Class 8

1:30 – 2:00

- Slides: Ecosystem Services
- Activity 1: Definition for 2 governing principles of Environmental Science

2:00 – 2:45

- Activity 2: Ecosystem Services
- Note: Numbering of questions on handout: 1 - 4

2:45 – 3:20

- Quiz 1

Ecosystems

Ecosystem Services

Humans are 0.01% of the biomass on Earth*

- **But have huge impact on Ecosystems**
- **Lowered *Ecosystem Productivity* for all Ecosystems**

(*The Biomass Distribution on Earth, Yinon M. Bar-On, et al, Proceedings of the National Academy of Sciences, Jun 2018, 115 (25) 6506-6511)

Productivity: A measure of growth

Growth:

- Growth of individuals *and* Growth of populations.
- Increases biomass

Productivity:

Amount of biomass produced

- Higher growth ==> Higher biomass ==> Higher productivity

Productivity measured at different levels of the Ecological Hierarchy

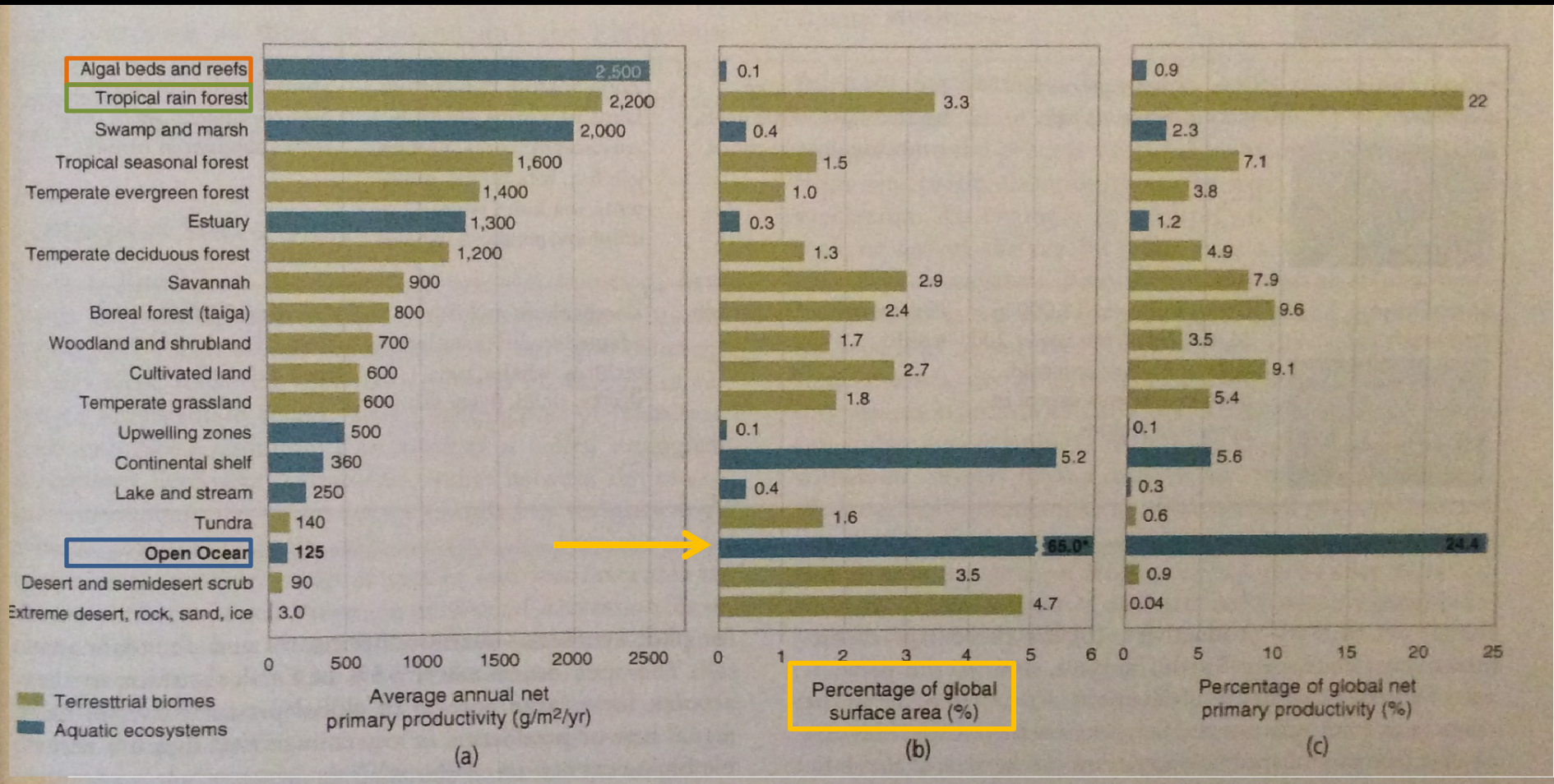
- a coast redwood tree
- a coast redwood population
  - e.g., in Santa Cruz Mountains
- a coast redwood community
  - Includes all the organisms typically found with redwoods
- a coast redwood forest ecosystem
- the coast redwood forests all over the world
  - Mostly all found in California!

