INTRODUCTION TO ECOLOGY KEY

Ecology = science of the interactions of living organisms with one another and with their physical environment

Levels of ecology

- Population = all individuals of a species that live in the same area
  - Ex: all the sea otters in Central California
- Community = all the organisms living in a certain area
  - Ex: all the organisms of the kelp forest of Monterey Bay
- Ecosystem = the organisms that exist and interact in an area and their physical environment (such as air, water, sunlight, and soil)
  - Ex: kelp forest of Monterey Bay

All the leopard sharks living in Monterey Bay make up a(n) population.

All the plants and animals living in Monterey Bay make up a(n) community.

All the plants and animals living in Monterey Bay, plus their physical environment, make up a(n) ecosystem.

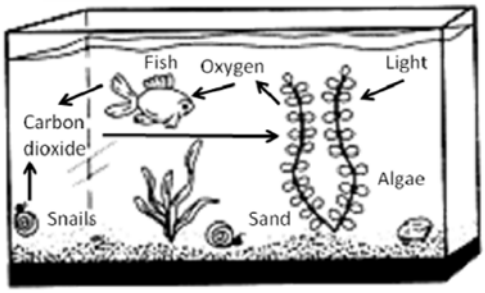
All the living members of an ecosystem make up a community.

A community is made up of many populations.

Do living things affect nonliving things? (Yes) / No (circle one)

Do nonliving things affect living things? (Yes) / No (circle one)

An aquarium is an ecosystem you may have in your home. A balanced aquarium is a healthy ecosystem in which all the organisms receive all the things they need to live. Using each of the 7 words/phrases in the diagram, list the living and nonliving parts of an aquarium ecosystem.



Living: fish, algae, snails

Nonliving: oxygen, sand, carbon dioxide, light

POPULATION ECOLOGY KEY

How does population size change from one year to the next?

- B = births
- D = deaths
- I = immigration
- E = emigration

$$N_{t+1} = N_t + B - D + I - E$$

Population Growth Problems

1. Scientists observed 2,813 sea otters along the Central Coast in 2009. 430 otters died and 328 pups were born. If there is no immigration or emigration, how many sea otters were there in 2010?

   N(2009) = 2,813
   D = 430
   B = 328
   I = E = 0

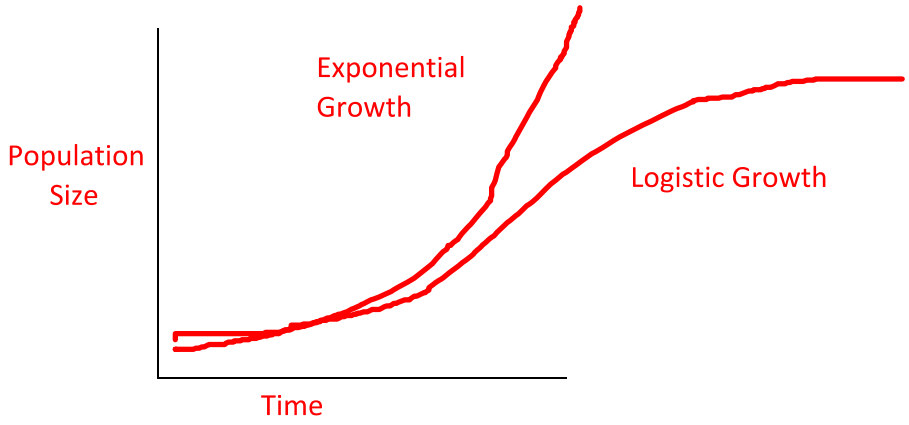
   N(2010) = N(2009)+B-D+I-E
   N(2010) = 2,813+328-430+0-0
   N(2010) = 2,711

2. If 10 sea otters leave the Central Coast population and 2 enter, what would the 2010 population be?

   N(2009)=2,813
   B=328 I = 2
   D=430 E = 10

   N(2010) = N(2009)+ B − D + I - E
   N(2010) = 2,813+328-430+2-10
   N(2010) = 2,703

Sketch and label 2 typical population growth patterns.



