

# Environmental Sustainability



<https://www.youtube.com/watch?v=7phg7QVT3R0>

# What is Sustainability ?

“Able to be maintained at a certain rate or level”

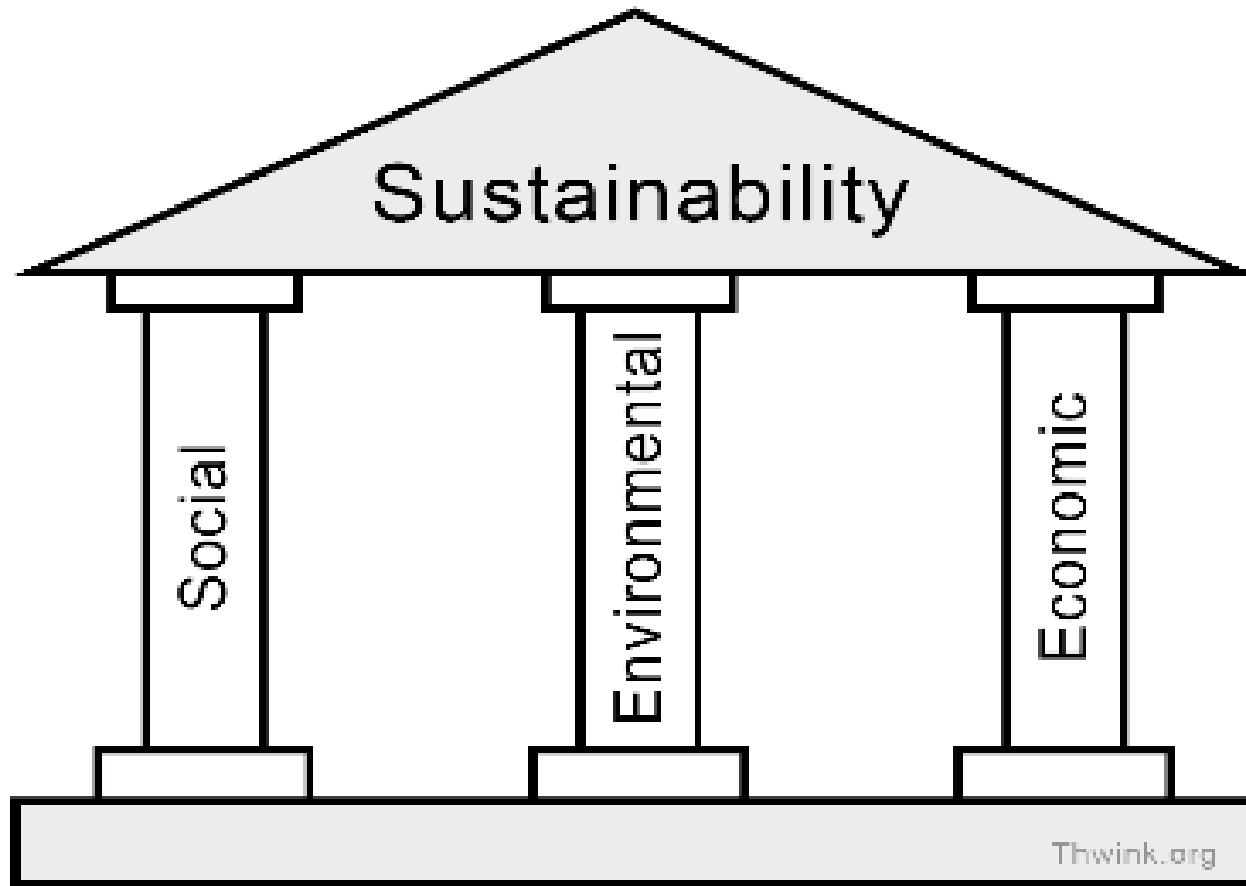
<https://www.youtube.com/watch?v=7phg7QVT3R0>

Sus·tain·a·ble *adj.*

- 1.** Able to be sustained.
- 2.** Able to be continued with minimal long-term effect on the environment

How can we make our industry sustainable ?

