U.S. BIOLOGY TEACHING

Save Time, Engage Students, Love Teaching

Lesson 1: introduction to ES and Sustainability

Environmental Science

Welcome-Find your seat

- On your desk you will find two index cards. Place your name (largely) on the front and back of one index card.
- On the second index card (lined side) answer the following questions:
  1. What is your favorite thing to do outside of school?
  2. What is something you consider yourself good at?
  3. What is a possible career or job you think you might pursue after high school?
  4. What grade do you hope to achieve in this course?
  5. What will one thing can you do each do to ensure you achieve the grade you want?
  6. What concerns do you have about this course?

Welcome to Environmental Science

- What does environmental science mean to you?
- What does sustainability mean to you?
- In what way do you think environmental science and sustainability are related?

- What do you think/hope to learn in this course?

What is sustainability?

Sustainability is the capacity of the Earth's natural systems to maintain stability of life (including **human social factors**) indefinitely.

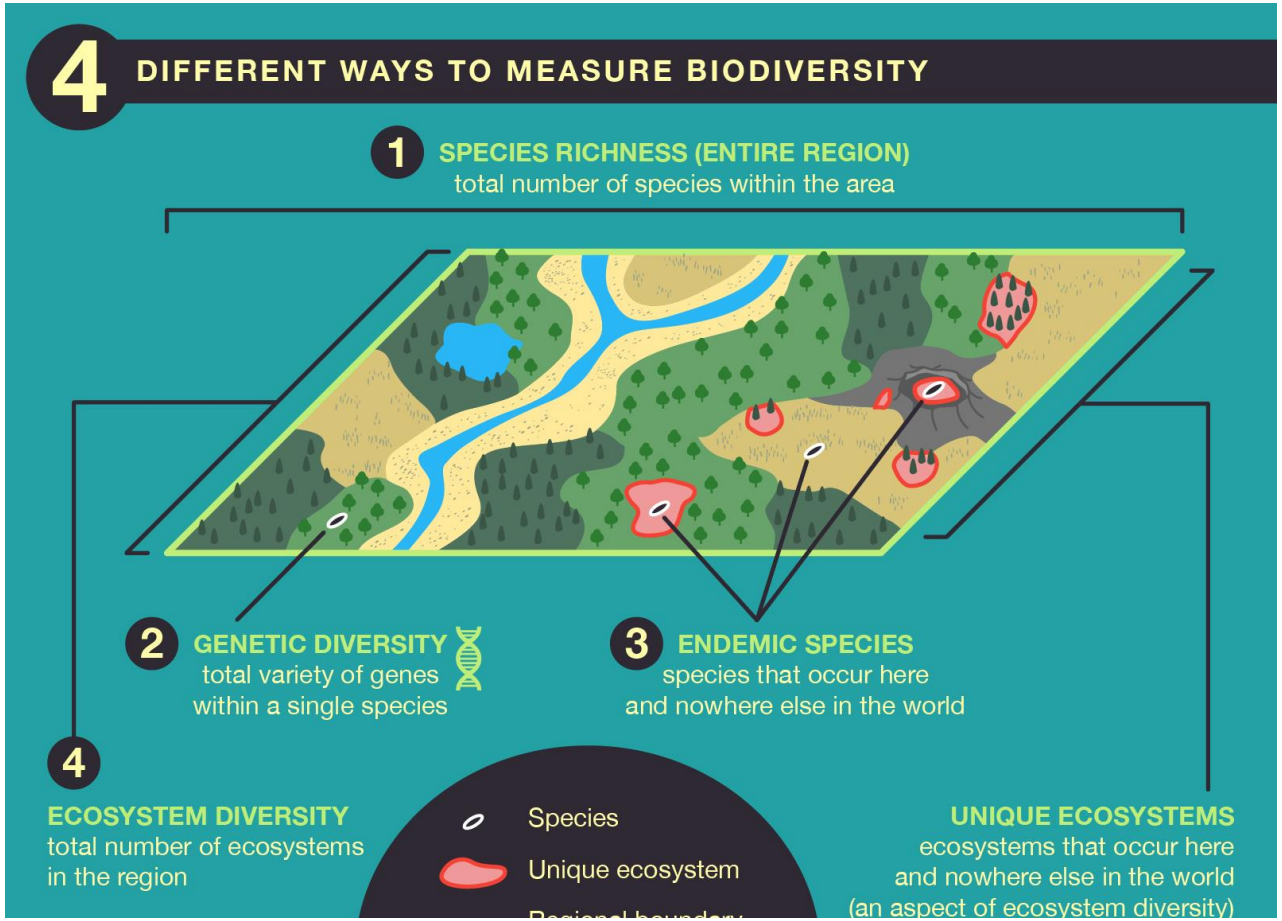
"Sustainability means meeting the needs of the present without compromising the ability of future generations to meet their needs."

