

Framework for Sustainability

ENSn4673

Brian D. Fath, Ph.D. – bfath@towson.edu

Professor, Department of Biological Sciences, Towson University, Baltimore, Maryland,
USA

Senior Research Scholar, International Institute for Applied Systems Analysis,
Laxenburg, Austria



Framework for Sustainability ENSn4673

(Autumn 2022)

- **Course Description:**
 - This investigates the concept of sustainability from first principles of energetics and ecology applied to socio-economic systems. It deals with the ecological, physical, economic, social, and moral dimensions of sustainability.
- **Grade evaluation (points available):**
 - Paper (50), Exercises (50), Discussion (50), Group discussion lead (50), Final Exam (100) = Total (400)
- **Format:**
 - Each session will begin with a ~30-minute overview and summary of the topic/reading, 20-minute exercise, and 40-minute discussion. Students are expected to come to class prepared and ready to discuss with an open and curious mind.

Schedule

Thursday 22. 9. 14:00-17:40, room M117

- Lecture 1: Introduction to sustainability and the Sustainable Development Goals.
- Lecture 2: Ways of valuing the environment. Introduction of cultural theory and ecosystem services

Thursday 6. 10. 14:00-17:40, room M117

- Lecture 3: Limits to Growth, planetary boundaries, Flourishing overview
- Lecture 4: Foundations for Sustainability (FfS) – Chapter 1 systems thinking and win-win

Thursday 20. 10. 14:00-17:40, room M117

- Lecture 5: FfS – Chapter 2 Ecologic metaphysics
- Lecture 6: FfS – Chapter 3 mutualism

Thursday 3.11. 14:00-17:40, room M117

- Lecture 7: FfS – Chapter 4 – origins of life
- Lecture 8: FfS – Chapter 5 – reforming reductionism
- **Paper topic due**

Thursday 24.11. 14:00–17:40, room U32

- Lecture 9: FfS – Chapter 6 – networks.
- Lecture 10: FfS – Chapter 7 – Rosen.

Thursday 1. 12. 14:00-17:40, room M117

- Lecture 11: FfS – Chapter 8 – applications
- Lecture 12: FfS – Chapter 9 – Sustainability for all
- **Paper due**

Introductions

Framing questions

- 1) What are the most important threats to achieving global sustainability in the 21st Century?
- 2) What may be the most practical and effective ways to mitigate these threats?

Sustainable Development

- “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”
 - *Our Common Future*/ United Nations Brundtland Report, 1987



Goal

- To develop?

Some of the most threatening environmental problems are caused by widespread poverty

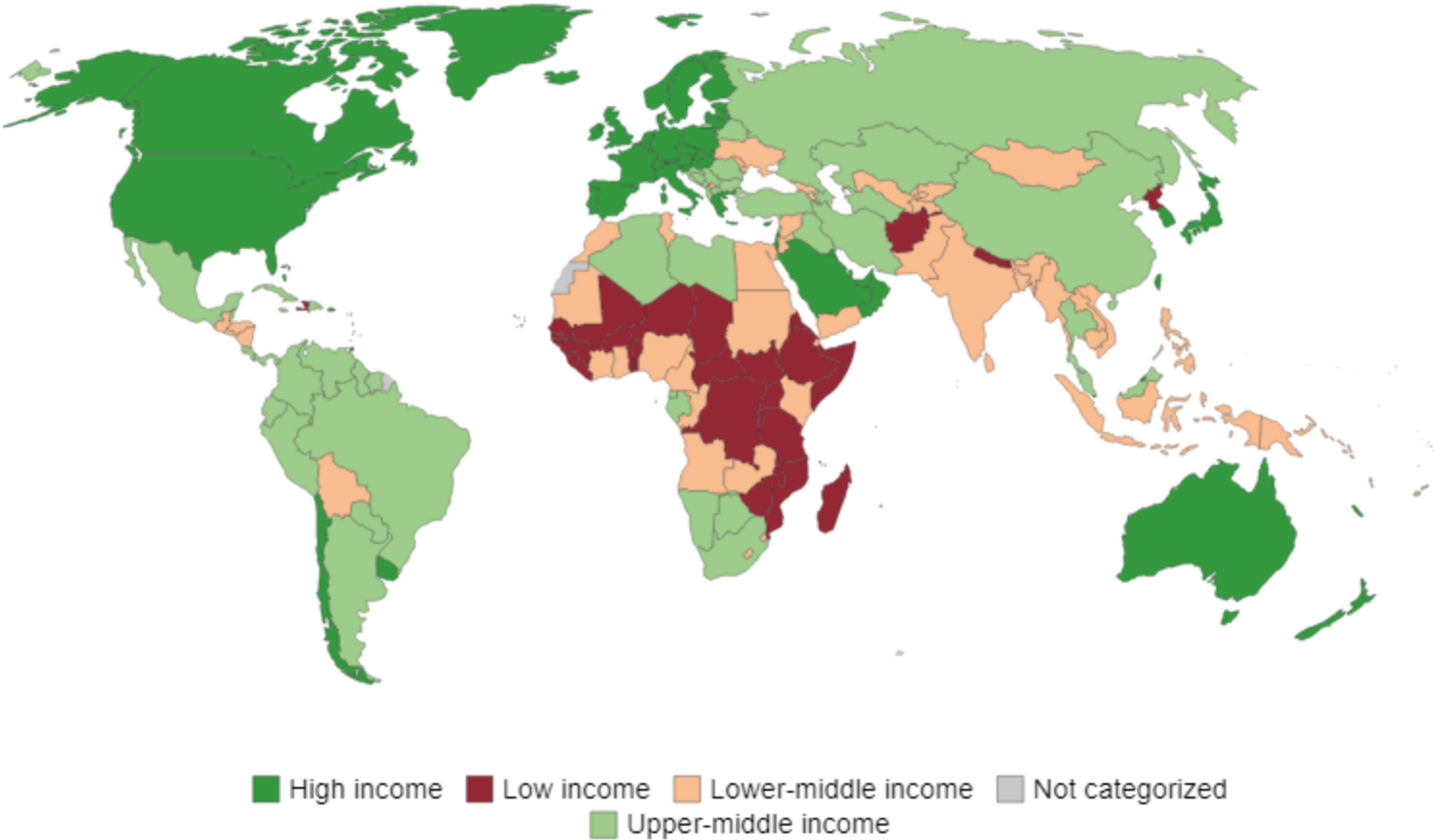
–Or

- To sustain?