List three reasons that populations generally do not grow exponentially:

- Limited resources (light, water, nutrients, food, space)
- Disease
- Predation

Describe a situation in which a population might grow exponentially:

Populations sometimes grow exponentially for a short time when resources are plentiful, such as when a population is recovering from near-extinction, like elephant seals, or is introduced to a new environment, like zebra mussels or bacteria in culture.

COMMUNITY ECOLOGY KEY

Succession = gradual process of change in an ecological community after a disturbance

- Primary Succession = where life has not existed before
  - Signs: bare rock (no soil), no seeds, no nutrients
  - 3 examples of disturbance: Glacier, volcano, landslides, new sand dunes
- Secondary Succession = where there has been previous growth
  - Signs: soil, seeds, nutrients
  - 3 examples of disturbance: fire, plowing, clear-cutting of forest, storm, invasion of exotic species, flood, tsunami

food chain = simple directional flow of materials and energy from one organism to another

Draw a food chain with sea otter, white shark, sea urchin, and kelp:

kelp -> sea urchin -> sea otter -> white shark

We can combine many food chains to create a food web.

Draw any food chain from the soil food web:

Various

Producers = organisms that make their own food using light energy from the sun in the process of photosynthesis

- Examples: olants, algae, phytoplankton

Consumers = organisms that feed on other organisms

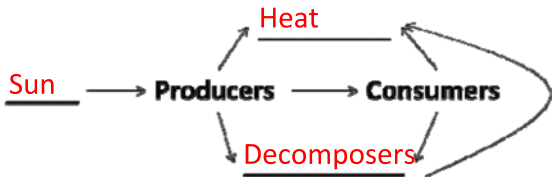
- Primary consumers = eats producers (herbivore)
  - Examples: sea urchins, parrotfish, songbirds, turtles
- Secondary consumers = eats consumers (carnivore)
  - Examples: sharks, dogs, mountain lions, dolphins

Decomposers = consumers that feed on dead plants and animals and return nutrients to the soil

- Examples: mushrooms, bacteria, worms, beetles, banana slugs, crabs, lobsters

ECOSYSTEM ECOLOGY KEY

Energy Flows (one-way)



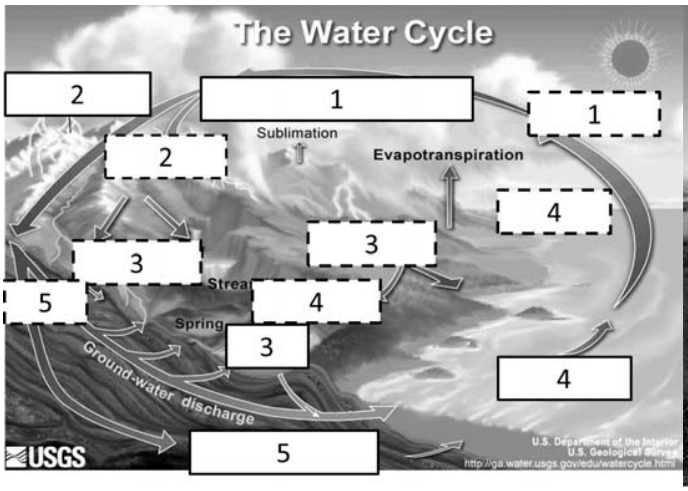
About 10 % of energy passes from one trophic level (e.g., producers) to another (e.g., consumers). The rest is lost as heat. This forms the energy pyramid. Draw one below!