- There are 3 major **scientific factors** that contribute to long term sustainability:
  - Solar Energy
  - Biodiversity
  - Nutrient Cycling

Solar Energy

- The Sun provides energy for **photosynthetic** organisms to make food which in turn provides energy for all living things.

- The Sun's energy indirectly powers:
  - Winds → wind generated electricity
  - The Water Cycle→ hydroelectric energy



- **Biodiversity** consists of the variety in forms of species, genes, ecosystems and environmental interactions.
- Biodiversity provides a way for organisms to adapt (evolve) to the ever- changing environment.

Biodiversity

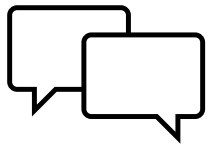
Human Social Factors of Sustainability

There are 3 Major Factors that influence our ability to become a sustainable:

- **Economic**
- **Political science**
- **Ethics**

Economics and Sustainability

Economics is a **social science** that is concerned with the production and consumption of goods and services in the creation/transfer of wealth.



Why do you think we should care about economics in environmental science class?

(discussion)

Economics and Sustainability

We should care because….

- The creation of some products can damage the environment.

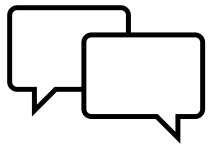
- Some economist encourage companies to include environmental costs of making their product into the market price.
  - Profit can then be used to mitigate the environmental damage.
  - This practice is call “full-cost pricing”
    - What challenge may this cause for a company?

Political Science

Political science is the study of systems of government and analysis of political behaviors.

Why do we care about political science in environmental science?

(discussion)



Political Science

We should care because political action leads to:

New **laws** that can protect the environment

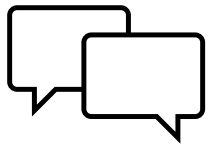
Allocation of **funding** to environmental or sustainability causes

Collaboration across the globe on environmental issues

Ethics

Ethics is a branch of philosophy and the systematic study of right and wrong actions.

- Why do we care about ethics in environmental science?



Ethics

- Right and wrong can often be difficult to determine when many perspectives are considered.
- Sometimes when making decisions about **protecting species** or the environment the livelihood of other individuals could be at stake.
  - Example: Your family owns a fishing company and you are suddenly told you cannot fish for the species that has supported your family for generations because it is now protected. How would you feel?

- **Ethicists** argue that society should leave the planet good or better condition they found it.

Sustainability and Natural Capital

Natural capital -consists of the **natural resources** and the **ecosystem services** that keep humans and other organisms alive and support human economies.

Natural Resources- are the materials and energy sources in nature that are essential or useful to humans.

- Examples: water, trees, petroleum, minerals, plants

Natural resources fall into one of three categories: inexhaustible, renewable and non-renewable.

Natural Resources

- **Inexhaustible resources-**a continuous resources that does not run out.
  - Example: The Sun (for at around another 6 billion years)→ results in wind and flowing water that can produce electricity.
- **Renewable Resource-** A resource that can be replenished by natural processes faster than it is used.
  - Can be forests, wildlife, grasslands, fertile topsoil, clean air
- **Nonrenewable Resources-** Exist in a fixed amount or it takes million or billions of years to make.
  - Example: Fossil fuels (coal, oil, natural gas), mineral resources (copper, salt)

Economic Services

Economic Services are natural services provided by the **ecosystem** that support life and human economies at no monetary cost.