Development is often based on squandering our biological capital

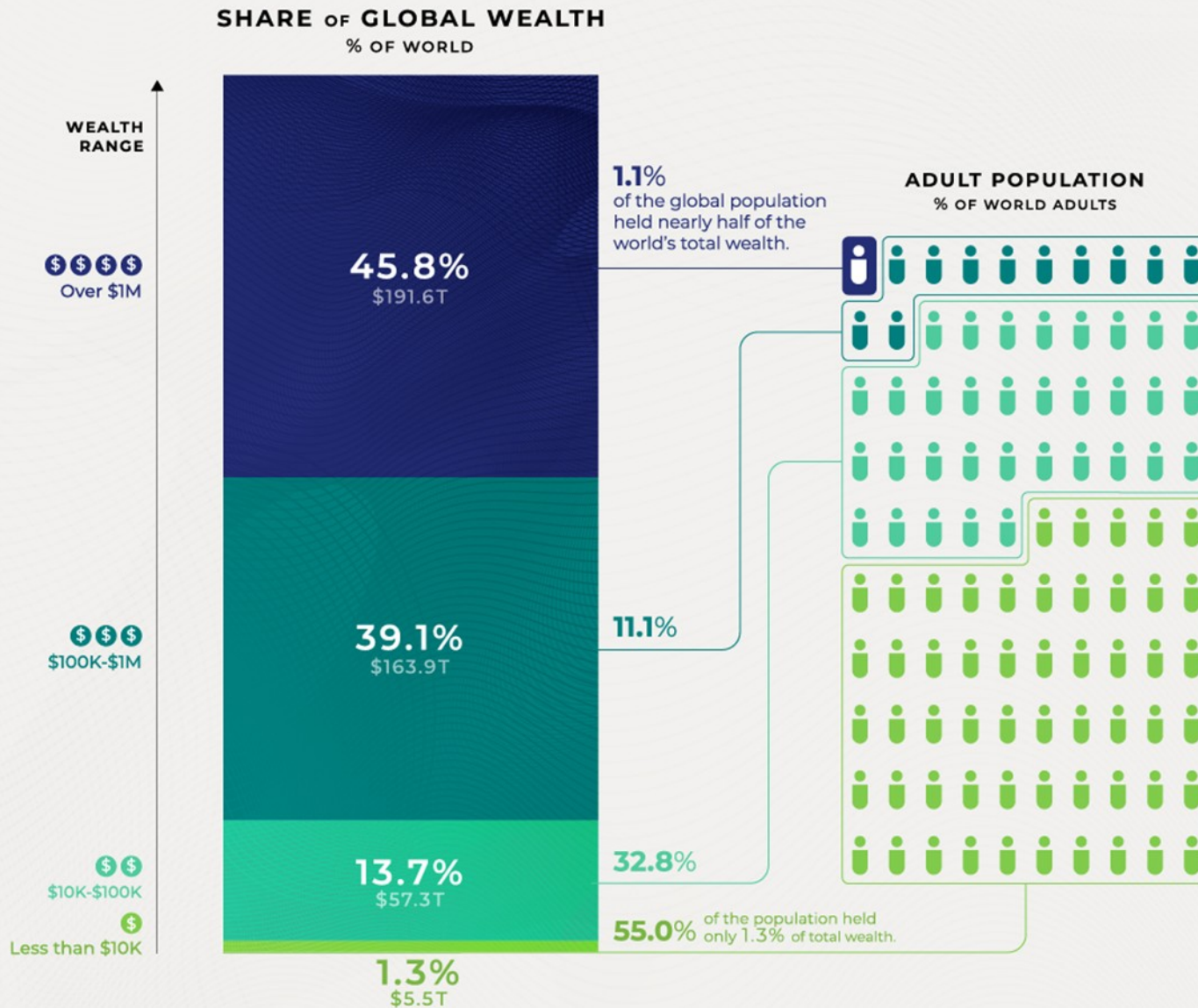
World Bank's Income Groups, 2016

The World Bank's income classifications split countries into one of four categories determined by the country's gross national income (GNI) per capita in US\$. The GNI thresholds between income groups has changed through time based on World Bank definitions.