Why Focus on Productivity?

- **We rely heavily on highly productive ecosystems**
  - ***E.g., Forests, Wetlands, Oceans, Estuaries***
  - **Ecosystems provide *Ecosystem Services***
    - *Food, Building material, Water purification , Carbon sink, …*
    - *Anthropocentric ethic*
    - *Rivers and Lakes provide an important resource – pure water*
  - **Even low productivity ecosystems are important**
    - *Deserts have unique organisms that have a right to thrive– Biocentric or Ecocentric ethic*
- **Productivity measures ecosystem health**
  - ***Higher productivity = robust and resilient***
    - *Intact Interactions of biotic communities*
  - ***Degraded ecosystems have lowered productivity***
- **Productivity is measured in Units: $g/m^2/year$**
  - ***Grams of biomass produced, per square meter, per year***

Relative Productivity of Ecosystems

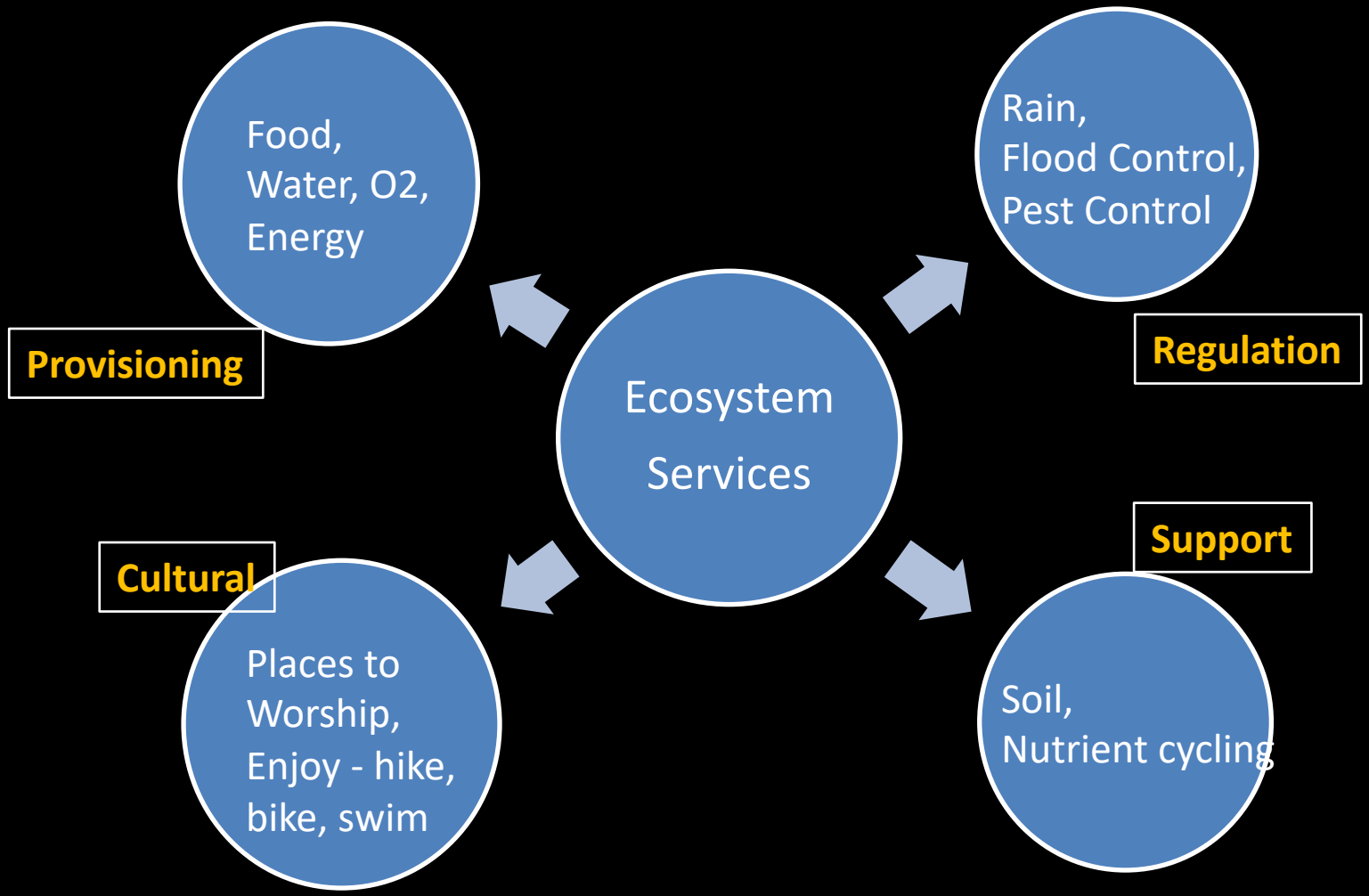
Page 113 of Textbook by Wright and Boorse



