global temperature change



Duration: 45 minutes

1.3 National temperature change

- Explore the website of your national meteorological institute and in a small group answer the questions on worksheet 1.3 about the data collection, data analysis and data representations of your national weather data.
- Present your summary and graphic of how your national temperature change relates to the global temperature change.

2. Background on big data

(Big) data as an SSI

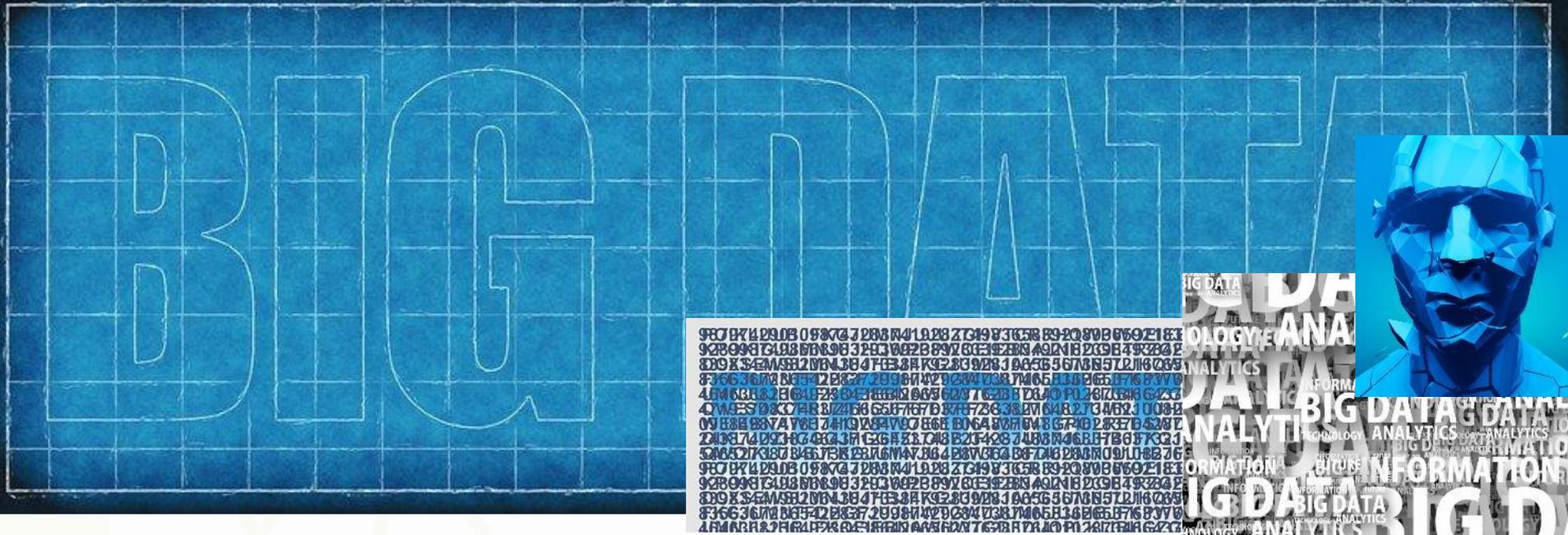
Activity 2.1

What is big data?



Duration: 30-45 minutes

2.1 What is big data? Write one or two words



Source: pixabay

2.1 What is Big data?

Explore one of these sources to find characteristics, definitions and examples (applications) of Big Data.

- TED talk: Kenneth Cukier (2014)
 - https://www.ted.com/talks/kenneth_cukier_big_data_is_better_data?referrer=playlist-talks_for_when_you_realize_you#t-936693
- Wikipedia on Big data
 - https://en.wikipedia.org/wiki/Big_data

2.1 What is big data?

- What did you learn from the sources?
- Do you experience Big Data in your own life? How?
- How is big data being analysed? What is different from analysing 'small' data?