Examples:

- Nutrient cycling
- Air/water purification
- Pest control
- Topsoil renewal
- Pollination

Review Questions

1. What are three scientific factors of sustainability?
2. What are three social factors of sustainability?
3. What factor(s) do you think will be most critical as we strive for a sustainable planet? Be prepared to defend your perspective.

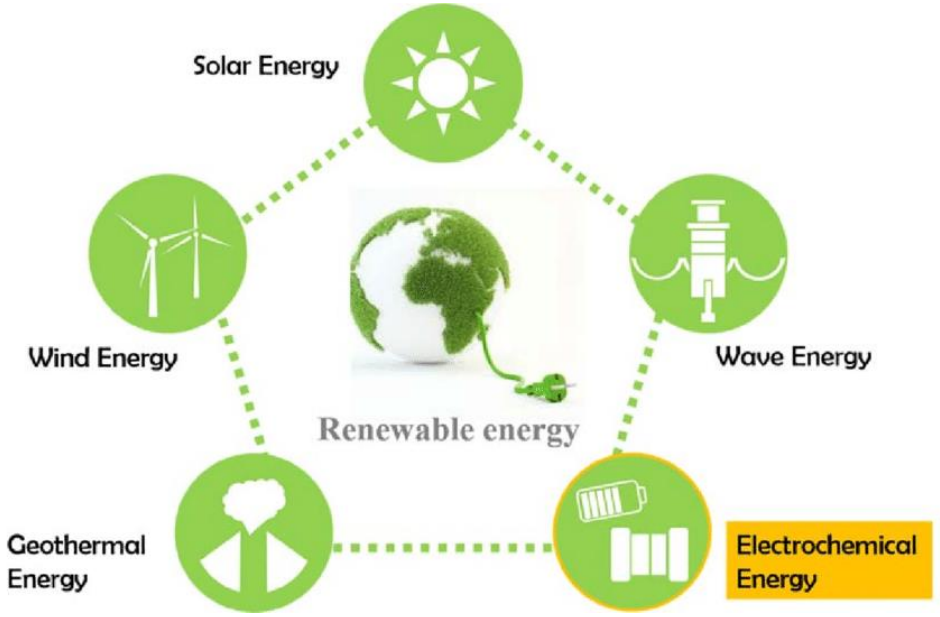
The Good News

- People can work together to make a difference
- Creative thinking, **scientific research**, political pressure by citizens and regulatory laws have improved the quality of life for many people on Earth….especially in developed countries.

More Good News

- We have learned how to harness amazing amounts of sustainable energy from the **<u>sun</u>**, **wind**, **<u>geothermal energy</u> and nuclear energy**.
- We can manipulate our environment and live in comfortable buildings.

What are some ways humans have improved their quality of life over time?