# Three Pillar of the Sustainability

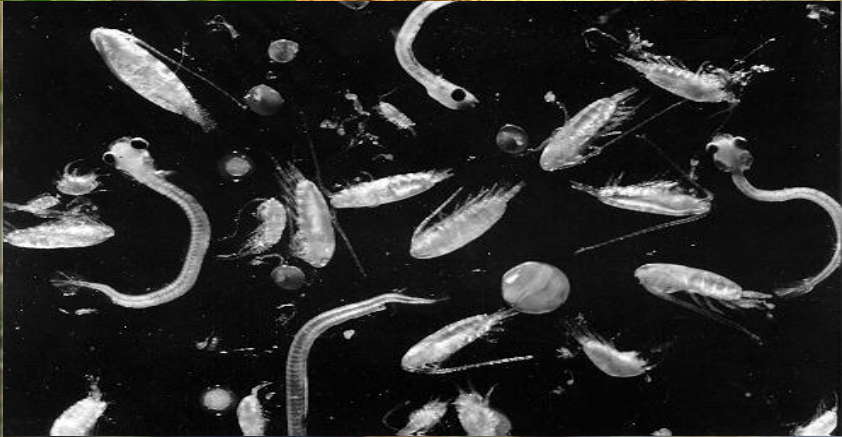


<https://www.youtube.com/watch?v=5yhnETtF64I>

# Drivers



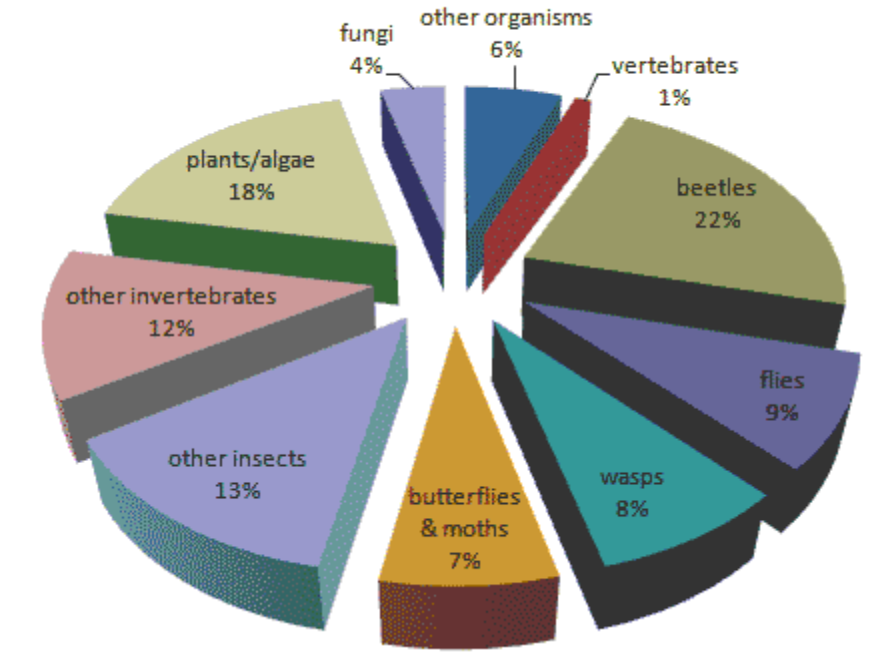
There are over 5 million different kinds of organism



Thousands more are discovered every year.

# Named Species

## RELATIVE NUMBERS OF NAMED SPECIES



This image does not contain microorganisms of which there are 6400 known species

# What is **Biodiversity**



There are two components to measuring **biodiversity**:

- Species richness (number of different species)
- Species abundance (the proportion each species represents in the community)

There are a number of different species diversity indices available which are based on both components.



# Loss of **Biodiversity**



Why biodiversity matters:

- Ethical reasons
- Loss of natural resources, e.g. plant species used for medicinal purposes.
- **Loss of genetic diversity** of a species and therefore valuable genetic potential
- Loss of natural processes provided by ecosystems which help to maintain the environment (e.g natural purification of water and air).



# Loss of Genetic Diversity

This results in a species being less able to adapt to a new environmental situation which may in turn result in extinction.

Some populations close to extinction are able to bounce back but others do not.

# Endangered

**A species is designated as endangered when its populations are very small'** Campbell *et al.* 2009.

- An **extinction vortex** leads small populations into an ever-decreasing spiral of species reduction.
- One of the key factors affecting this vortex is the loss of genetic diversity.

# Human Intervention

Sometimes we can help an organism recover, e.g. *Oryx leucoryx* and Giant pandas



# Extinct

Other species are not so lucky.



Caspian Tiger



Dodo

# What affects Biodiversity

Natural events (e.g. volcanoes, meteorites, weather events, changes in environmental conditions)

Human intervention – these include three factors

1. Inputs
  - e.g solid and liquid wastes
2. Outputs
  - e.g resource depletion
3. Management
  - e.g how can we manage the wild?



# Overpopulation

- From 1650, the human population grew faster
- 1960's growth began to slow.
- Within the last 40 years, the rate has fallen by 10%

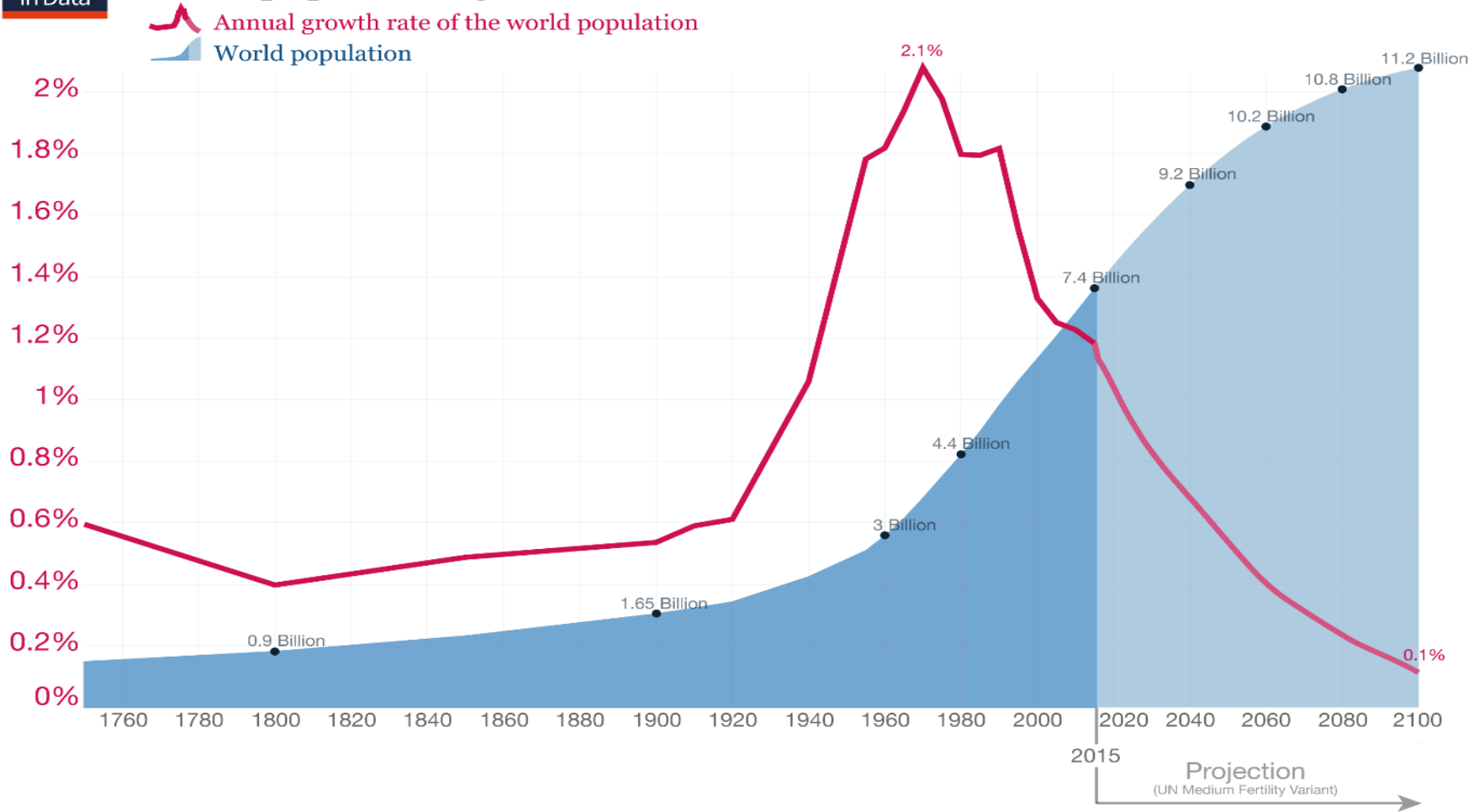
The projected global population for 2050 is between 7.8 - 10.8 billion people.