Activity 2.2

Big data as an SSI: dilemmas and other issues



Duration: 30-45 minutes

2.2. Introduction

Statement

Big data analytics and artificial intelligence (AI) increasingly replace human decision making.

- Do you agree? If so, can you give examples?
- If this is/becomes true: what issues may arise?
- How is big data involved in this? What is the role of algorithms? What is meant by 'algorithmic ethics' ?

2.2 explore examples (in 4 small groups)

In a small group study one of the examples of issues and dilemma's regarding the use of big data and algorithms. Use the worksheet(s).

A: Big data and algorithms in the Smart city (worksheet 2.2A)

B: Sampling bias: data gaps (worksheet 2.2B)

C: Algorithmic bias: Feedback loops (worksheet 2.2C)

D: Information bias (worksheet 2.2D)

2.2 Reflection (whole group)

- Each group: What did you learn?

Further discussion:

- How can we address big data as an SSI in (statistics) education?
- What can you do as a teacher?

3. Analyzing and representing (big) data

The ecological footprint

Activity 3.2

SSI and data: (global) ecological footprint

					+		Duration: 20 + 30 minutes
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3.2A Ecological footprint

*The ecological footprint is a metric that compares the ecological resource demand of individuals, governments, and businesses against Earth's capacity for biological regeneration. Humans use as much **ecological resources*** as if we lived on 1.6 Earths.*

*) can you name some examples?

3.2A How big is your ecological footprint?

How fair do you think is your personal (ecological) consumption compared with other people all around the world?

- Take position on the imaginary line: fair – neutral – unfair.
- What knowledge and feelings have you used to decide on your position?
- What data would you need to be better able to determine your own position?

3.2A Your ecological footprint calculated (worksheet 3.2A)

Go to the footprint calculator at
<https://www.footprintcalculator.org/>

- Individually ‘calculate’ your ecological footprint (make notes of the data you enter)
- In pairs: compare and discuss your personal footprints. What may have caused different outcomes?
- Whole group: estimate the average footprint of your whole group (in the ‘number of earths’)

3.2B Comparing countries by analysing graphs and data

In pairs

Go to <https://data.footprintnetwork.org> and explore the footprint of the country assigned to you and do the tasks on worksheet 3.2 part B.

3.2B Comparing countries by analysing graphs and data

Whole group discussion

- What are the similarities and differences between the trends in the countries explored by the pairs?
- How fair is the consumption of each of these countries compared to the world? And compared to your own national footprint?
- What can you tell about the data used on this website? Try to imagine the structure and size of the database underlying this website.

3.2B optional discussion on measures

what measures can be taken to reduce our footprint?