Nutrients Cycle

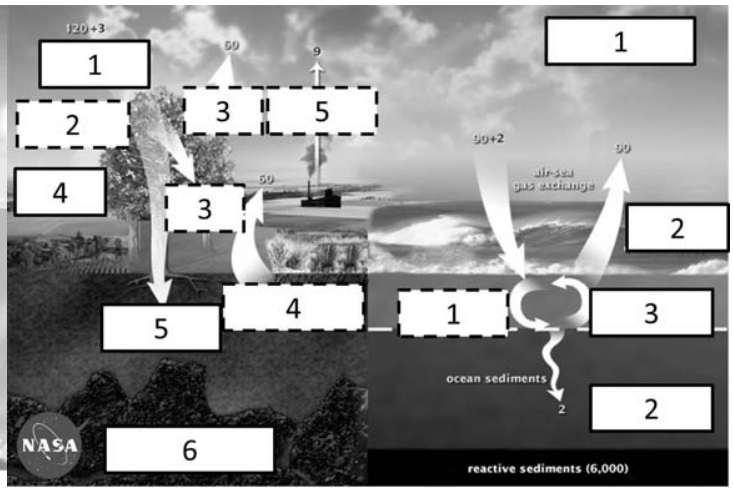
Water Cycle

Reservoirs (solid lines)	Processes (dashed lines)	
1. Atmosphere	1. Condensation	= from vapor (gas) to liquid
2. Ice & snow	2. Precipitation	= from water vapor (clouds) to land, streams, lakes, and ocean
3. Lakes & streams	3. Runoff	= from land to streams, lakes, and ocean
4. Ocean	4. Evaporation	= from streams, lakes and ocean to water vapor in the air
5. Groundwater	5. Infiltation (or percolation)	= from streams, lakes, and the surface of the land to groundwater

Water Cycle



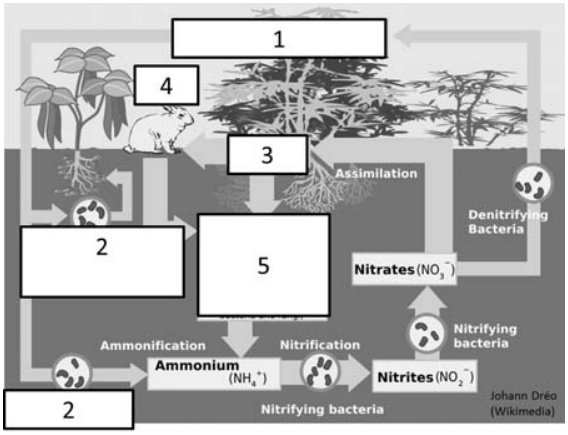
Carbon Cycle



Carbon Cycle

Reservoirs (solid lines)	Processes (dashed lines)	
1. Atmosphere	1. Photosynthesis	From air to plants
2. Ocean	2. Consumption	From plants to animals
3. Plants	3. Respiration	From living organisms to air
4. Animals	4. Decomposition	From ~~living~~ organisms to nutrients in soil
5. Soil	5. Human emissions	From human use of fossil fuels to air
6. Fossil fuels		

Nitrogen Cycle



Reservoirs (dashed lines)	
1. Atmospheric nitrogen (N2)	(78% of air in the atmosphere)
2. N-fixing bacteria (in legume root nodules & soil)	
3. Plants	
4. Animals	
5. Decomposers	

Nitrogen is very important for living organisms because we use it to make proteins.

Most processes in the nitrogen cycle are conducted by bacteria located in the soil.

CONSERVATION ECOLOGY KEY

1. biodiversity = the variety of organisms in a community
2. The two ecosystems with the highest biodiversity are tropical rainforest and coral reef, but California is very biodiverse too!
3. Over half of the species currently known are insects.
4. Of over a million animal species known, only 4,000 are mammals and only 42,000 have a backbone!
5. How do humans impact ecosystems and biodiversity?
   - Introduction of exotic species
   - Habitat destruction
   - Hunting/fishing
   - Pollution
   - Climate change

6. Invasive species are non-native species that harm the ecology, economy, or environment of areas to which they are introduced. Two examples of important invasive species in California are light brown apple moth and yellow starthistle, algae Caulerpa taxifolia.
7. We should be careful to minimize habitat destruction because it reduces biodiversity, increases our vulnerability to natural disasteres (such as Hurricane Katrina), and reduces ecosystem services (such as pollination of crops, cleaning of air and water, cycling of nutrients, and temperature regulation).
8. Hunting and fishing have caused many species to go extinct (including the Tasmanian tiger, Caribbean monk seal, and Baiji river dolphin) or become too rare to be worth hunting or fishing. However, we can help support environmentally friendly fishing by only buying and eating fishes that are green (color) on the Seafood Watch pocket guides.
9. The world's average air temperature has increased about 0.5 degrees Celsius in the last hundred years and is predicted to increase 1.8-4 degrees Celsius in the 21st century. This parallels an increase in atmospheric CO2 concentration, which is caused by combustion of fossil fuels in cars, power plants, and factories. This global warming will cause many problems, including sea level rise, melting of glaciers, and more droughts, heat waves, storms, and species extinctions.