# Overpopulation

Our World  
in Data

## World population growth, 1750-2100



Data sources: Up to 2015 OurWorldInData series based on UN and HYDE. Projections for 2015 to 2100: UN Population Division (2015) – Medium Variant. The data visualization is taken from [OurWorldInData.org](https://ourworldindata.org). There you find the raw data and more visualizations on this topic.

# World's Carrying Capacity

The global carrying capacity is extremely difficult to estimate with figures varying from 1 -10 billion.

The ecological footprint concept (**EF**).

**<http://www.footprintcalculator.org/food1>**

**EF = the aggregate land and water use per person to produce all the resources it consumes and absorb all waste generated.**



# Ecological Footprint

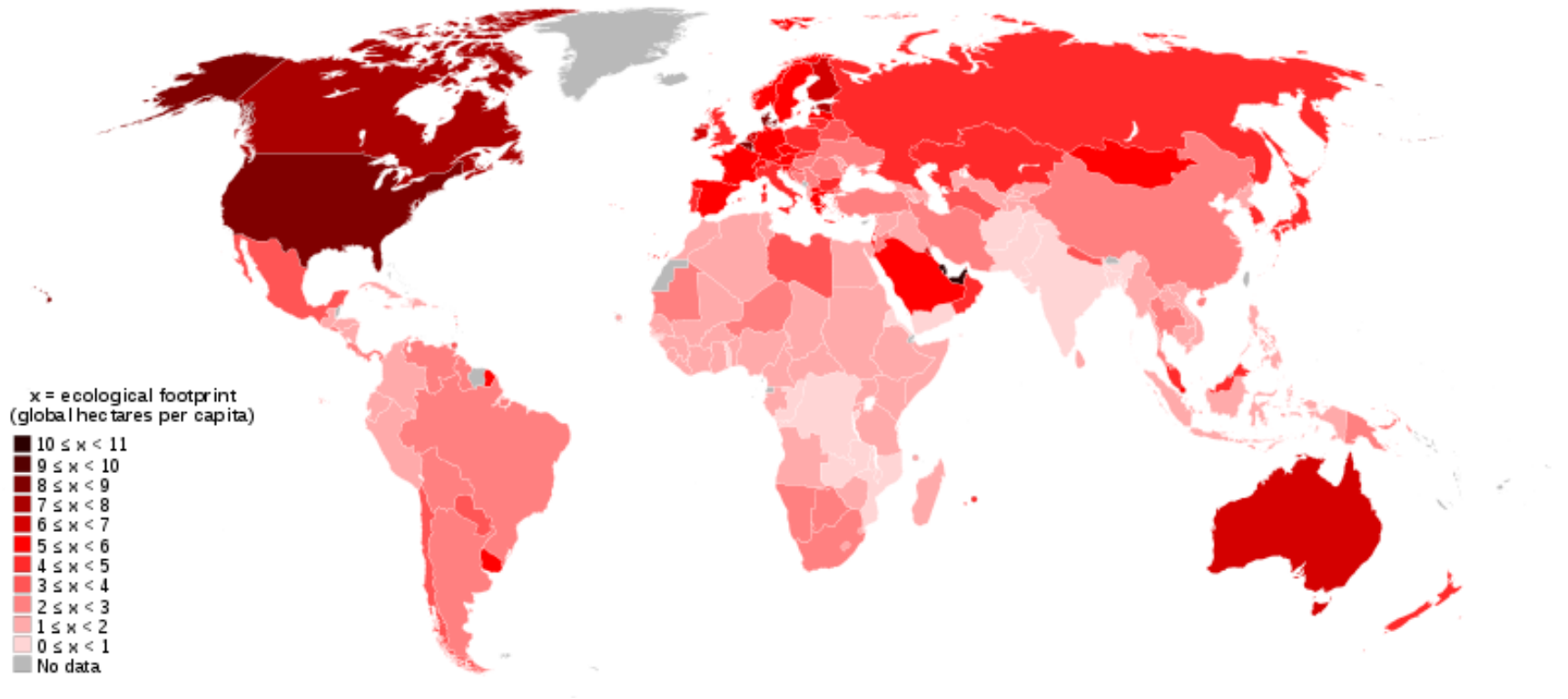
EF can be estimated using the following equation:

**EF = Global area of ecologically productive land (ha)/total number of population.**

Original estimates of 2 ha per person were then reduced to 1.7 ha per person to allow for unproductive land - (e.g. parks).