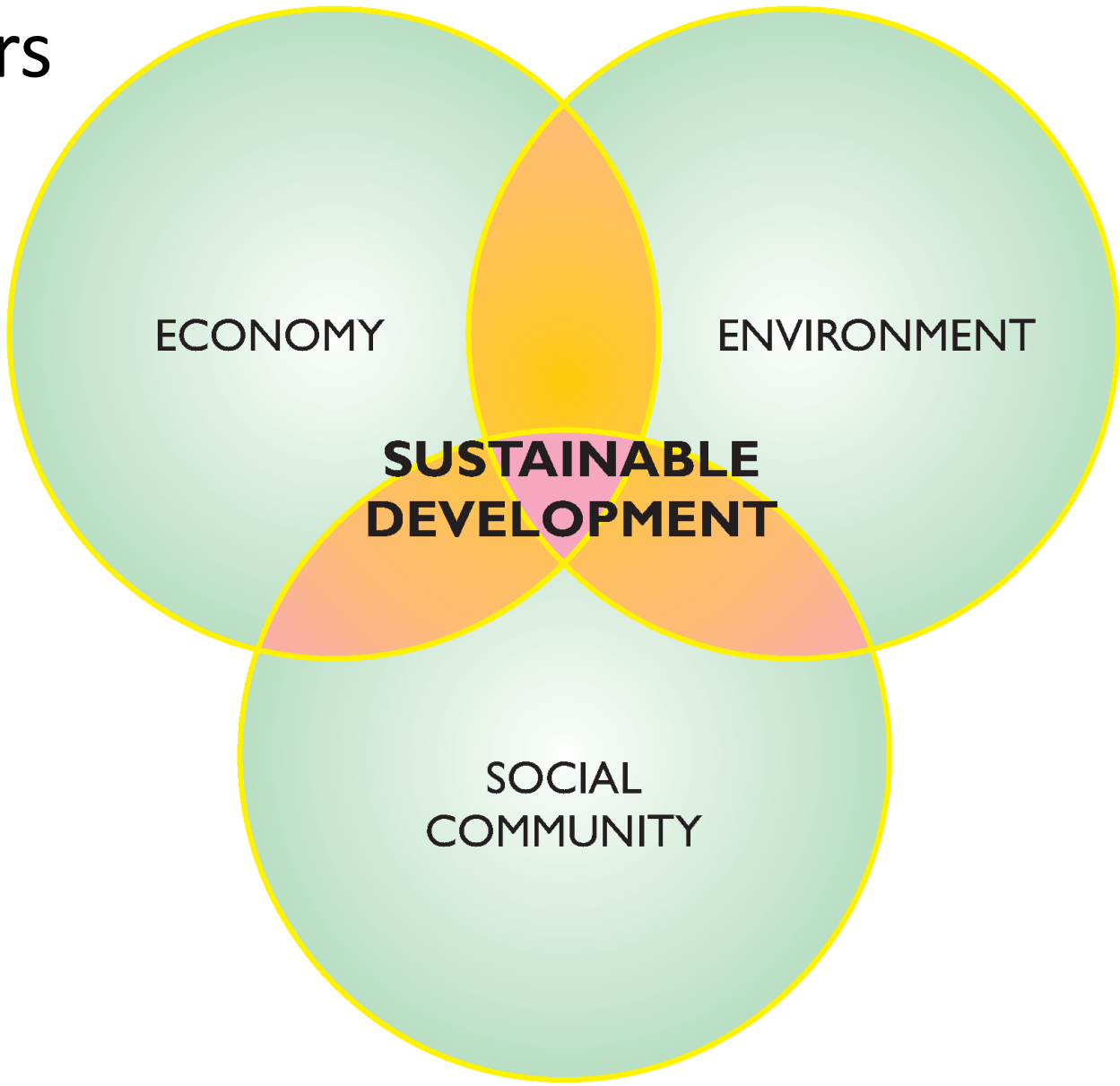


Source: World Bank

THE GLOBAL WEALTH DISTRIBUTION



Three pillars of SD

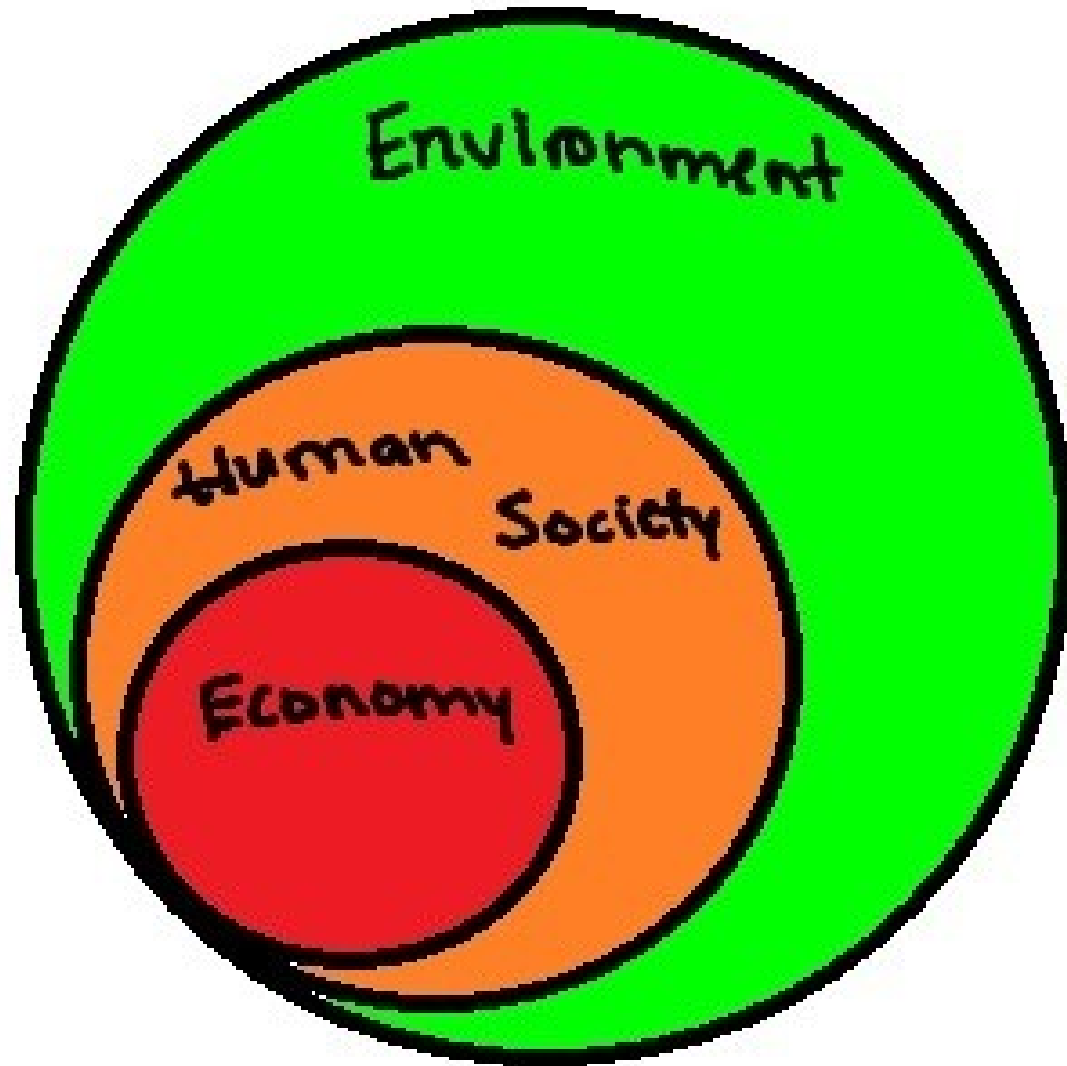


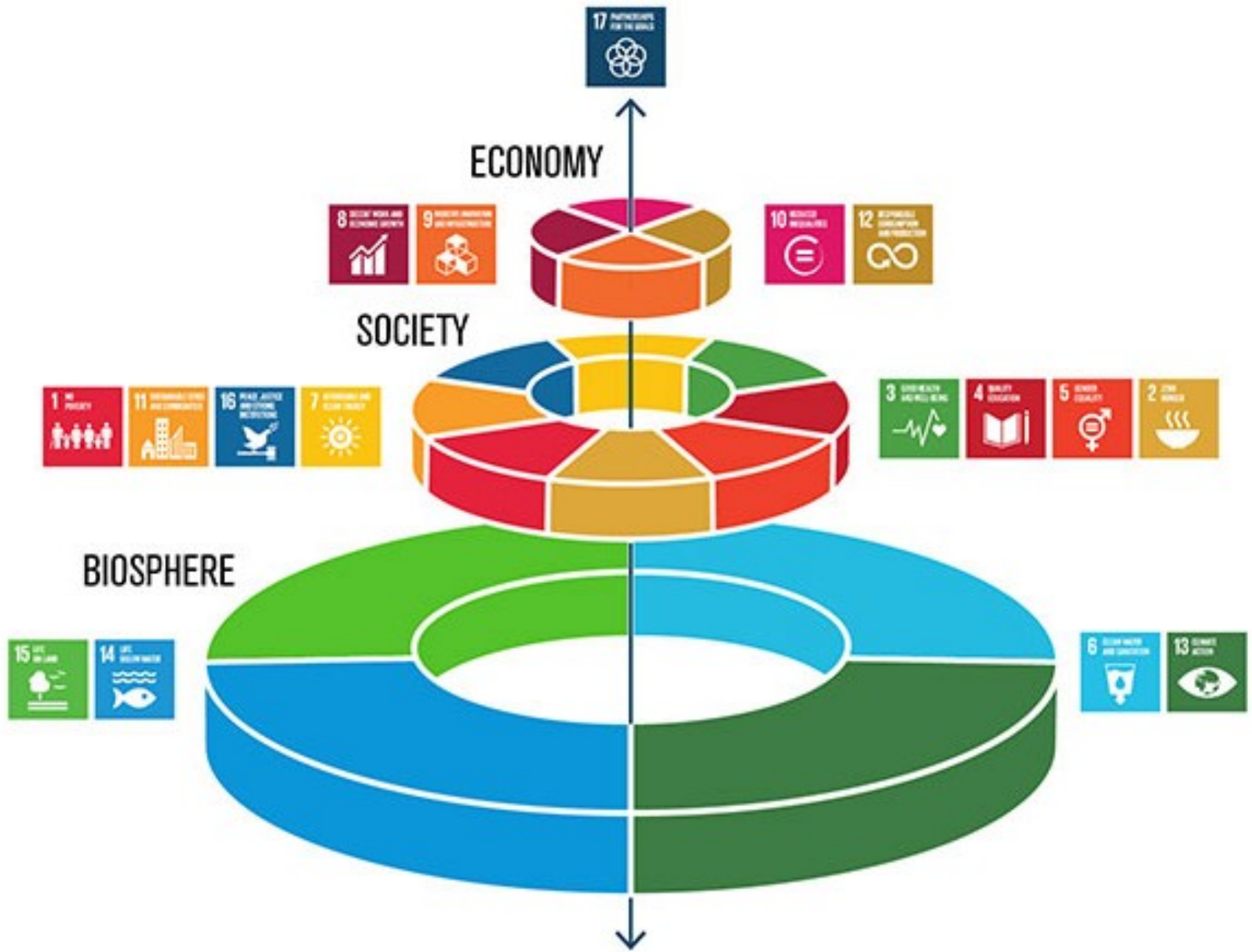
SUSTAINABLE DEVELOPMENT GOALS



Adopted September 2015 – also called Agenda 2030

Environment is foundation for all aspects, others are subsets





Sustainable Development vs Sustainability

- Sustainable Development: “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” – *Our Common Future/ Brundtland Report, 1987*
What are “our needs”?
- Sustainability: “the capacity to endure” –
wikipedia



Hurricane

https://en.wikipedia.org/wiki/Hurricane_Irma



Tornado

<https://www.weather.gov/safety/tornado>



Ecosystem



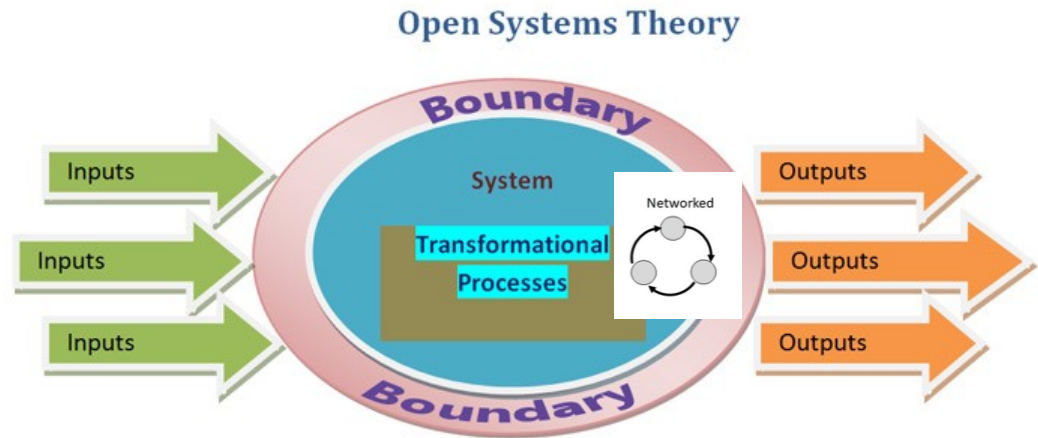
City



Campus

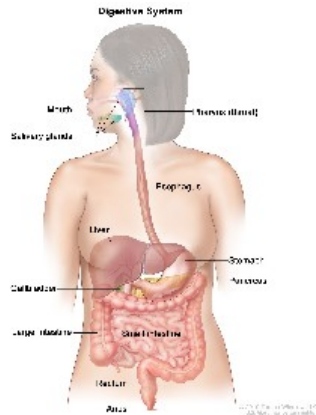
All are open systems with energy driving and maintaining the processes

All import, reuse, and export resources (water, wood, waste, minerals, metals, materials, etc.)



