

Population

Foundational Knowledge

- 1.1 | Remember that as an essentially closed thermodynamic system, all substances annually consumed by humans must be annually produced by the earth's biological systems (e.g., food) or from a finite reserve stock of that resource (e.g., fossil fuels).
- 1.2 | Remember that as an essentially closed thermodynamic system, all wastes annually produced by the human population must annually be absorbed or detoxified by earth's biological systems. If they are not absorbed or detoxified, they will accumulate within the earth system.
- 1.3 | Understand that population, which is the number of people on the planet at a given time, can be viewed as a stock that increases through births and decreases through deaths; the net rate of change in population is equal to the net difference between the birth rate and death rate. (annual population growth rate = annual birth rate – annual death rate).
- 1.4 | Understand that the environmental impact of the earth's population is a product of that population and the way in which they live ("life style"); this can be simply expressed as the $I=P*A*T$ equation where I is the impact, P is the population, A represents the affluence per person and T represents the technological resource impact per affluence.
- 1.5 | Understand that the carrying capacity of the earth represents the annual population that the earth as a closed thermodynamic system can sustain under the rate of consumption ("lifestyle") of the population; it changes with the bioproductivity of the earth's natural resources and the lifestyle behaviors and technologies (i.e., the A*T term in the IPAT equation).
- 1.6 | Understand that the ability of the earth to sustain the human population depends on the environmental impact of the lifestyle behavior of the population. This can be thought of as the product of the A and T terms in the IPAT equation.
- 1.7 | The ecological footprint of a person represents the area of bioproductive land required to yield the annual mass of resources consumed by that person and absorb the CO₂ produced by that person's use of the fossil fuels; it can be considered the product of the A and T terms in the IPAT equation.
- 1.8 | Remember that the earth's area of bioproductive land is a finite resource that can be increased through restoration or decreased through destruction.

Application

Critical Thinking:

- 2.1 | Critique ways in which engineering activity influences population.
- 2.2 | When given Meadows' nine levels of systemic intervention, create an example of a specific intervention at each of the nine levels that can potentially decrease the environmental impact of a population.

Practical Thinking

- 2.3 | Approximate the carrying capacity if given the population, its average ecological footprint, and the earth's total area of bioproductive land.
- 2.4 | Identify environmental, social, health, public policy, and economic factors that influence population growth; state how population growth is influenced.

Integration

- 3.1 | Relate the interaction among social, economic, health, and environmental factors to population dynamics.
- 3.2 | Relate the connection of population with sustainability through a systems thinking/systems model approach.
- 3.3 | Identify the interaction between exceeding the earth's annual carrying capacity and political and social instability.
- 3.4 | Relate the choices of one's own life style to potential global impact through the ecological footprint.
- 3.5 | Connect the global climate change trends with segments of existing and future populations that are at a greater risk due to environmental exposure.

Human Dimension

- 4.1 | Come to see themselves as part of the global population system.
- 4.2 | Come to see that their actions affect the sustainability of the global system through their influence on the carrying capacity.
- 4.3 | Come to see themselves as having great power ("self-authorship") as an engineer to improve or worsen the well-being for the population.
- 4.4 | Come to see that recognizing and suspending one's viewpoint is needed in order to understand the perspective of another.

Caring

- 5.1 | Feel they (the students) are important in terms of addressing population challenges.
- 5.2 | Care about serving all of humanity, including populations of lower socioeconomic status and indigenous peoples in both developed and developing countries.
- 5.3 | Value the perspectives brought by other disciplines in solving population challenges.
- 5.4 | Feel "part of the solution" for sustainable development.

Learning How to Learn

definition: Designing and executing a plan for learning what one needs to learn.

- 6.1 | Identify what one needs to learn to achieve a learning objective.
- 6.2 | Formulate relevant questions around 6.1.
- 6.3 | Identify resources for information to answer questions from 6.2.
- 6.4 | Answer 6.2 by synthesizing information found through self-directed learning.
- 6.5 | Practice the virtues of critical thinking when evaluating new information:
 1. Intellectual integrity, 2. Intellectual humility, 3. Confidence in Reason, 4. Intellectual Perseverance, 5. Fairmindedness, 6. Intellectual Courage, 7. Intellectual Empathy, 8. Intellectual Autonomy

What impact do I want this module experience to have on students, that will still be there a year or more after the course is over?