# World Map of EF

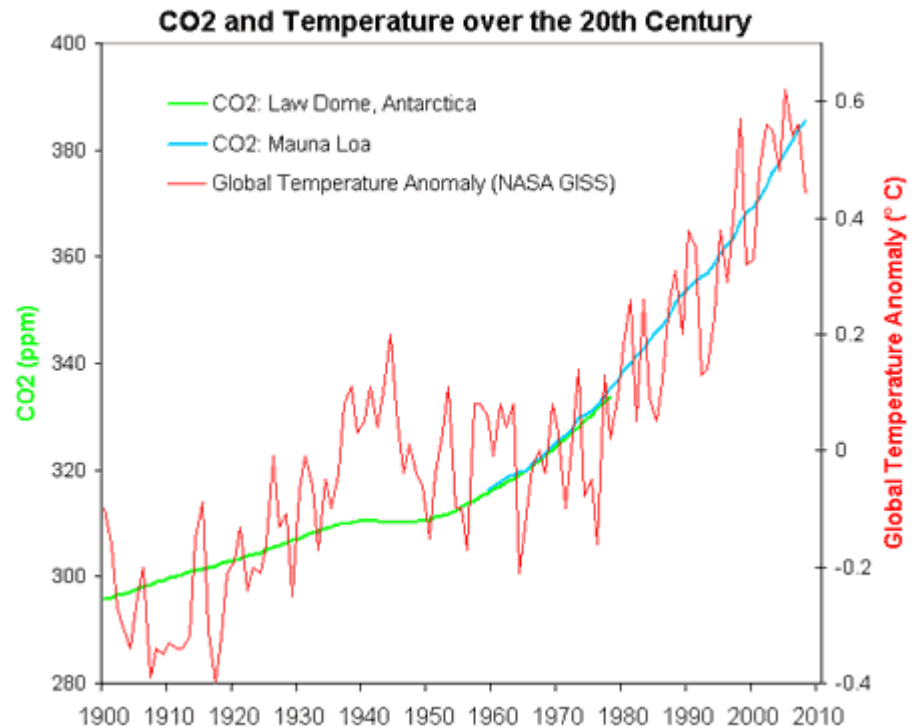


**World Ecological Footprint in global  
hectares per capita**

# Rising Atmospheric CO<sub>2</sub> Levels

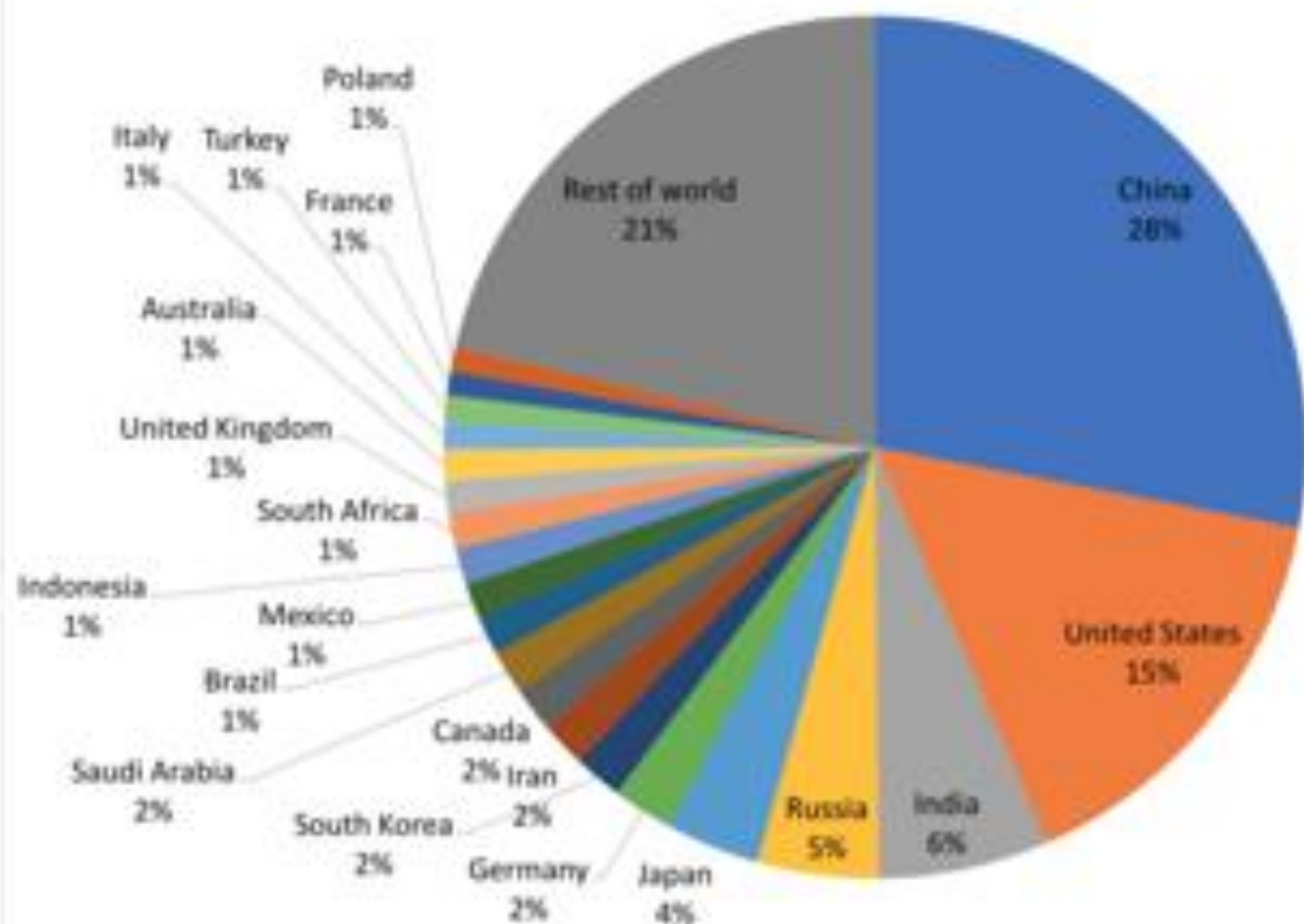
Between 1974 - 2007, Earth's atmospheric [CO<sub>2</sub>] increased from approx. 330ppm to 385ppm.

Predict [CO<sub>2</sub>] in 2100



What factors may affect the actual [CO<sub>2</sub>] in 2100?

## Share of global carbon dioxide emissions from fuel combustion (2015)



<b>2015 total emissions country rank</b>	<b>Country</b>	<b>2015 total carbon dioxide emissions from fuel combustion (million metric tons)</b>	<b>2015 per capita carbon dioxide emissions from fuel combustion (metric tons)</b>
1	China	9040.74	6.59
2	United States	4997.50	15.53
3	India	2066.01	1.58
4	Russia	1468.99	10.19
5	Japan	1141.58	8.99
6	Germany	729.77	8.93
7	South Korea	585.99	11.58
8	Iran	552.40	6.98
9	Canada	549.23	15.32
10	Saudi Arabia	531.46	16.85
11	Brazil	450.79	2.17
12	Mexico	442.31	3.66
13	Indonesia	441.91	1.72

<https://www.youtube.com/watch?v=-UIwclvoPLk>

# Engineering Industry

How does this industry affect our environment and what can we do to protect it ?