Understanding SYSTEMS!

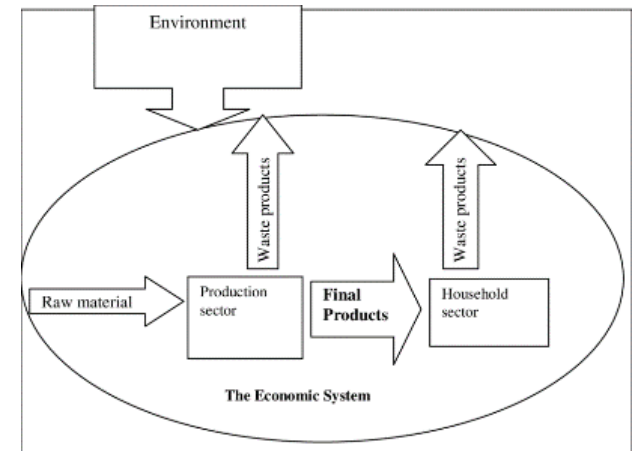
- A set of inter-relationships between components or parts that function together to act as a whole



Digestive system



Computer system




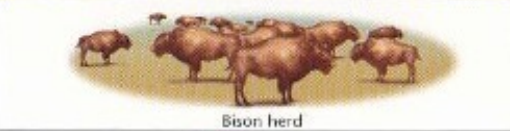

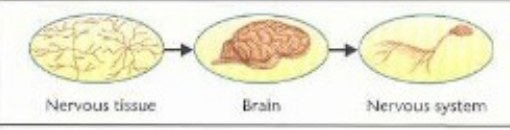
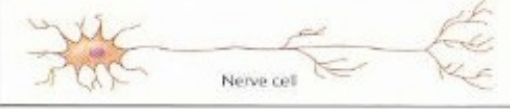



Economic system

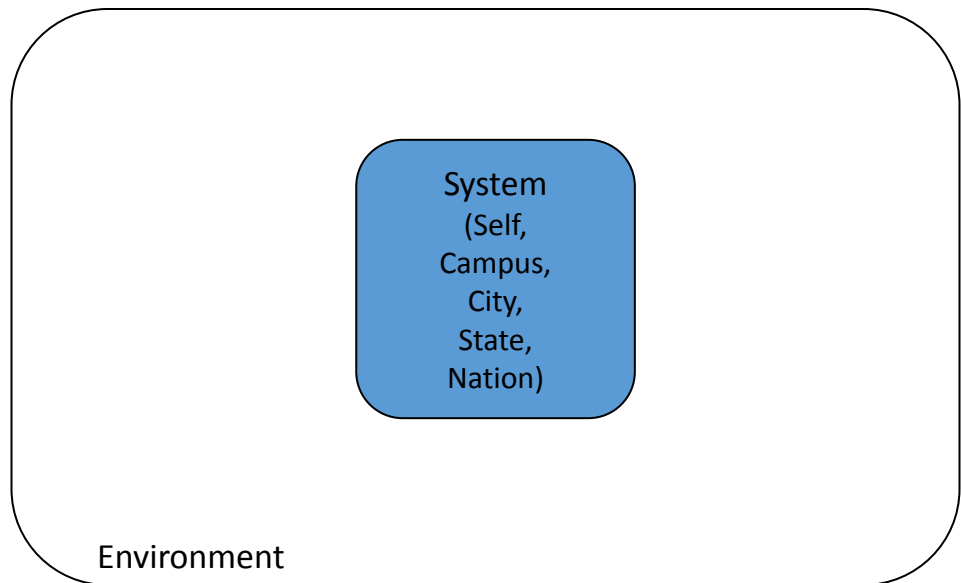
- A system is simultaneously both a system and a part of a larger system

Hierarchy

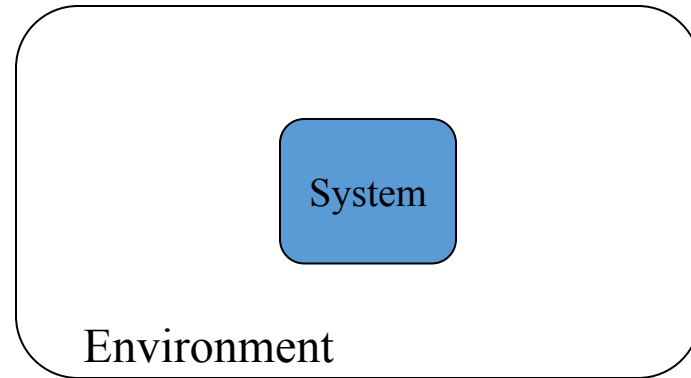
- A system is simultaneously both a system and a part of a larger system
- Better to think in terms of processes and connections than parts

Biosphere	The part of Earth that contains all ecosystems	
Ecosystem	Community and its nonliving surroundings	 Hawk, snake, bison, prairie dog, grass, stream, rocks, air
Community	Populations that live together in a defined area	 Hawk, snake, bison, prairie dog, grass
Population	Group of organisms of one type that live in the same area	 Bison herd
Organism	Individual living thing	 Bison
Groups of Cells	Tissues, organs, and organ systems	 Nervous tissue Brain Nervous system
Cells	Smallest functional unit of life	 Nerve cell
Molecules	Groups of atoms; smallest unit of most chemical compounds	 Water DNA

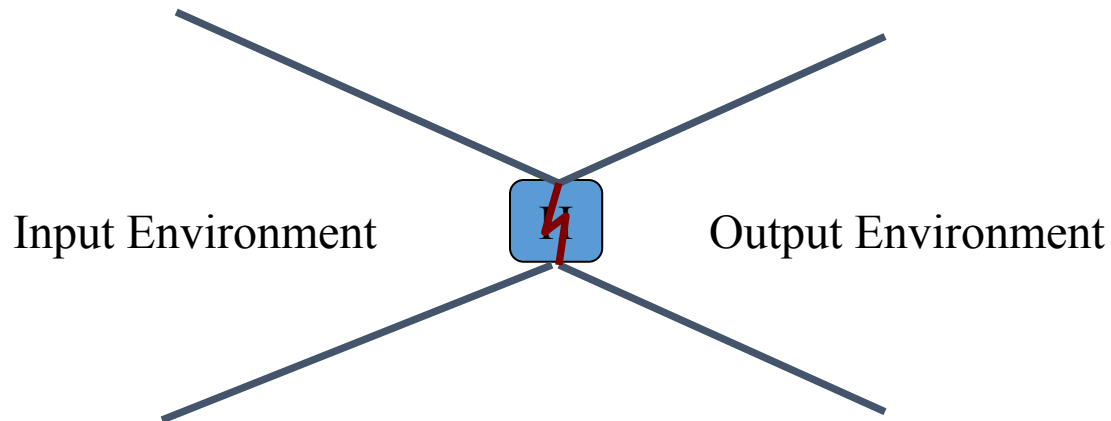
System Boundary – identifies the system from its external environment, but it is always part of and interacting with this environment



Old perspective, dichotomy between system and environment



New perspective, system is focus of two environments



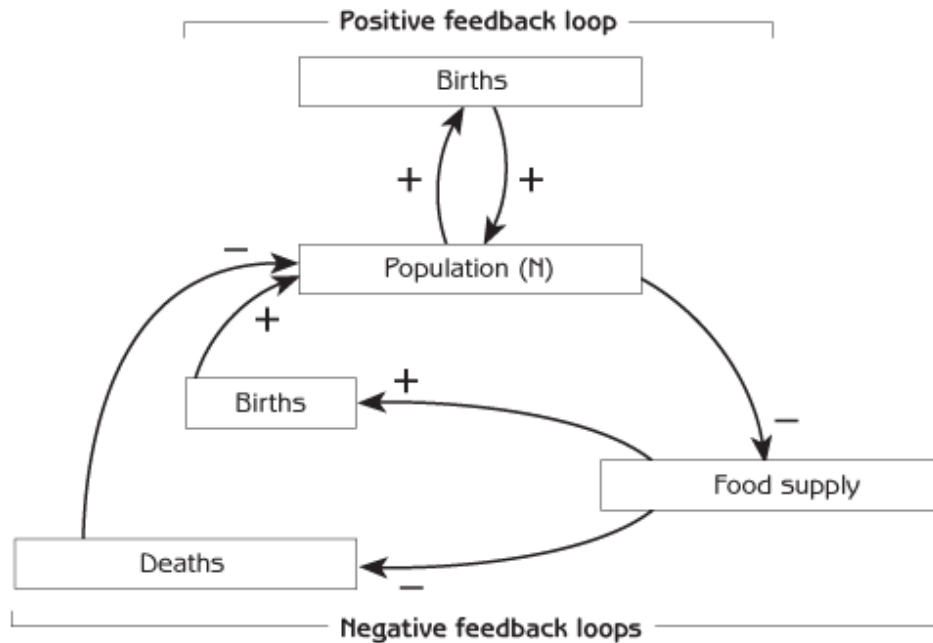
Where does it come from? Where does it go?