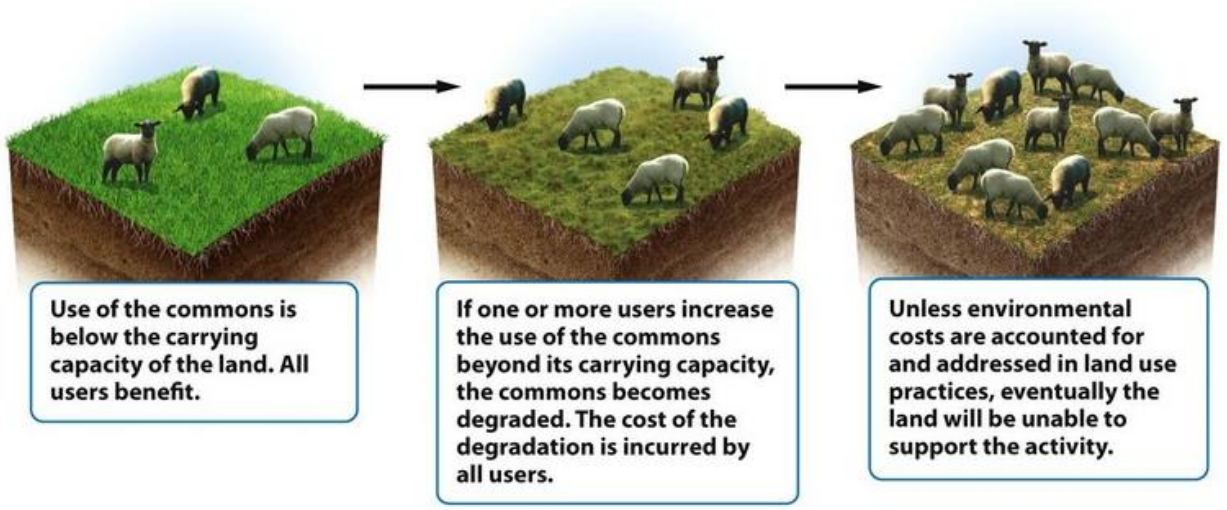
The Bad News-Unsustainable Living

- People are living unsustainably.
- People continually deplete and waste the Earth's **natural capital** this is known as **environmental degradation.**
- People do not always realize they are participants in environmental degradation, but we all are to some extent.
- Why do you think **environmental degradation** occurs? In what ways do you participate?

Why do humans behave in this manner?

- Biologist Garret Hardin (1915-2003)- the "**Tragedy of the Commons**"
- The conflict between the short-term interests of individuals and the long-term welfare of society.

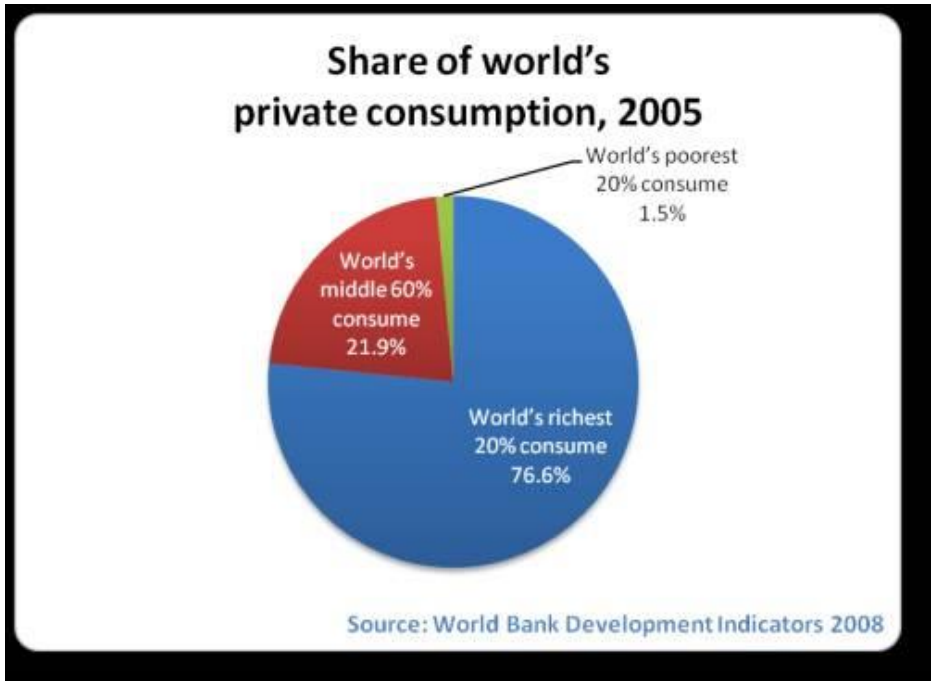
The idea that "the little bit that I use or pollute won't make a difference."



"**Commons**" is a shared resource. Global commons include oceans, air and habitable earth

What is the result of this behavior?