# Engineering Influences 3 Main Areas

Air



Soil



Water



# AIR POLLUTION





# 2 Videos on Air Pollution

- China's toxic smog:

<https://youtu.be/2nFZaSbkf0U>

- Smoggy conditions persist over Korea:

<https://youtu.be/2L65WMaJvSY>



# Soil

One of life's essential substrates

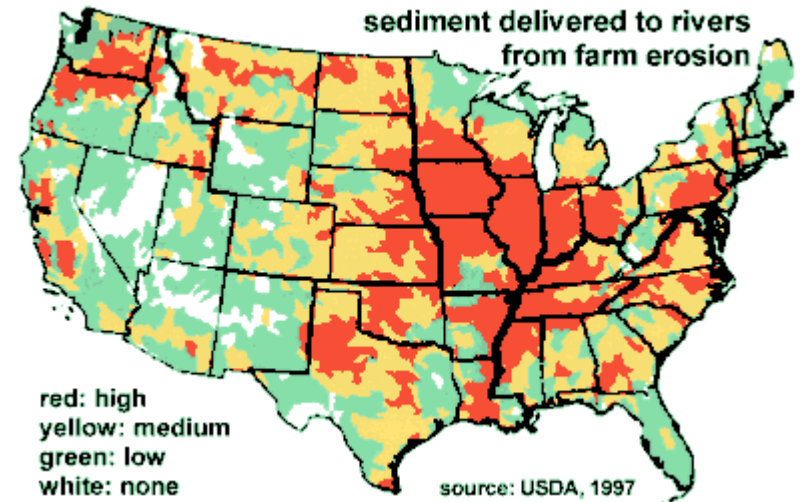
Described as “The factory of life.”

~ 90% of the World's food comes from land-based agricultural systems and this percentage is growing as the ocean's fish and natural ecosystems are depleted (Nebel & Wright, 2000).



# Soil Formation

Soil formation is roughly 25mm in 1000 years (or 240t/acre) and for natural ecosystems the annual production is close to 0.4 ton/acre.



USA - loss of >14 tons of topsoil per acre per year !

# Erosion and Sediment Control

Land disturbance at an Earthwork's site can increase **erosion** rate due to the loss of ground cover, which protects the soils from erosion.

Erosion is a natural process occurring over geological timescales of hundreds or thousands of years.



# Urbanisation

Urbanised areas have a significantly greater **sediment** yield than any other land use (approx. 100 t/km<sup>2</sup>/y in urban areas and 50 t/km<sup>2</sup>/y in non-urban areas)

Sediment yield for areas with 100% construction?

**16800 t/km<sup>2</sup>/y !!**



# Increased Sediment Loads

Create problems such as:

- Blocking of culverts and storm drain systems
- Loss of storage capacity in water supply reservoirs
- Requirement for water filtration
- Loss of habitat (i.e. vegetation, species).



# Sediment in Streams

Negative impacts include:

- Initial drastic reduction in the number and density of benthos
- Aquatic vegetation is often destroyed due to burial or lack of sunlight.
- Reduction in primary production by aquatic vegetation can reduce the dissolved oxygen content of the water body and hence reduce aquatic biodiversity