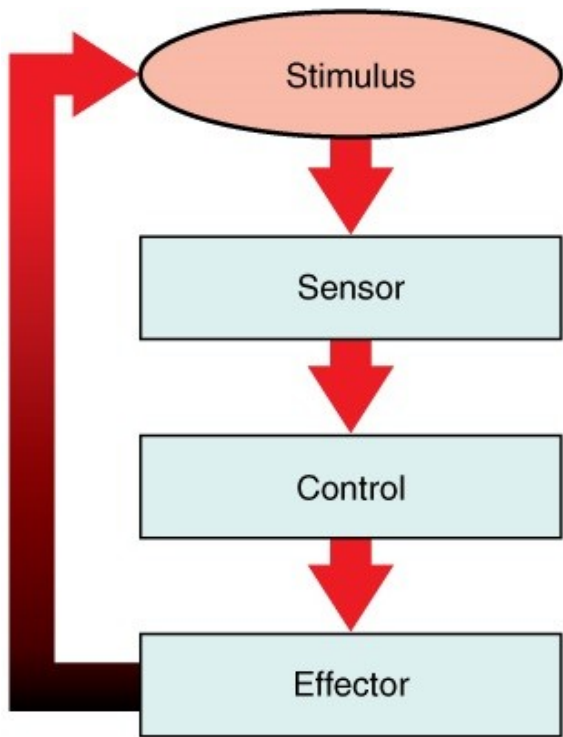
FEEDBACK as a consequence of interconnections

Systems possess capacity for

(a) self-regulation: negative feedback – balancing, stabilizing

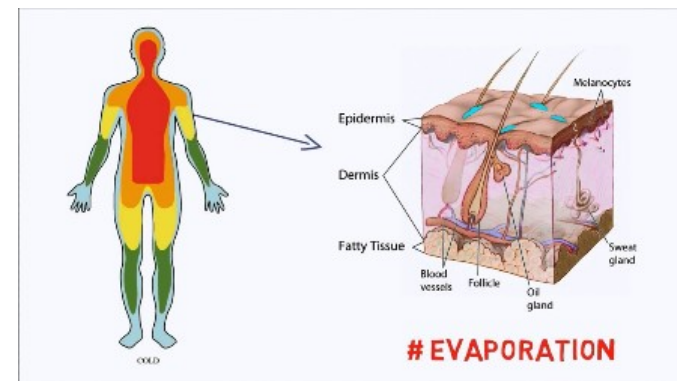
(b) self-adaptation: positive feedback – reinforcing, destabilizing





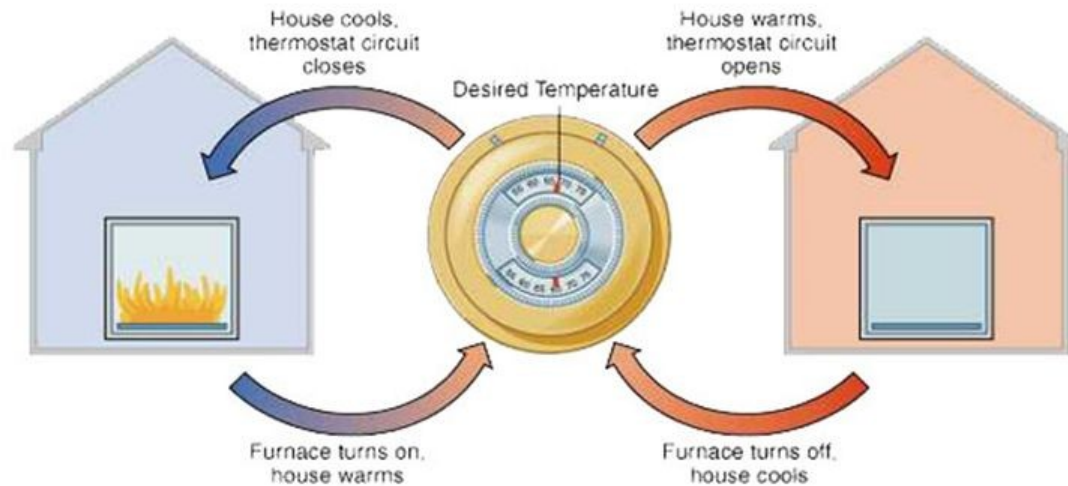
(a) Negative feedback loop

Stabilizes
body
temperature

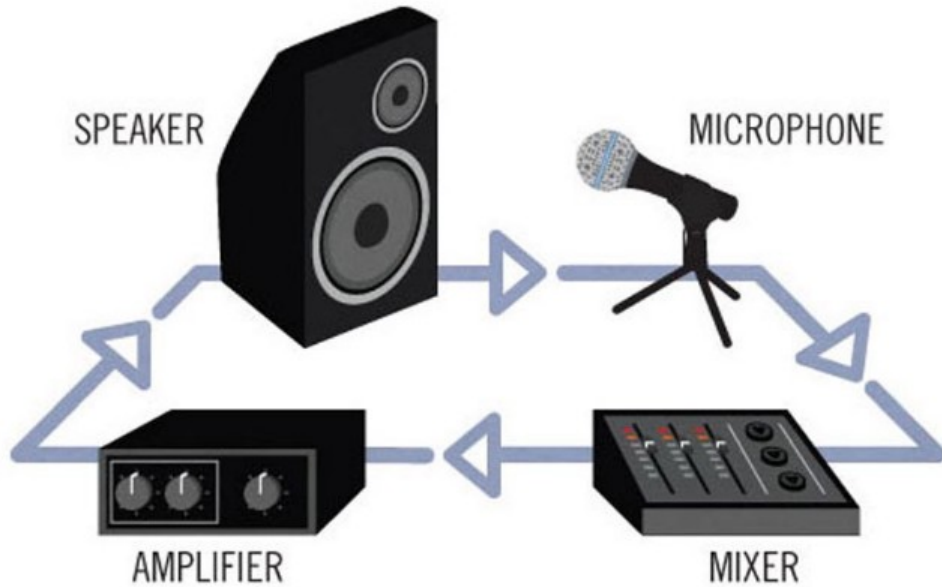


Negative feedback

- Process by which a mechanism is activated to restore conditions to their original state
- It ensures that small changes don't become too large.
- Why is a thermostat a negative feedback system?



Positive feedback – when the signal is amplified and moves the system further from its original condition



Sound system

Positive feedbacks can't go on forever, coming up against constraints

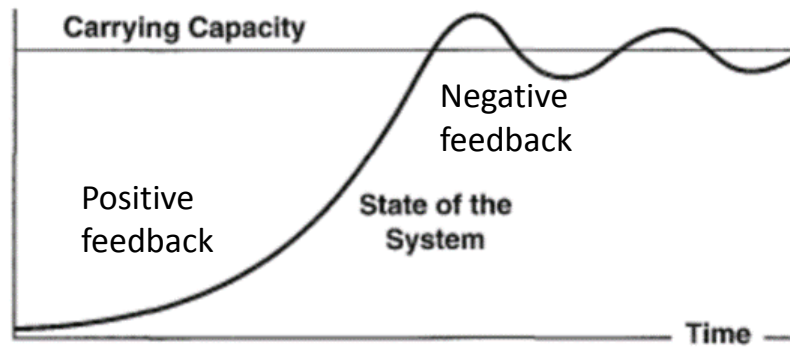
Biological growth is a positive feedback



More biomass → more photosynthesis → more biomass



All system dynamics are an interplay of positive feedbacks that grow and change the system and negative feedbacks that stabilize and maintain the system
For example:



Casual Loop Diagrams (CLD)

A visual representation of interrelation between variables.