- 60% of the Earth's ecosystem services are being **overused** and most of the degradation has occurred since 1950.
- Since countries differ in their available resources, they also differ in how they are used.
- The **more resources** that are available to individuals or countries, the more the tend to consume.
- The less available resources, the **less** individuals or countries consume.



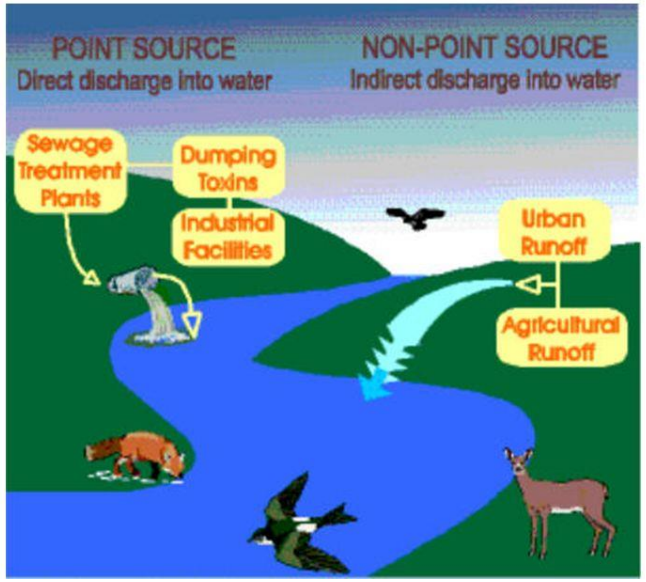
Tragedy of Commons-Pollution

- **Pollution** is the contamination of the environment by any chemical or agent, such as noise or thermal levels considered to be harmful to living organisms.

Types of Pollution

- **Point Source-** any identifiable source of pollution from which a pollutant is discharged.
  - Smokestack, chimney, oil spill
- **Non-Point Source**- consists of pollutants that come from many diffuse sources and are hard to pinpoint.
  - Run off, residential areas, construction sites, highways and etc..

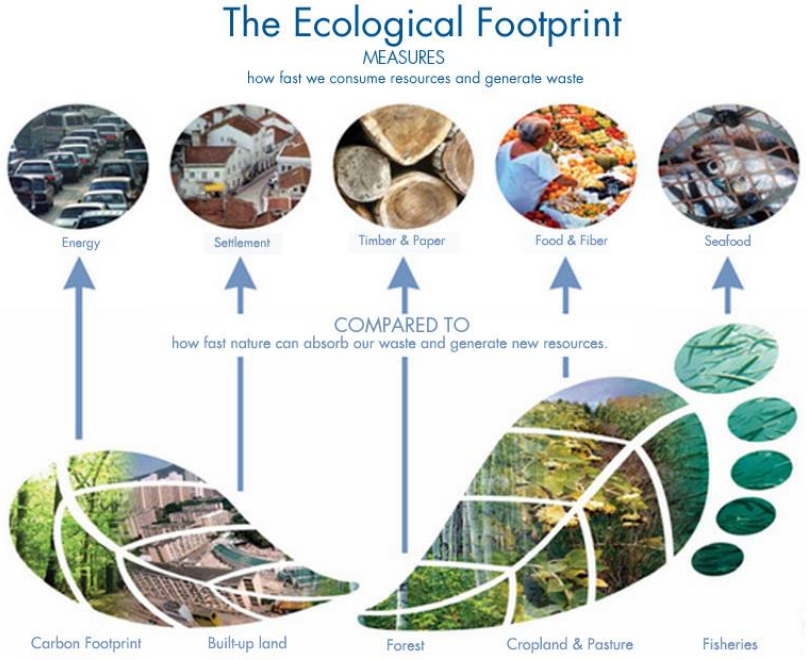
Point vs. Nonpoint Sources



How Big Is Your Ecological Footprint?

- **Ecological footprint** is the amount of land and water needed to supply an individual or population with renewable resources and to absorb and recycle the wastes and pollution produced.
- The size of the footprint is typically proportional to the amount of resources consumed.