# Pollution of Soils

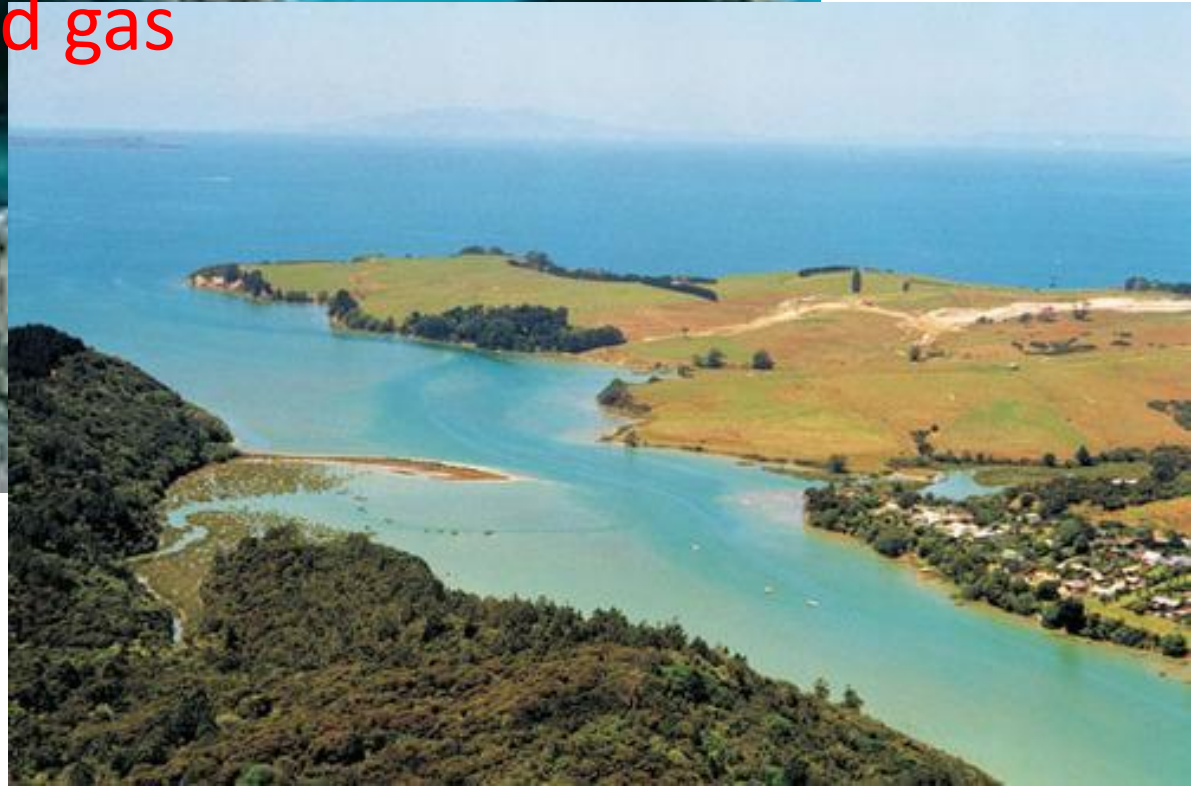
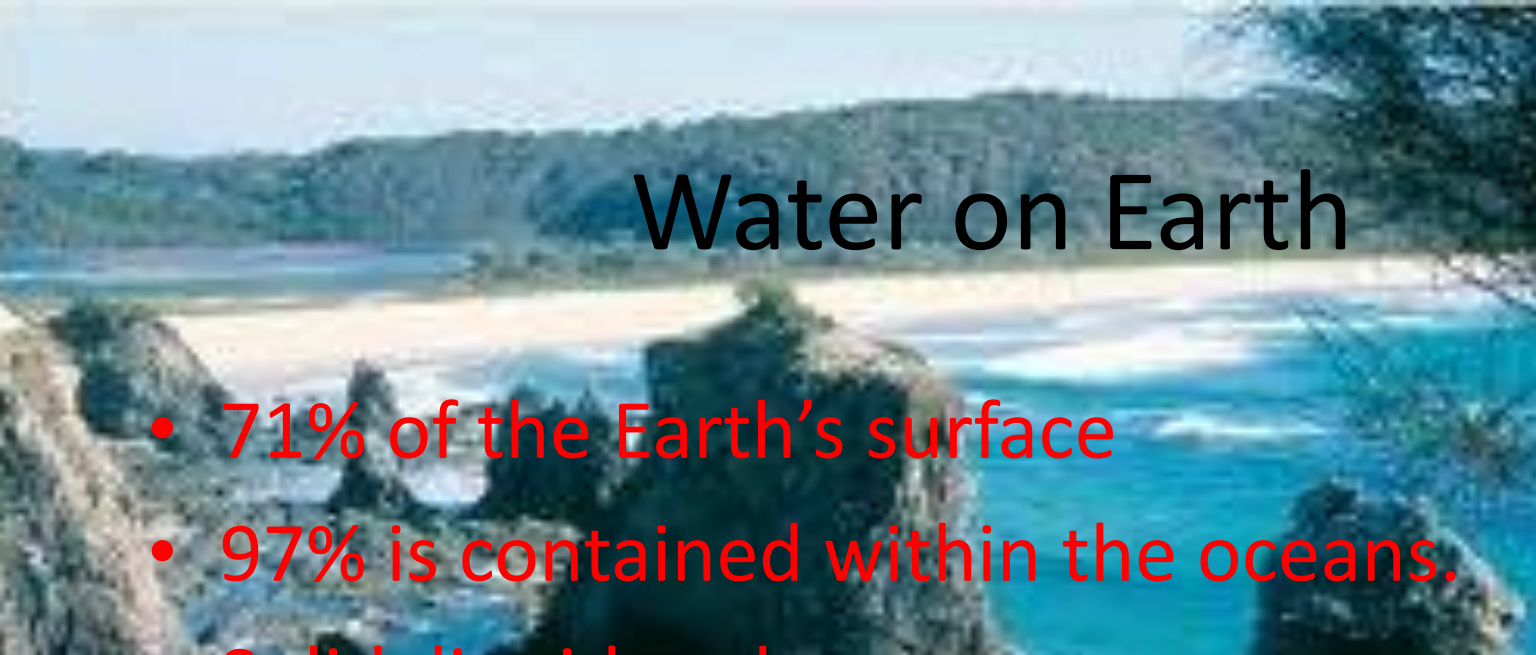
- Oil pollution in Niger Delta:

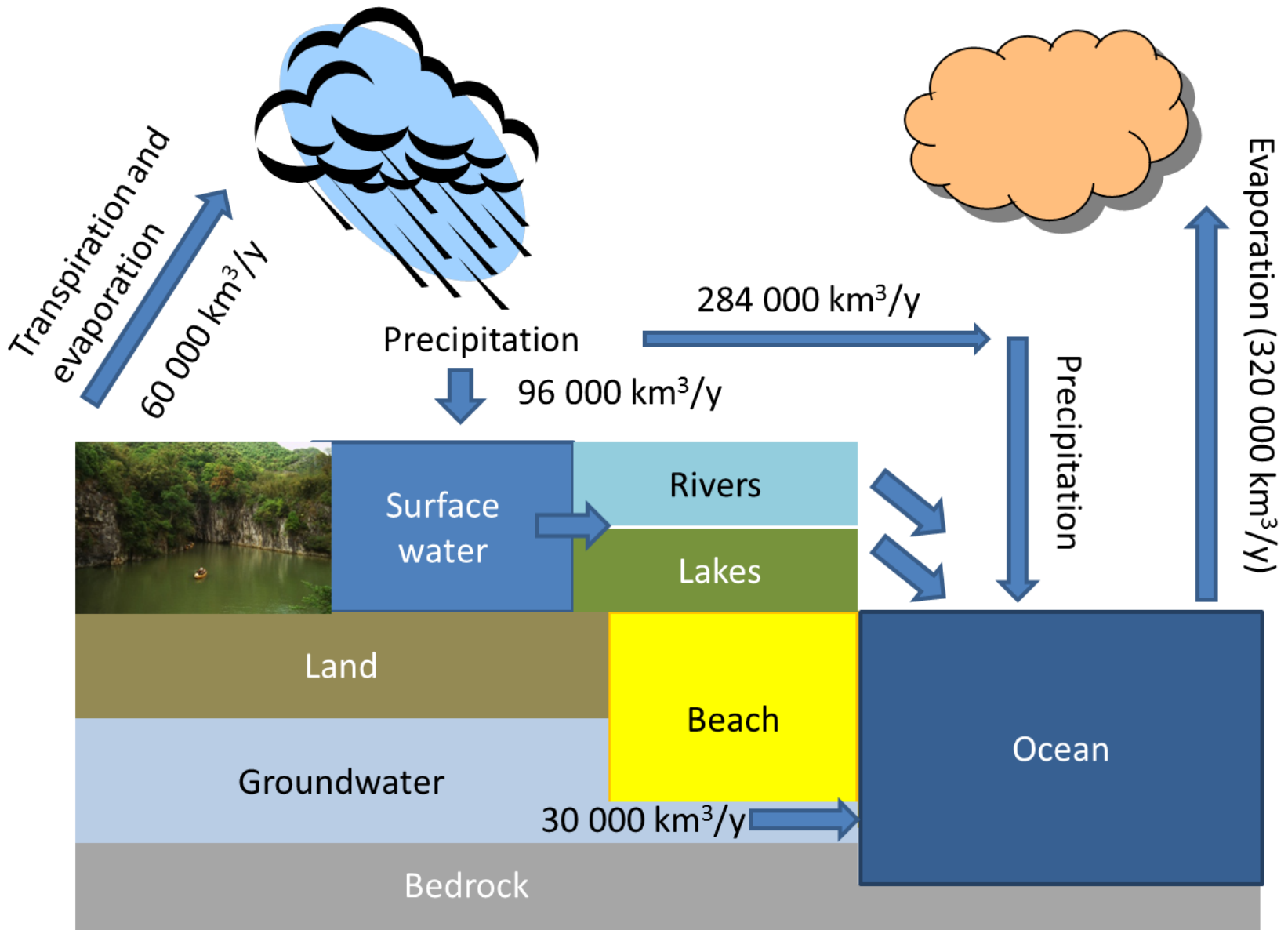
<https://www.youtube.com/watch?v=VhIW-DzaosQ&feature=youtu.be>