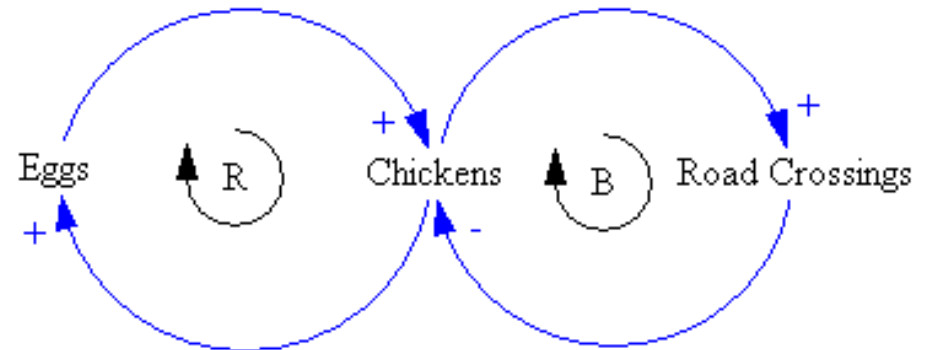
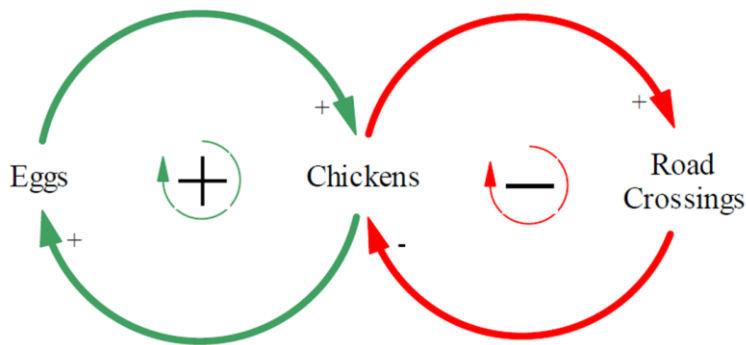
Positive causal link means that the two variables change in the same direction.

Negative causal link means that the two variables change in opposite directions.

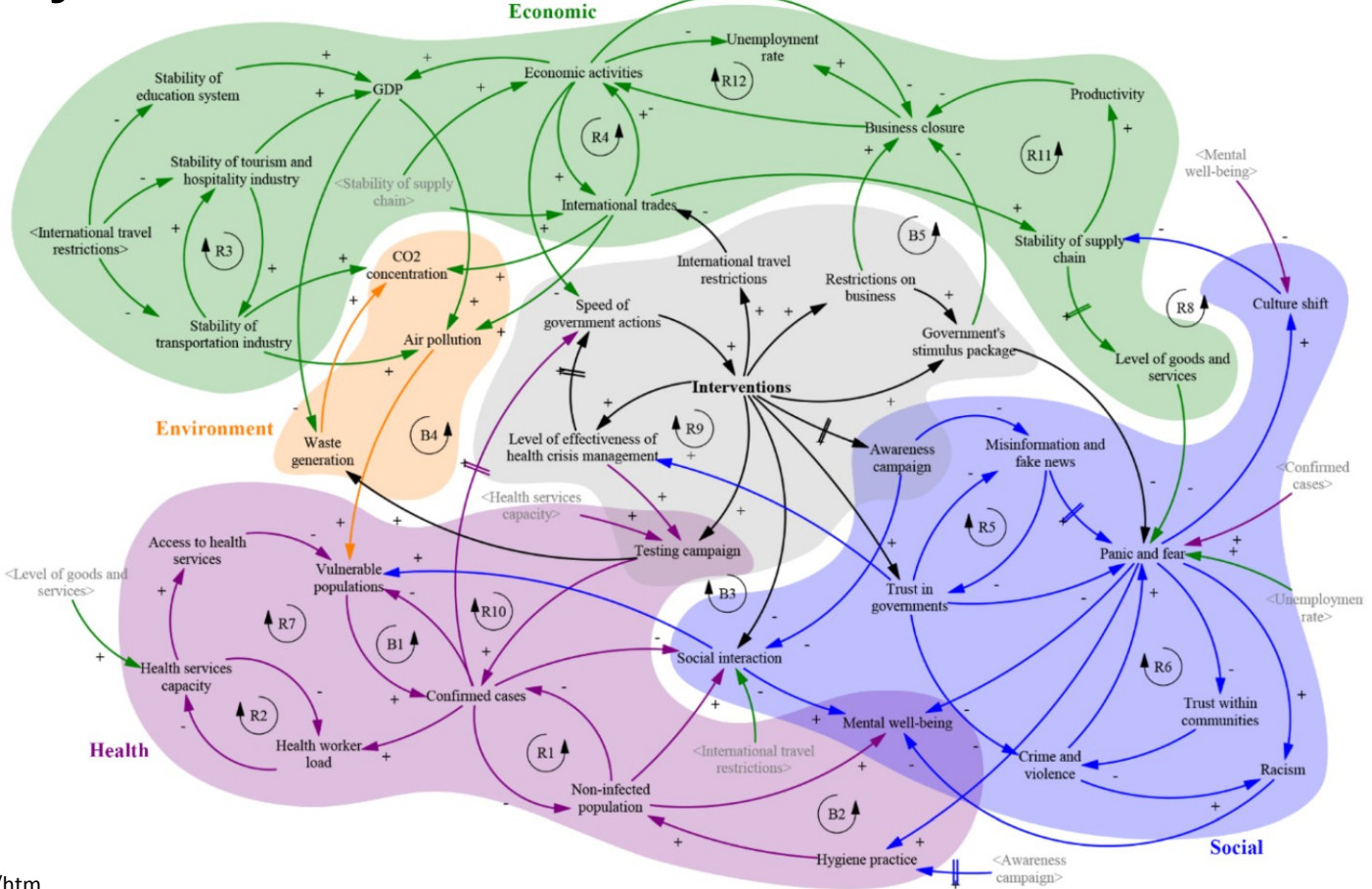
The loop is:

reinforcing if, after going around the loop, one ends up with the same result as the initial assumption.

balancing if the result contradicts the initial assumption.



Developing a Preliminary Causal Loop Diagram for Understanding the Wicked Complexity of the COVID-19 Pandemic