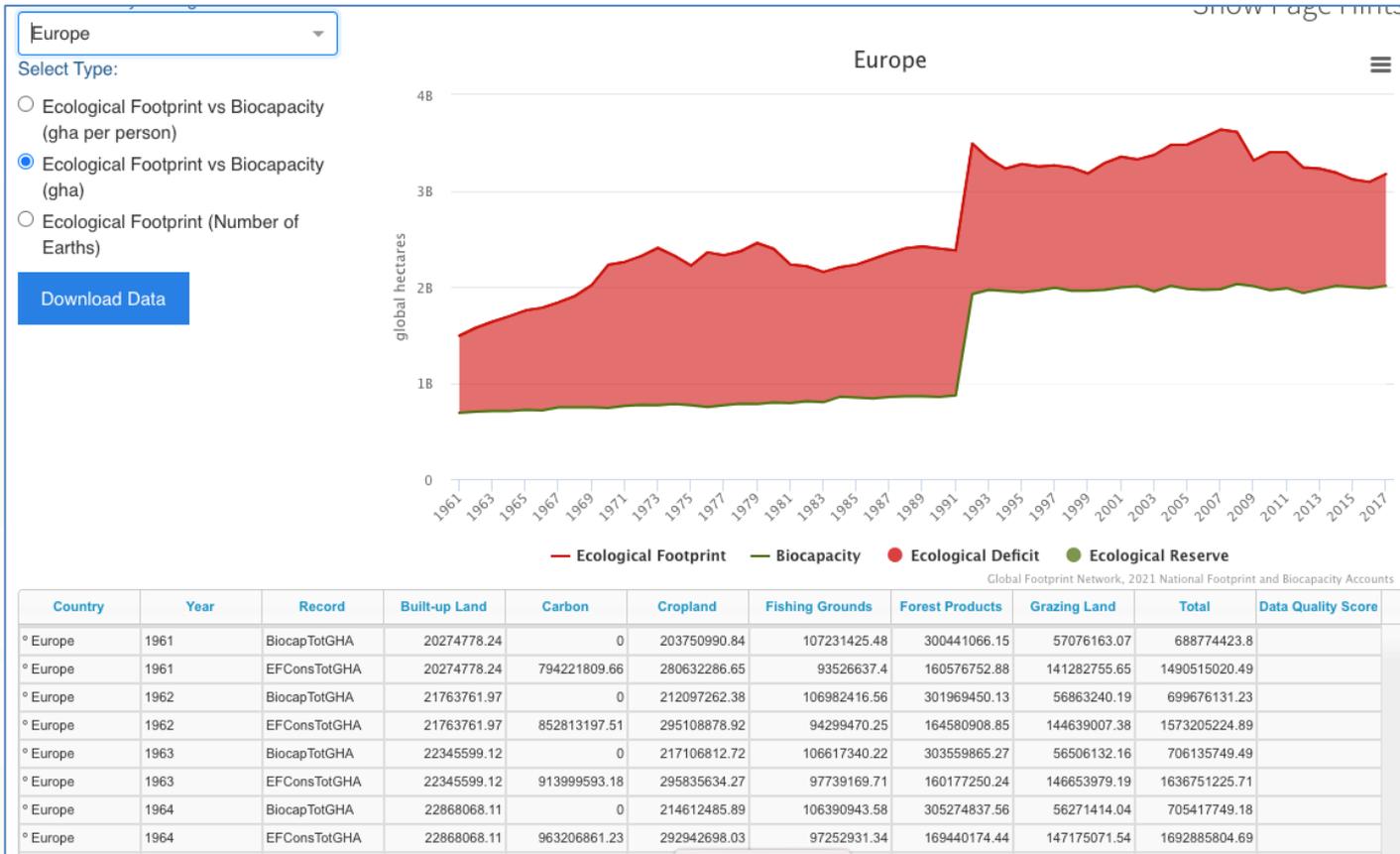
For examples see information/suggestions on the website <https://www.overshootday.org/100-days-of-possibility/> or use other (national or local) sources.

Activity 3.3

Analysing a large data set



Duration: **30 minutes**



Here you see part of the website of the [footprintnet work](https://www.footprintnetwork.org/) with data from Europe.

Data from the world have been made available for you in an excel file.

Global Footprint Network National Footprint and Biocapacity Accounts, 2021 Edition Downloaded 20210902]from <https://data.footprintnetwork.org/>.