# Water on Earth

- 71% of the Earth's surface
- 97% is contained within the oceans.
- Solid, liquid and gas





Note: flux from continent to oceans includes groundwater, surface water, rivers and lakes.

# Groundwater Contamination

- Rural areas, groundwater is often predominant source of potable water

Sources	Contaminants
Domestic waste	Pathogens, nutrients and particulates.
Industrial waste	Inorganic and organic wastes, solid waste, heat, etc. Accidental release may include radioactive substances.
Agricultural waste	Fertilisers, pesticides, insecticides and herbicides, etc.

- Note: landfill leachate may be produced from each of the three waste sources.

# Surface Water Pollution



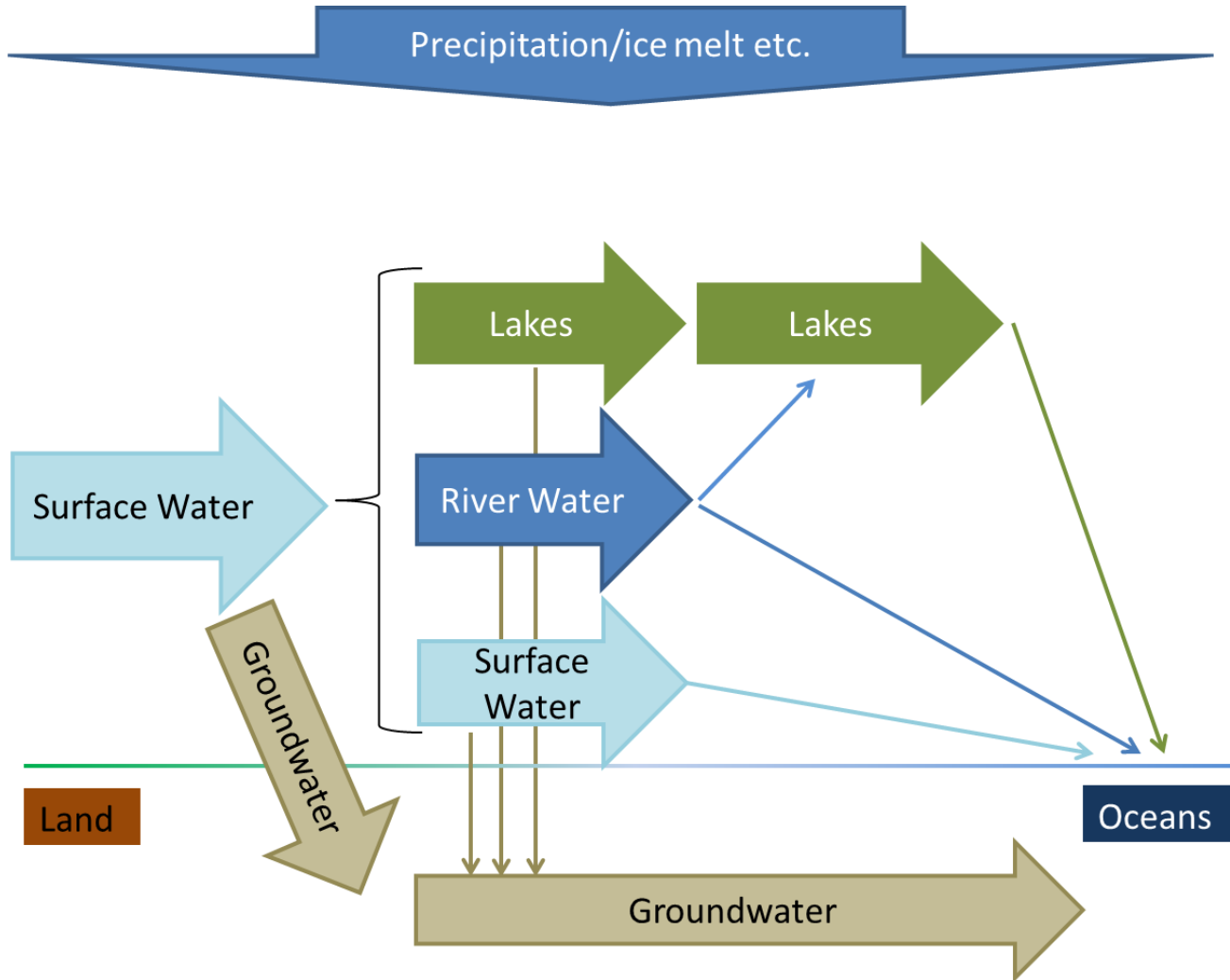


# Stormwater

When rainwater cannot find its way to the sea, rivers, streams or underground aquifers and flows over the ground and follows the path of least resistance downhill to the sea. Problems include:

- Flooding
- Introduction of chemical toxins and litter to receiving water

# All drains lead to....



A photograph showing a massive pile of marine debris, including plastic bottles, bags, and wood, with a small pool of water in the foreground. The debris is piled up along a shoreline, and the water is a deep blue. The sky is clear and blue. The text "Marine Pollution" is overlaid in white on the image.