Which countries do you think have the highest ecological footprint?



Ecological Footprints by Country/Region

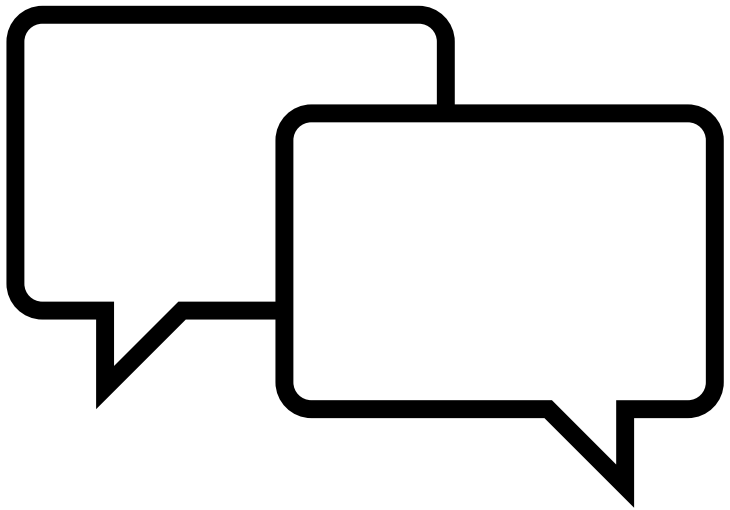
World-2.75 gha/person

Top 5 Largest Footprint (gha/person) as of 2020

1. Luxembourg-15.82
2. Aruba-11.88
3. Qatar-10.8
4. Australia-9.31
5. United States-8.22

Bottom 5 Smallest Footprints (gha/person) as of 2020

1. Eritrea-.49
2. Timor-Leste-.48
3. Haiti-.61
4. Bangladesh-.72
5. Pakistan-.79

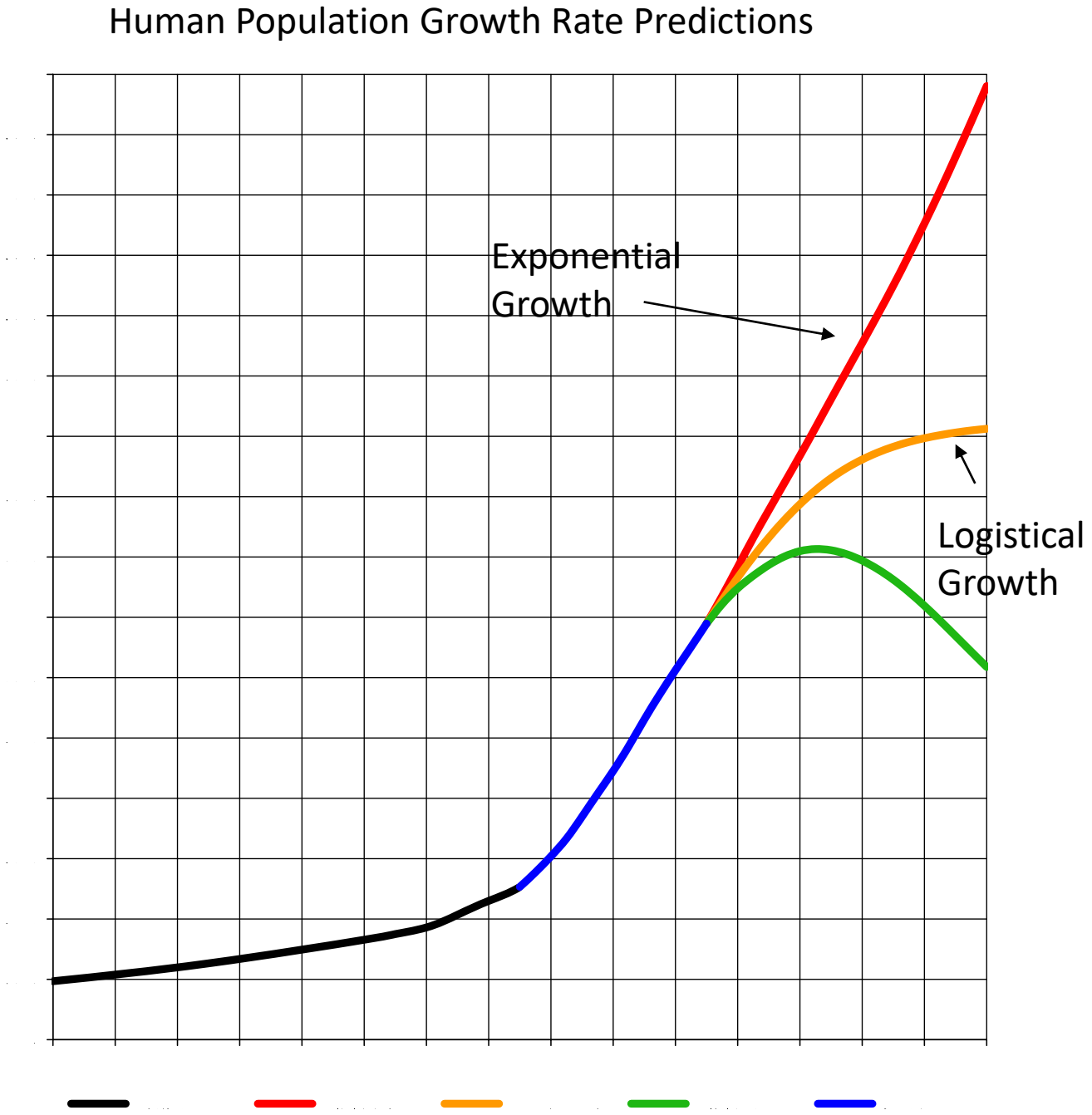


What Causes Environmental Problems and Why Do the Persist?

Human Population Growth

- Most scientists agree that major causes for environmental problems is human population growth.