3.3 Exploring and analysing footprint data (worksheet 3.3)

- Download the excel file with footprint data

1	country	year	country_code	record	crop_land	grazing_land	forest_land	fishing_ground	built_up_land	carbon	total	QScore
2	Armenia	1992		1 AreaPerCap	0,140292375	0,199546297	0,097188051	0,036888471	0,029319945	0	0,50323514	3A
3	Armenia	1992		1 AreaTotHA	483000	687000	334600	127000	100943,0008	0	1732543,001	3A
4	Armenia	1992		1 BiocapPerCap	0,159804414	0,135261012	0,084003213	0,013742132	0,033397799	0	0,426208571	3A
5	Armenia	1992		1 BiocapTotGHA	550176,2427	465677,9722	289207,1078	47311,55172	114982,2793	0	1467355,154	3A
6	Armenia	1992		1 EFConsPerCap	0,387510218	0,189462185	1,26E-06	0,004164833	0,033397799	1,114092872	1,728629163	3A
7	Armenia	1992		1 EFConsTotGHA	1334124,075	652282,3147	4,328086713	14338,72898	114982,2793	3835610,145	5951341,871	3A
8	Armenia	1992		1 EFProdPerCap	0,159804414	0,135261012	0	0,001265868	0,033397799	1,074630813	1,404359906	3A
9	Armenia	1992		1 EFProdTotGHA	550176,2427	465677,9722	0	4358,142036	114982,2793	3699749,773	4834944,41	3A
10	Armenia	1993		1 AreaPerCap	0,146590939	0,204573156	0,099432069	0,037762777	0,029319882	0	0,517678822	3A
11	Armenia	1993		1 AreaTotHA	493000	688000	334400	127000	98605,69763	0	1741005,698	3A
12	Armenia	1993		1 BiocapPerCap	0,159190047	0,138571059	0,095021576	0,014069106	0,031630639	0	0,428488574	3A

- Explore the data-file using the questions on the worksheet and the codebook (see next slide)

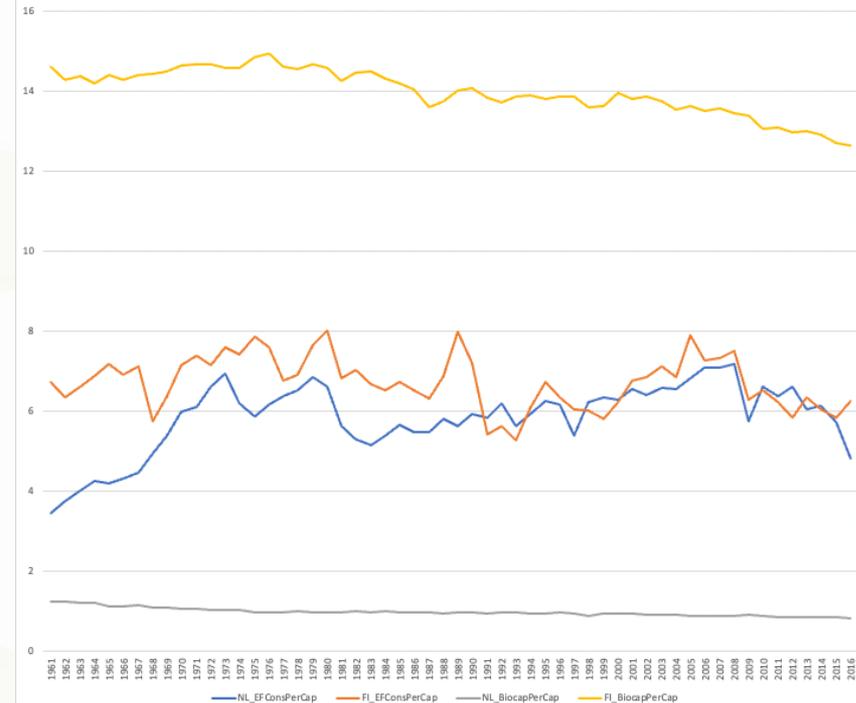
Questions to explore the excel file

- How many rows? How many columns? How many cells? What types of data?
- Why are some numbers big and others small (even in the same column)?
- What is meant by the headings of columns? What special columns are there? What is in them?
- How is the data organised in the table?

HINT: use the codebook to further explore and understand

3.3 Selecting and graphing the data

- Use the worksheet and the Excel file to make a combined line graph for 2 countries
- Compare the results in the whole group and discuss your ways of working.