1. **Which ecosystem has the highest annual net productivity?**
2. **Which ecosystem has the second highest annual net productivity?**
3. **Which ecosystem has the third lowest annual net productivity?**
4. **Why does this ecosystem have a high percentage of global net productivity?**

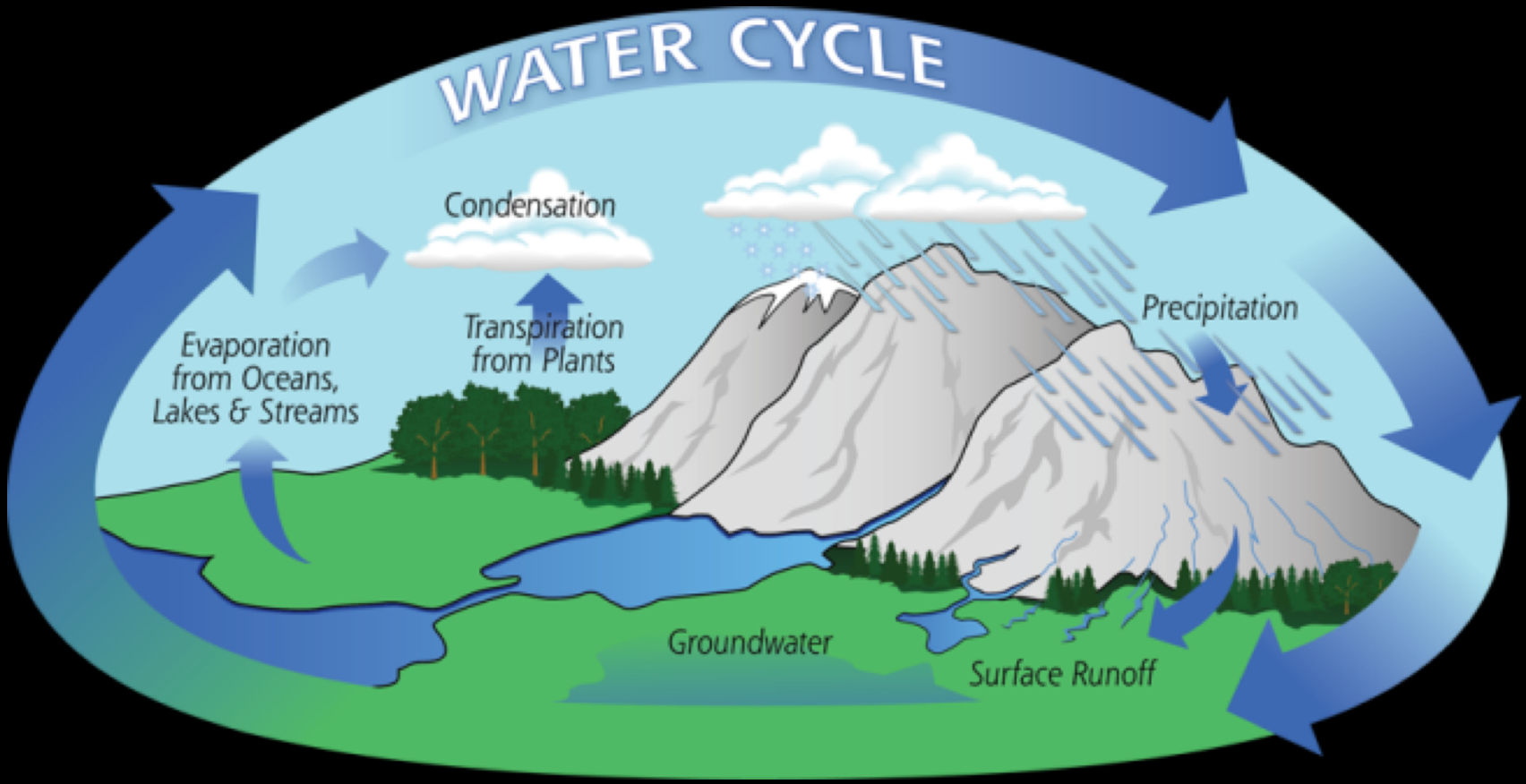
