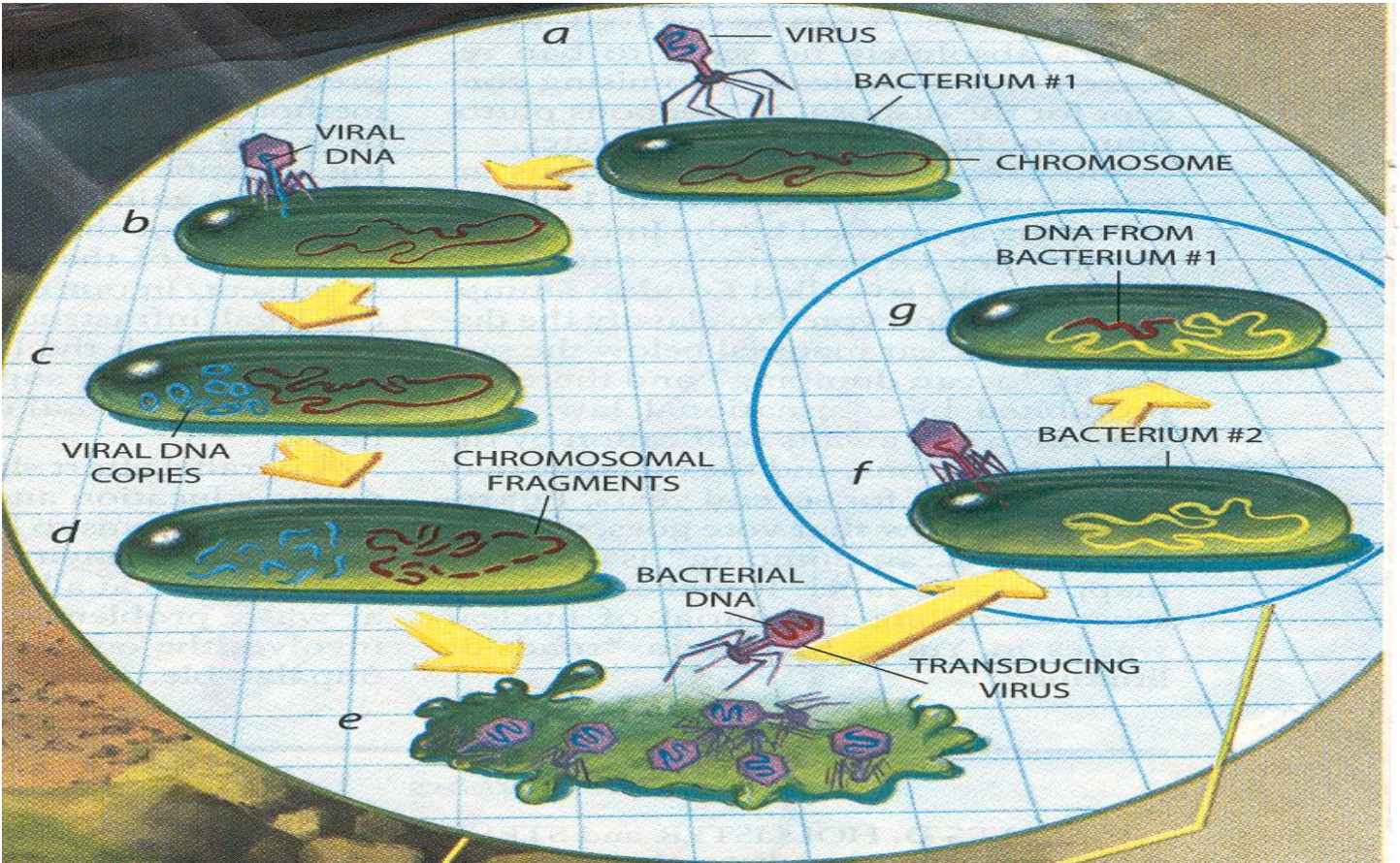
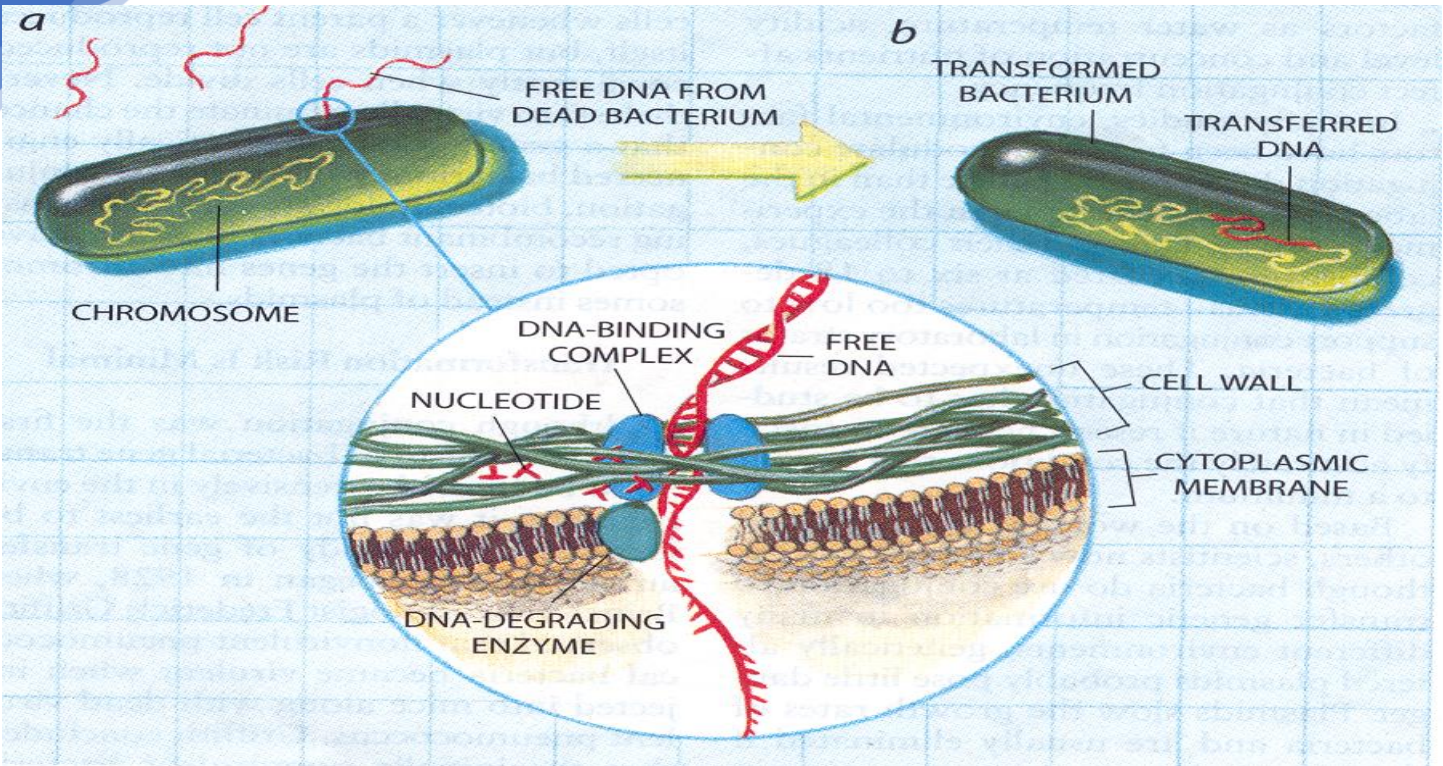
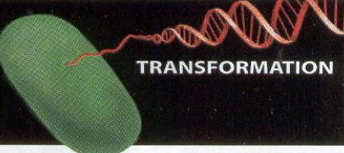
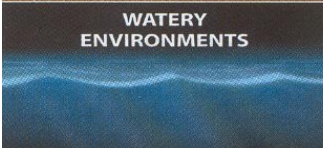
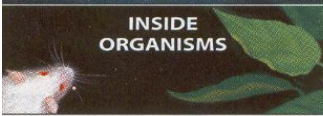