- Exponential growth occurs when a quantity increases at a fixed percentage per unit of time for example the current human populations growth rate is 1.1% per year.



Affluence and Resource Use

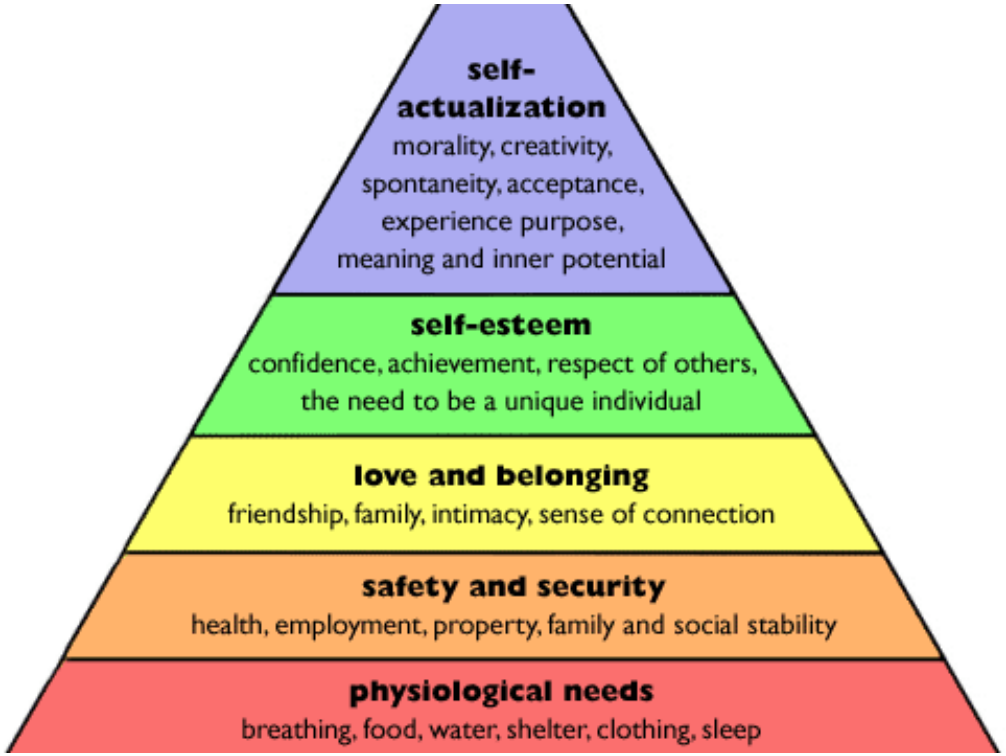
- The lifestyles of the **growing population** of consumers are built on growing affluence (wealth).
- The wealthier an individual or populations is the **more resources** they consume. This is a problem with a growing population unless individuals make the choice to live more sustainably.
- The World Wildlife Fund predicted in 2012 that if every person lived like an American that we would need **five** Earth's to sustain the consumption.
- By 2050, it is estimated we will need 3 Earth's to be sustainable.