Ecosystems and Human Well-being

Can we live without them?



Ecosystems* provide *Services* *we rely on

Ecosystem Service - Water



! FREE water purification - It happens without human intervention !

Ecosystem Services

Ecosystems & Ecosystem Services

The basis of our existence!

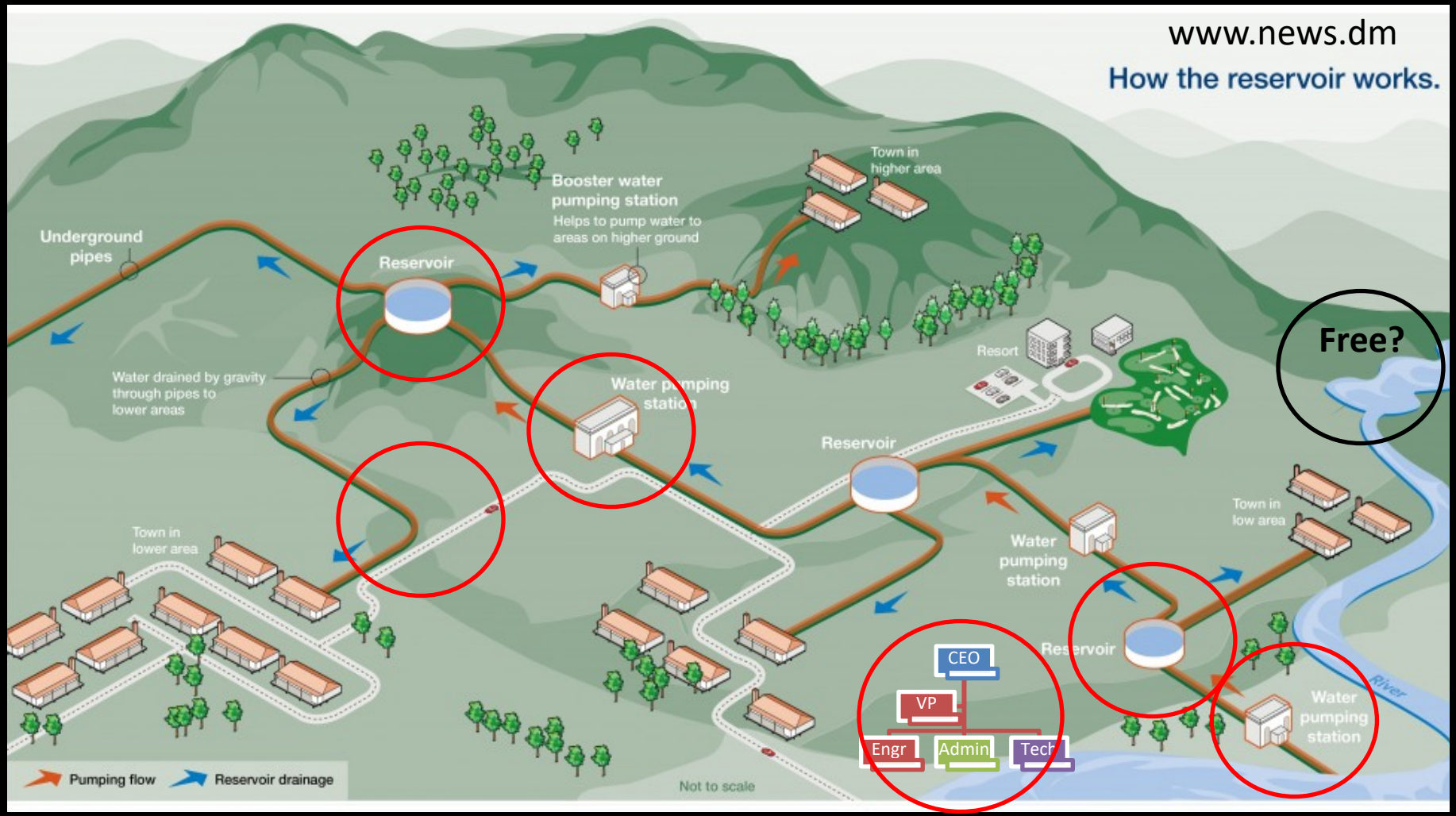
What does it cost us?