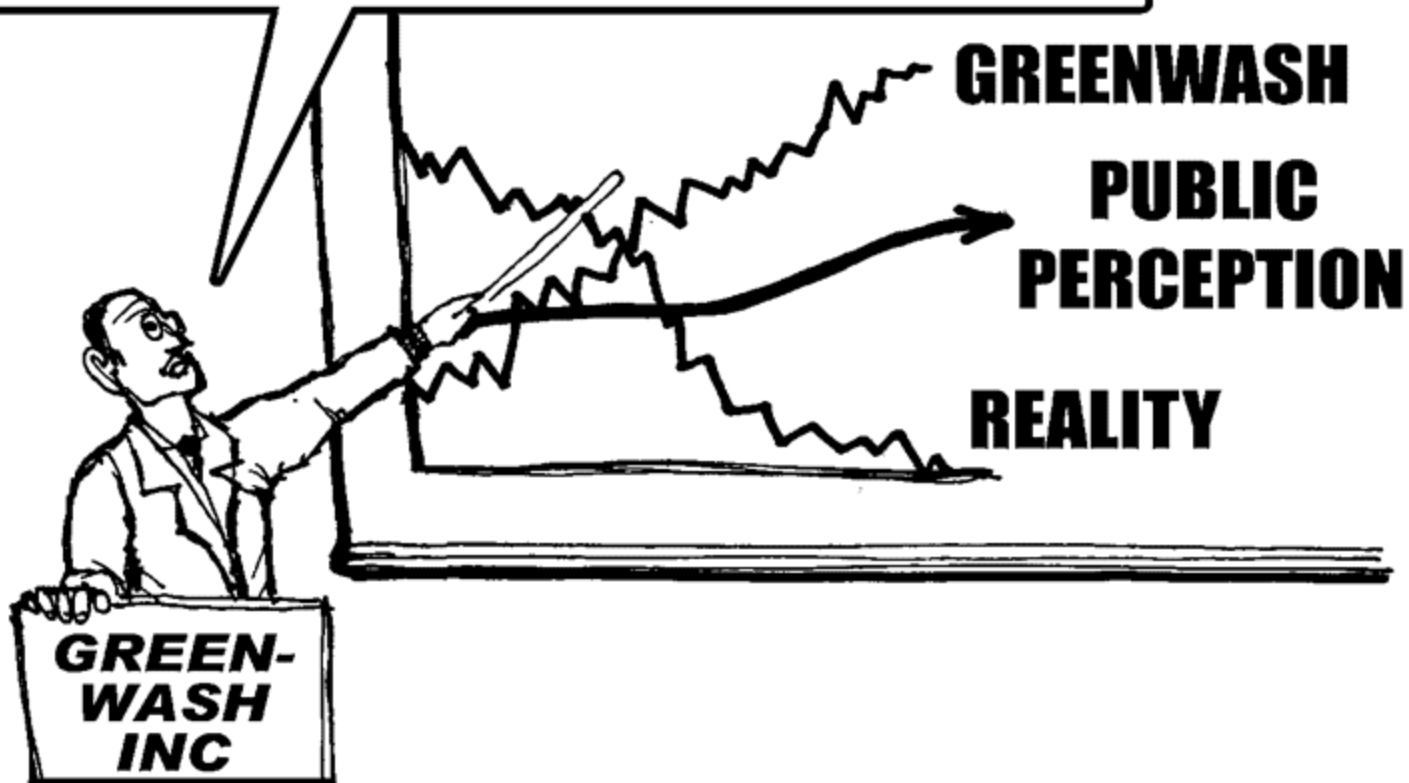


Misuse of the term sustainable

- Adjective that means “green”
- “A little better for the environment than the alternative”
- Less bad
- greenwashing



*YOU CAN IMPROVE PUBLIC PERCEPTION BY
OFFSETTING THE REALITY OF YOUR PROJECT
WITH MORE INVESTMENT IN GREENWASH INC*

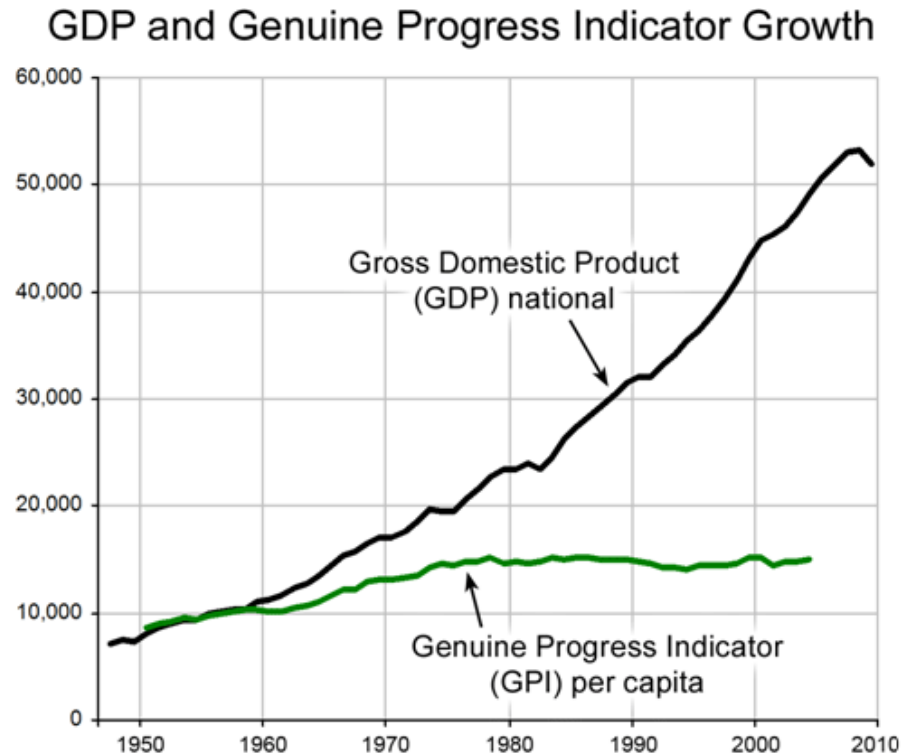




What are we tracking?

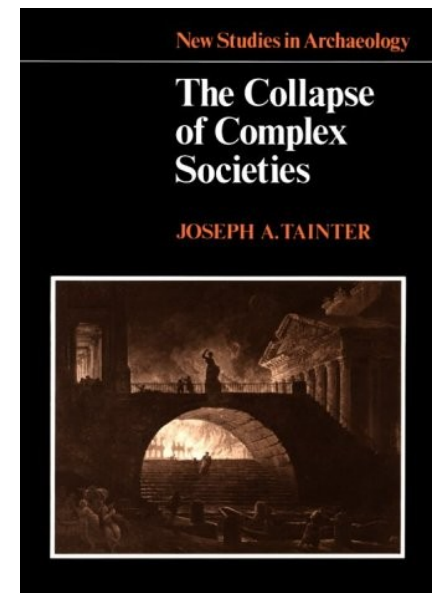
- If development is not sustainable, is it development – why so many bad decisions?

Too often we focus first and only on economic indicators, namely GDP, ignoring Environmental & Social factors



Is sustainability still possible?

- “Growing human populations are eating more meat, using more carbon-based energy, shouldering aside more natural resources, and tapping into more renewable and nonrenewable commodities than ever before.”
- “If humanity fails to achieve sustainability, when, and how, will unsustainable trends end?”



Is sustainability still possible?

- Why has it proved so hard to conform human behavior to the needs of a life-supporting future?
- Our political and economic institutions evolved before anyone imagined the need to restrain human behavior out of concern for the future.

Alternative approaches

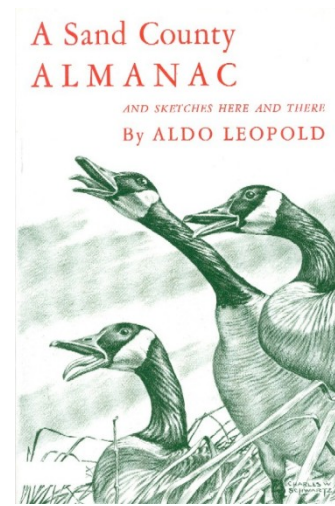
Great Law of the Iroquois

- In every deliberation, we must consider the impact on the seventh generation (~140 years into the future)
- What is the purpose of expressing concern for the consequences of decision-making down to the seventh generation from their own?

Guidance for answers

- Western insight into the needed physical and ethical transformations
- Alternatively, we should look to other traditions as well: indigenous, Eastern

Aldo Leopold



- Forest Service and Wisconsin professor, eloquent and passionate writer of our duty to protect the balance of nature:
 - humans should extend to nature the same ethical sense of responsibility that we extend to each other.
- A Sand County Almanac (1949) – regarded as the most influential book on conservation ever written.
- “The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.”