Where in Nature?

	 TRANSDUCTION	 CONJUGATION	 TRANSFORMATION
 TERRESTRIAL ENVIRONMENTS	Soil, plant surfaces	Soil, plant surfaces	Soil
 WATERY ENVIRONMENTS	Lakes, oceans, rivers, sewage in treatment facilities	Lakes, oceans, marine sediments, rivers, epilithon (slime layer) on river stones, sewage in treatment facilities	Marine sediments, rivers, epilithon on river stones
 INSIDE ORGANISMS	Shellfish, mice	Plants, insects, chickens, mice, humans	Plants, insects, mice

Summary of Prokaryote Evolution Mechanisms

- Mutation (micro or macro) changes genotype and possibly phenotype.
- Mobile genetic elements (insertions sequences and transposons) may rearrange genes between and within DNA molecules and this may cause mutations.
- Horizontal gene transfer (conjugation, transformation, transduction) may result in recombination of completely new genes.
- Selective pressures in the environment determine if a new phenotype becomes dominant in a population.
- Many changes in genotype are neutral or benign to phenotype and survival; these “cryptic” changes over time may result in genetic drift, i.e. a harmless variation of a gene randomly becomes dominant.

86-Evolutionary Biodiversity in Proterozoic Eon

Endosymbiosis and the Origin of Eukaryotic Cells

- Formed from several prokaryotic cells
 - In a symbiotic relationship
 - Symbiosis,
 - involving a prolonged association of two or more dissimilar organisms,
 - is quite common today
- In many cases both symbionts benefit from the association
 - as occurs in lichens,
 - once thought to be plants
 - but actually symbiotic fungi and algae

Evidence for Endosymbiosis

- Supporting evidence for endosymbiosis
 - comes from studies of living eukaryotic cells
 - containing internal structures called organelles,
 - such as mitochondria and plastids,
 - which contain their own genetic material
- In addition, prokaryotic cells
 - synthesize proteins as a single system,
- whereas eukaryotic cells
 - are a combination of protein-synthesizing systems

Organelles Capable of Protein Synthesis

- That is, some of the organelles
 - within eukaryotic cells are capable of protein synthesis
- These organelles
 - with their own genetic material

- and protein-synthesizing capabilities
- are thought to have been free-living bacteria
 - that entered into a symbiotic relationship,
 - eventually giving rise to eukaryotic cells

Multi-celled Organisms

- Obviously multi-celled organisms
 - are made up of many cells,
 - perhaps billions,
 - as opposed to a single cell as in prokaryotes
- In addition, multi-celled organisms
 - have cells specialized to perform specific functions
 - such as respiration,
 - food gathering,
 - and reproduction

87-Dawn of Multicelled Organisms

- We know from the fossil record
 - that multi-celled organisms were present during the Proterozoic,
 - but we do not know exactly when they appeared
- What seem to be some kind of multi-celled algae appear
 - in the 2.1-billion-year-old fossils
 - from the Negaunee Iron Formation in Michigan
 - as carbonaceous filaments
 - from 1.8 billion-year-old rocks in China
 - as somewhat younger carbonaceous impressions of filaments and spherical forms

Multi-celled Algae?

- Carbonaceous impressions
 - in Proterozoic rocks, Montana
- These may be impressions of multi-celled algae

The Multi-celled Advantage?

- Is there any particular advantage to being multi-celled?
- For something on the order of 1.5 billion years
 - all organisms were single-celled
 - and life seems to have thrived
- In fact, single-celled organisms
 - are quite good at what they do

- but what they do is very limited
- single celled organisms
 - can not grow very large, because as size increases proportionately less of a cell is exposed to the external environment in relation to its volume
 - and the proportion of surface area decreases
- Transferring materials from the exterior to the interior becomes less efficient
- Multi-celled organisms live longer,
 - since cells can be replaced and more offspring can be produced
- Cells have increased functional efficiency
 - when they are specialized into organs with specific capabilities