Poverties Impact on the Environment

- **Poverty** is the condition where people do not have enough money to fulfill their basic needs for food, water, shelter, health care and education.
- 3 in 10 people on Earth live in poverty (~$3.10/day) or about 2.1 Billion people.
  - Of the 2.1 Billion- 900 million live in extreme poverty (~$1.90/day)
  - 900 million is about 3 times the US population (~330million)

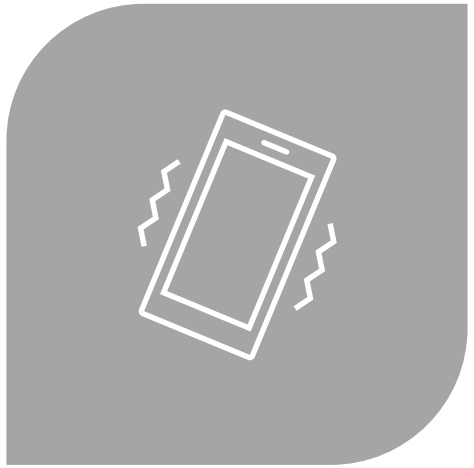
Impact of Poverty

- People living in poverty focus on getting their **daily needs** met (food, water, fuel for heating water and the shelter)
- As a result, the long-term environmental consequences are not a concern…**survival is**.
- People in these situations may be forced to degrade their resources just to survive.



People are Becoming Increasingly Isolated from Nature

MORE THAN HALF OF THE WORLD'S PEOPLE LIVE IN URBAN AREAS.



THE INCREASED USE OF ELECTRONIC DEVICES IS ISOLATING PEOPLE FROM THE NATURAL WORLD THUS THEY ARE MORE LIKELY TO NOT HAVE A PERSONAL CONNECTION TO ENVIRONMENTAL ISSUES.

People Have Different Perspectives About Environmental Issues

- People's opinions differ on the seriousness of environmental problems.
- These difference occur because people have varying environmental worldviews.
  - **Environmental worldview** is your set of assumptions and values concerning the natural world and what you think your role is in managing it.
  - **Environmental Ethics** is the study of varying beliefs about what is right and wrong with how people treat the environment.

Types of Environmental Worldviews

- **Human Centered-** sees the natural world as a support system for human life. Humans are separate from and in charge of nature and humans should mange the Earth in a way that is beneficial to humans.

- **Life Centered-** all species have value in fulfilling their role within the biosphere regardless of their use or value to society. We have a responsibility to protect species.

- **Earth Centered-** people are part of and dependent on nature. The Earth's natural capital exists for all species, not just human.

What is your worldview?

Will we become environmentally sustainable society?

What will it take?

An **environmentally sustainable society** is a society that protects its natural capital and lives off its income.

- A society that meets the needs now and for the future generations without compromising future generations ability to meet their basic needs.
- Living sustainably mean living on **natural income** which is the proportion of natural resources that can be used sustainably.