IS IT FREE?

E.g., Fresh Drinking Water

Ecosystem Service: Drinking Water

What are we paying for when we drink a glass of pure water?



What is the environmental cost of extracting pure water from rivers and streams?
Who benefits? Who pays? What is paid for? What is not?

External Costs: Drinking Water

Clean fresh water is an ecosystem service provided by the aquatic systems: rivers and streams, ponds and lakes

- How are rivers modified to provide water for cities?
  - Dams and Reservoirs built near the source, which are far away from the cities
  - Pipes and Pumps transport water
- What do city people pay for?
  - Construction + maintenance of the engineered water systems mentioned above

- What are the impacts of dams?
  - Inundation of original ecosystem
  - Loss of habitat for people, flora and fauna who lived there
  - Loss of free clean water for local people, flora and fauna
  - Loss of connectivity for some species like salmons
  - Cultural loss, for all people
- Are these people and species compensated for their loss? No!
  - External Costs
  - Environmental Justice

Should Ecosystem Services Be Free?

Pros

- Everyone owns it
- Everyone can benefit
- Renewable, Self-Sustainable
  - We do not need to work or use energy for them
- Productivity and diversity of resources
  - Food: Plants, Fish, Meat
  - Water: Surface, ground
  - Air: Oxygen from terrestrial plants and ocean living phytoplankton

Cons

- Who pays the External Cost?
  - Users far removed from the service providing ecosystem
  - Are users of an ecosystem service aware of it and its value if they do not pay?
- Tragedy of the Commons
  - Over-exploitation and Pollution
  - Degradation of ecosystems
- What is the solution?
  - Precautionary Principle
  - Public Trust Doctrine
  - We must all become educated stewards of the environment!

Class 08 Activity 1
Two governing principles in Environmental Science

- Research the meaning of the two principles as it applies to Environmental Science
  - Precautionary Principle:
  - Public Trust Doctrine:
- Write down one or two sentences in your journal for each

(For a detailed perspective, see: Kriebel, D et al. “The precautionary principle in environmental science.” *Environmental health perspectives* vol. 109,9 (2001): 871-6. doi:10.1289/ehp.01109871)

Class 8 Activity 2: Ecosystem Services

Each team, select **ONE** of the following ecosystems.
Freshwater Aquatic Systems: ***Lakes and Ponds, Streams and Rivers, Inland Wetlands***
Terrestrial Biomes: ***Grasslands and Prairies, Coniferous Forests***

Then, Research the Ecosystem Services for your ecosystem (One of the above) and Answer the following questions: ***Also see Table 5-3, page 125 in textbook***

1. On the handout titled, "Ecosystem Services and Functions",
   a) Check all the services that your ecosystem provides
   b) For each service, explain briefly how the service is provided. Use the concepts of productivity, sustainability, food webs, biogeochemical cycles.
2. How have humans modified the ecosystem? (Use the concepts of ecological hierarchy, productivity, degradation, tragedy of the commons)
3. Is the society you are living in paying for the ecosystem services? Explain using the concept of External cost.
4. Give one recommendation that your team proposes to help society see the value of the ecosystem. (Use the concepts of Stewardship, Public Trust Doctrine, Precautionary Principle).