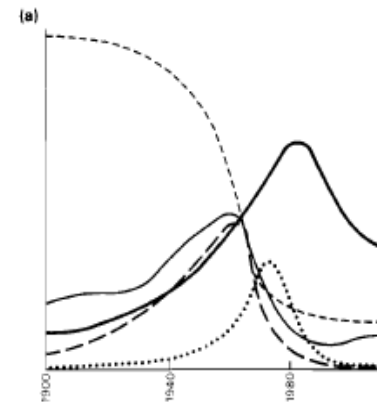
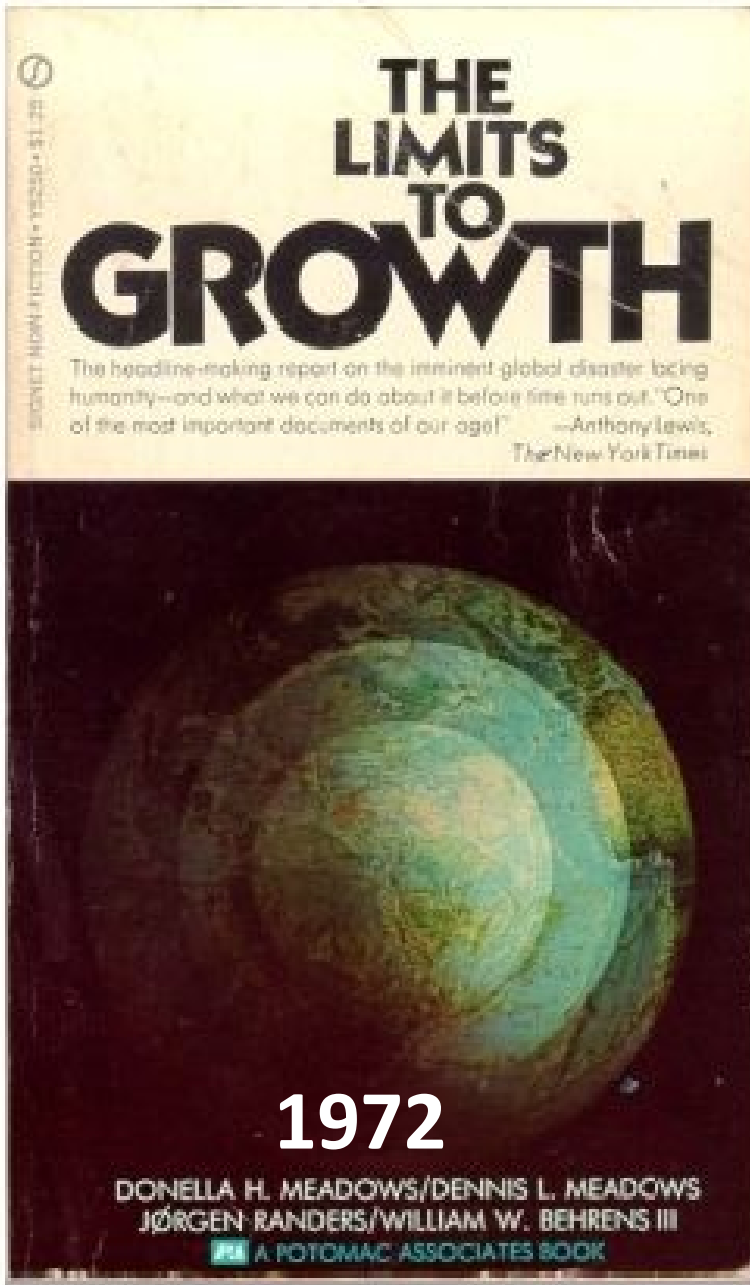
Rachel Carson



- 1960s – **The modern environmental movement is born**
- 1962 *Silent Spring*
- Carson, writer and marine biologist, told how chemical use on farms, forests, and gardens, poison the environment. Insects were dying (not just the pest species) which meant no food for the birds. No birds, no bird song – a silent spring
- Public awareness that humans are damaging environment

Apollo 17,
Dec 1972,
put world
and all its
people
and
resources
into one
frame





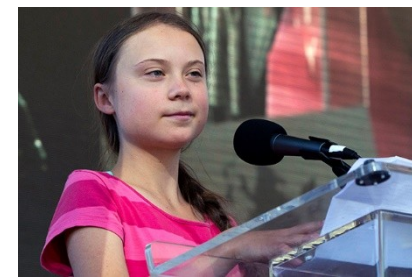
- population (total number of persons)
- - - industrial output *per capita* (dollar equivalent per person per year)
- food *per capita* (kilogram - grain equivalent per person per year)
- pollution (multiple of 1970 level)
- - - - non-renewable resources (fraction of 1900 reserves remaining)



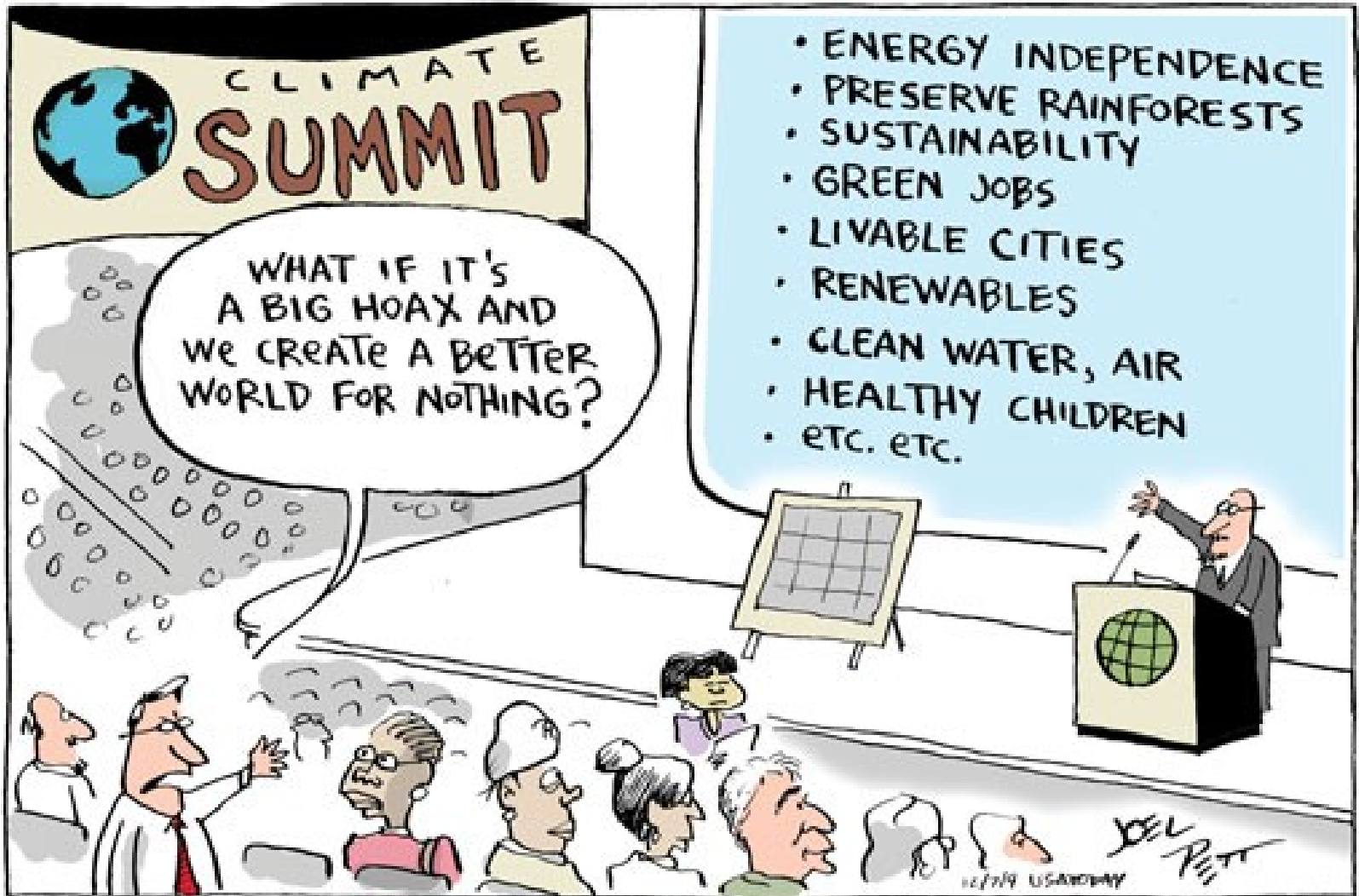
Integrated global model showing that indefinite growth on a finite planet is not possible



Greta Thunberg



- 2018 – School Strike for climate – Friday’s for Future
- 2019 Spoke before UN Climate conference
- We will remember...



CLIMATE
SUMMIT

WHAT IF IT'S
A BIG HOAX AND
WE CREATE A BETTER
WORLD FOR NOTHING?

- ENERGY INDEPENDENCE
- PRESERVE RAINFORESTS
- SUSTAINABILITY
- GREEN JOBS
- LIVABLE CITIES
- RENEWABLES
- CLEAN WATER, AIR
- HEALTHY CHILDREN
- etc. etc.

JUL PITT
11/19 USA TODAY