4. Teaching

Activity 4.1

Analysing and reviewing a lesson



Duration: 15 + 30 minutes

4.1 Reviewing a lesson

- Select one of the 2 lessons
- Individually: do the tasks
- In pairs: share your work and discuss it (see worksheet 4.1)
 - Your opinion about the topic and the tasks
 - How this lesson fits the topics and goals of the secondary school curriculum
 - Improvements you would make
 - What you need to teach this lesson

Global warming
You may have heard people say that the world temperatures are rising. Ice on the north and south poles is melting and summers seem to be warmer. **What is the evidence for global warming?**



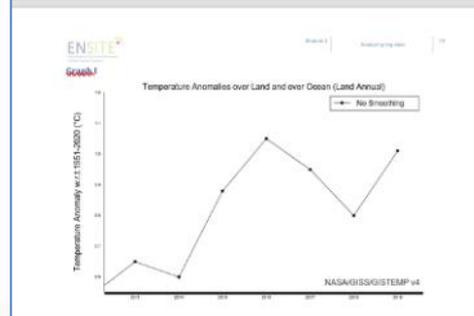
Source: <http://www.flickr.com/photos/14810000@N00/10000000000/>

1. "What do you think is global warming happening?"
 - a. Do you notice signs of global warming in your own environment?
 - b. Do you hear of global warming at school, at home in the news or other media?
What is the evidence?
 - c. What sources would you need to be sure global warming is happening?

Worldwide **scientists** like NASA collect data on temperature. They observe **temperature anomalies** in the data. This means that they look for **differences** between the measured temperature and the **average** temperature over a long time.

2. On the next page you see two graphs of 'temperature anomalies'. Study these graphs carefully. For each graph write if it supports the statement: 'global warming is happening'. Also explain how the graph does or does not support this statement.
Graph I supports/does not support this statement because, _____
Graph II supports/does not support this statement because, _____
3. Compare your answers in class. What conclusions can you derive from the graphs?

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The ecological footprint
The ecological footprint is a measure to compare how much ecological resources are used by individuals, groups and countries against the earth's capacity for biological regeneration. Humans now worldwide use as much ecological resources as if we lived on 1.6 Earths. This means **his resources** are quickly diminishing. There are large differences between countries in the size of their ecological footprint and in how this develops over time.

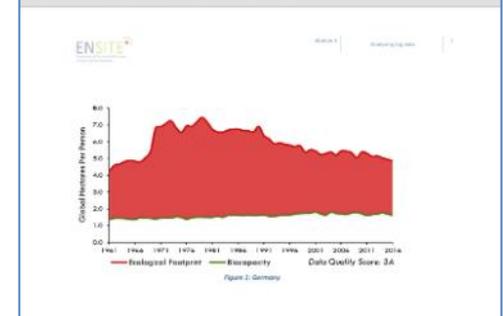
On the next page you see the graphs of two countries showing the trend of ecological footprint and biocapacity from 1961 to 2016. Using the information on the graphs answer the following questions:

1. What are the trends in each of the countries (Germany and Pakistan) in terms of the ecological footprint? Please explain briefly.
2. What are the trends of these countries in terms of biocapacity? Please explain briefly.
3. What are the similarities and differences between the trends of these countries?

Worldwide there are 4.7 biologically productive acres available per person, and this doesn't include all of the other **plants** and animals' needs.

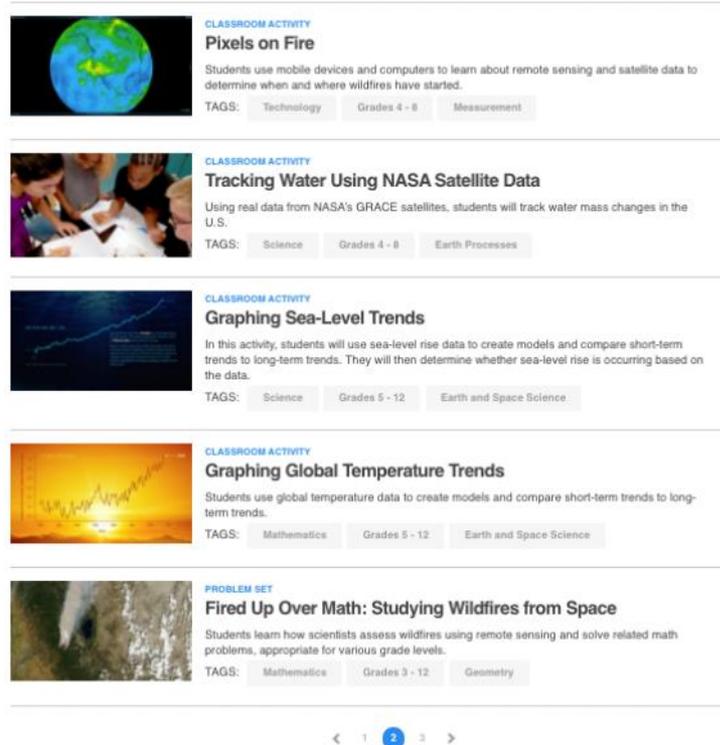
4. Based on this information and the graphs, how fair is the consumption of given countries comparing with the world?