88-Other Proterozoic Animal Fossils

- A jellyfish-like impression is present in rocks 200 m below the Ediacara Hills
- Wormlike and algae fossils come from 700 to 900 million-year-old rocks in China but the identity and age of these "fossils" has been questioned

Wormlike Fossils from China

- Wormlike fossils from Late Proterozoic rocks in China

Soft Bodies

- All known Proterozoic animals were soft-bodied, but there is some evidence that the earliest stages in the origin of skeletons was underway
- Even some Ediacaran animals may have had a chitinous carapace and others appear to have had areas of calcium carbonate
- The odd creature known as *Kimberella* from the latest Proterozoic of Russia had a tough outer covering similar to that of some present-day marine invertebrates

Latest Proterozoic *Kimberella*

- *Kimberella*, an animal from latest Proterozoic rocks in Russia
 - Exactly what *Kimberella* was remains uncertain
 - Some think it was a sluglike creature
 - whereas others think it was more like a mollusk

Durable Skeletons

- Latest Proterozoic fossils
 - of minute scraps of shell-like material and small tooth like denticles and spicules, presumably from sponges indicate that several animals with skeletons or at least partial skeletons existed
- More durable skeletons of
 - silica, calcium carbonate, and chitin (a complex organic substance) did not appear in abundance until the beginning of the Phanerozoic Eon 545 million years ago = Cambrian age

89-Exploitation

Predation, Herbivory, Parasites and Disease

- The diversity of interactions between herbivores and plants, between predators and prey, and between parasites, pathogens, and hosts can be grouped under the heading of exploitation-- interactions between species that enhance the fitness of one individual at the expense of another.
- Exploitation weaves populations into a web of relationships that defy easy generalization.
- The number of exploitative interactions between species far exceeds the number of species in the biosphere, and the nature of exploitation goes far beyond the typical consumption of one organism by another.
- For instance, many parasites and pathogens manipulate host behaviour to enhance their own fitness at the expense of the host.
- Spiny-headed worms alter the behaviour of a variety of crustacean hosts in a way that increases the probability that the one host species will be eaten by another.
- A pathogenic fungus manipulates the growth program of its host plant in a way to produce "pseudoflowers," structures aimed at promoting the reproduction of the pathogen.
- In the process the pathogen usually kills the host plant and always renders it sterile.
- Predation by one flour beetle species on another can be used as a potent means of interference competition except in the presence of a protozoan parasite, which seems to give a competitive advantage to less predaceous species.

Examples

- Predators, parasites, and pathogens influence the distribution, abundance, and structure of prey and host populations.
- Herbivorous stream insects have been shown to control the density of their algal and bacterial food.
- The herbivorous moth larva *Cactoblastis cactorum* combined with pathogenic microbes reduced the coverage of prickly pear cactus in Australia from millions of hectares to a few thousand.
- A parasitic infestation reduced the red fox population in Sweden by 70%, which in turn led to increases in the abundance of several prey species eaten by foxes.
- This parasitic disease revealed the influence of a predator on its prey populations.

90-Ecological Relationships Ecological Relationships of Predator-prey, parasite-host, and pathogen-host

Relationships

- Predator-prey, parasite-host, and pathogen-host relationships are dynamic.
- Populations of a wide variety of predators and prey show highly dynamic fluctuations in abundance ranging from days to decades.
- A particularly well-studied example of predator-prey cycles is that of snowshoe hares and their predators, which have been shown to result from the combined effects of the snowshoe hares on the quantity and quality of their food and of the predators on the snowshoe hare population.

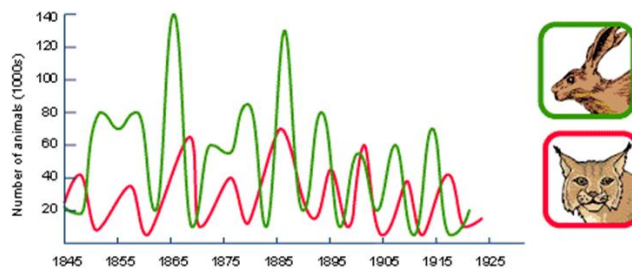
1. Predator Prey Relationships

Learning Objectives

- Be able to describe the relationship between predators and their prey.