# Marine Pollution

# Oil Pollution

Major oil spills are **just one** source of pollution to the environment

Other inputs include:

- atmospheric fall out
- municipal and industrial wastes,
- urban run-off
- coastal refineries
- tanker operations (such as tank cleaning)





# How much solid waste ?

The total annual input of marine debris into the oceans is?

≈ 6.4 million tons.

No of item of litter per day ?

≈ 8 million items

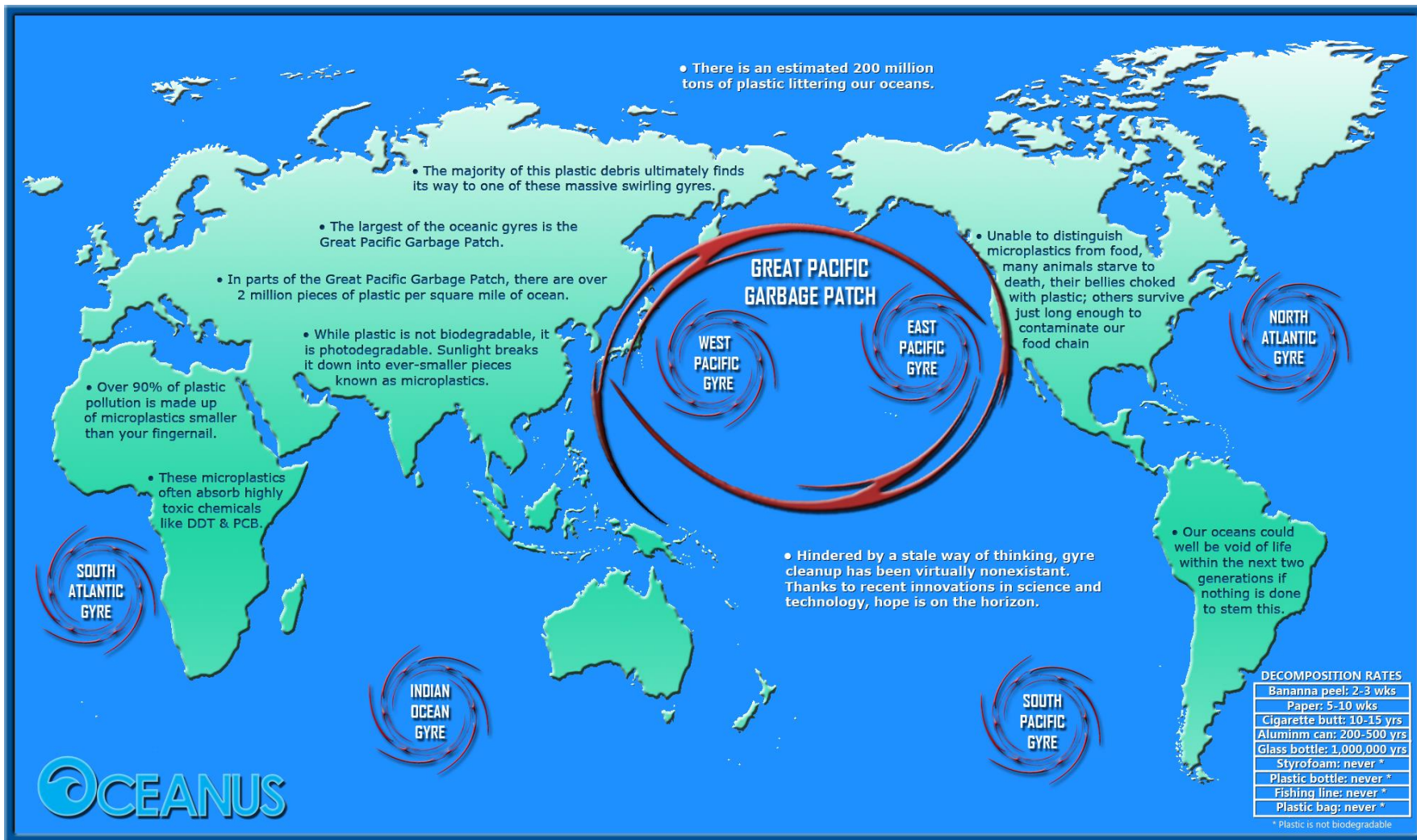


# Plastics Fate

No biodegradation

Fates for the plastics which reach the ocean include:

- Deposition on land = visible pollution or resulting in ingestion or entanglement with local wildlife.
- Photo-degradation of floating plastic to produce a "plastic soup" which increases the chances of ingestion.
- Garbage patch in the oceans
- How We Can Keep Plastics Out of Our Ocean:  
<https://youtu.be/HQTUWK7CM-Y>



# RMA

To *promote* the sustainable management of natural and physical resources.

# Waterview Connection Project

- Preservation of green spaces & vegetation;
- existing watercourse protection & enhancement; species protection;
- protection of coastal environment;
- existing human habitats, stormwater runoff quality;
- construction elements;
- others?



# Long Bay Subdivision



- Incorporating Urban Design principles; **Built with people in mind, not the other way around.**
- preservation of natural character of the overall site;
- enhancement of existing watercourses;
- coastal fringe management;
- Sustainable development




▲ Preliminary Concept Master Plan - a possible design outcome

# Eco-Bricks





Centro de orientación   
El maestro en casa

15:54 09/APR/2009