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4.1 Optional follow-up activity

- On the internet (for example on websites of NASA, EU and other sites) you can find data and educational materials on environmental SSI.
- Choose teaching materials that fit your pupils and review these, using worksheet 4.1.



CLASSROOM ACTIVITY
Pixels on Fire
Students use mobile devices and computers to learn about remote sensing and satellite data to determine when and where wildfires have started.
TAGS: Technology Grades 4 - 8 Measurement

CLASSROOM ACTIVITY
Tracking Water Using NASA Satellite Data
Using real data from NASA's GRACE satellites, students will track water mass changes in the U.S.
TAGS: Science Grades 4 - 8 Earth Processes

CLASSROOM ACTIVITY
Graphing Sea-Level Trends
In this activity, students will use sea-level rise data to create models and compare short-term trends to long-term trends. They will then determine whether sea-level rise is occurring based on the data.
TAGS: Science Grades 5 - 12 Earth and Space Science

CLASSROOM ACTIVITY
Graphing Global Temperature Trends
Students use global temperature data to create models and compare short-term trends to long-term trends.
TAGS: Mathematics Grades 5 - 12 Earth and Space Science

PROBLEM SET
Fired Up Over Math: Studying Wildfires from Space
Students learn how scientists assess wildfires using remote sensing and solve related math problems, appropriate for various grade levels.
TAGS: Mathematics Grades 3 - 12 Geometry

< 1 2 3 >

<https://www.jpl.nasa.gov/edu/teach/tag/search/Climate+Change>

Activity 4.2

optional

(Re)designing a lesson or a data talk activity



or



45 minutes

4.2 (re)designing a lesson or an data talk activity including an environmental SSI

Data talks are short 5-10 minute classroom discussions to help students develop data literacy.

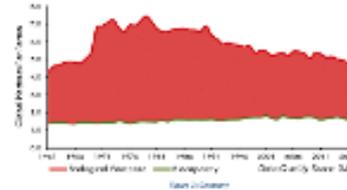
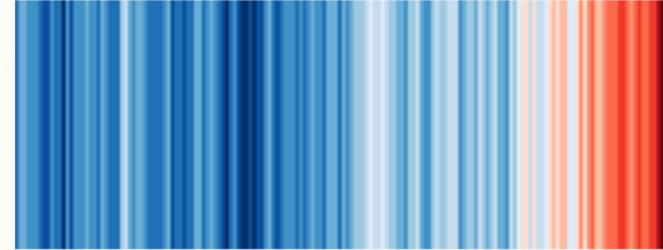
<https://www.youcubed.org/resource/data-talks/>

Find a graphic and ask:

- What do you notice?
- What do you wonder?
- What is going on in this data visualization?

Data talk

- What do you notice?
- What do you wonder?
- What is going on in this data visualization?



4.2 Requirements, your design should include:

- A lesson plan
- A teachers guide: including some background on teaching goals, pre-requisite knowledge, content/context (environmental SSI), relations to the curriculum, pedagogical approach....
- The teaching materials for the students/pupils.