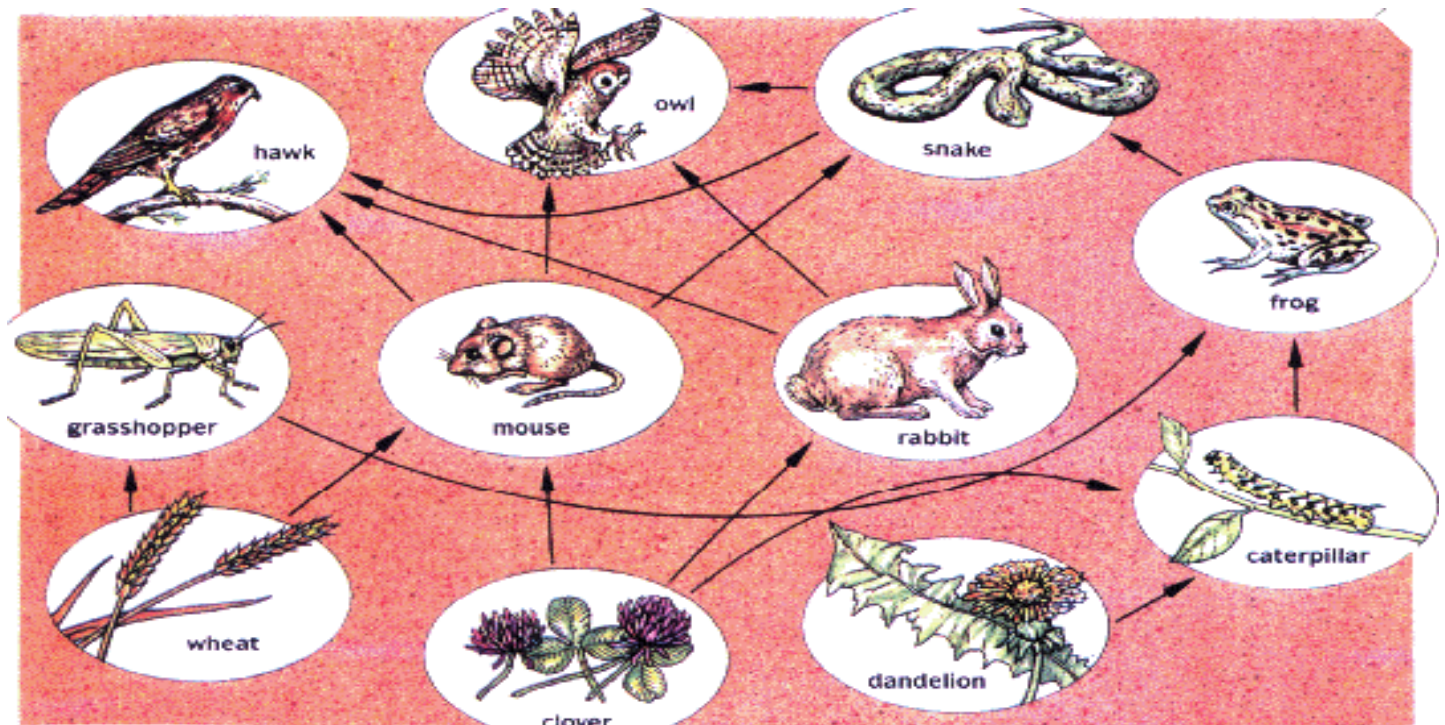
- Be able to explain the shape of a predator – prey graph.



2. Food web - Interdependence

Starter

If the mouse is considered a pest and baited, find as many effects on the food web as you can, in 3 minutes.



3. Food web – Interdependence

... and that was a simplified food web. Imagine the interactions in a less simplified web. Do you think the bobcat would be affected if the mosquito larvae were destroyed as a malaria risk?