Student learning objectives:
- Outline beneficial and negative ways that insects are important to people;
- Biodiversity and factors defining insect diversity and richness
- Ecological levels with a focus on agroecosystems
- Insect roles in ecosystem

Required reading: Pedigo and Rice Chapter 1

**Pest:** Any undesirable organism;
- Competitors for space or food
- Feed on desirable species
- Risk to human health
- Interfere with comfort and welfare

Anthropocentric (human-centered), ecologically artificial construct – no specific set of biological characteristics automatically define an insect as a pest

Insects as pests:
1. **Damaging** to crops, livestock, pets, ornamentals, natural resources through direct feeding or transmitting pathogens
   E.g. every plant, every plant part, every plant growth stage attacked by insects
2. **Injury** (e.g. bites, sting) and health risks to humans (e.g. vectors of various pathogens), annoyance
   - Bite/suck blood/external & internal parasites
   - Toxins
     - Sting & bite venoms
     - Allergens
   - Vector (transmit) pathogens
     - Malaria, yellow fever, filariasis, dengue, encephalitis
   - Psychological fear
     - Entomophobia
     - Delusory parasitosis
3. **Destruction of stored products, possessions and structures** (storage pests, pests of structures, museums)
   - Damage via consumption/contamination/heating & molds
   - annually destroy 5-10% world food production Example: carpet beetles

Insects as beneficial:
1. **Primary resource:** Direct use of insects and their products;
   Example 1; Honeybees:
   - Honey from floral nectar (= 60% water + 35% sucrose + 5% other) via honey bee collection, regurgitation, evaporation and gut enzymes to sweet thick fluid
(17% water + 31% glucose + 38.5% fructose + 1.5% sucrose + 7.2% maltose + 4.2% complex polysaccharides + antibiotics [gluconic acid & hydrogen peroxide]

- Other honey bee products: Wax from abdominal gland secretions of worker honey bee for comb-building to cosmetics (lip stick, lotions) and smokeless candles; royal jelly from hormonal secretion of worker honey bee mouthparts to folkloric “magic” medicine dietary supplement

Example 2; Silk moths:
- Silk fine fibrous protein filament produced by salivary gland of larval stage of silk moth, *Bombyx mori* (Lepidoptera: Bombycidae)

Example 3; Human foods (entomophagy) feeding on insects as a food source would have both Environmental and dietary benefits:

*Environmental benefit:*
- High food conversion efficiency
- Low greenhouse gas and ammonia emissions
- Reduced zoonotic infections
- Water conservation

*Dietary value:*
- Source of protein; quality may vary based on insect species and its developmental stage,
- Source of fat; groups such as termites and palm weevil larvae contain high fat contents,
- Iron and Zinc content of insect is of greater importance; mostly overlooked,
- Chitin, chitosan and chitooligosaccharides are compounds with immunity enhancing effects

2. Intermediate (secondary) resource: Interact w/environment to indirectly provide products/services

- Pollination- transfer of male gametophyte (pollen) from stamen in seed plants to receptive surface of female organs (stigma) for fertilization of ovule two pollen-transfer mechanisms:
  a. Abiotic transfer via non-living physical forces esp. wind floral features: small, inconspicuous flowers no nectar-producing glands millions of tiny, dry pollen grains plant examples: grasses, conifer trees, hardwood shade trees
  b. Biological transfer via living agents esp. insects (bees & wasps, flies, butterflies & moths, beetles) floral features: large, showy, smelly flowers; glands produce sugary nectar smaller amounts of pollen; large, sticky grains

  Plant examples: fruits & vegetables that require honeybees- cane berries: raspberries & others; pome fruits: apple, pears, stone fruits apricots, cherries, peaches, cucurbits cucumbers, melons, pumpkins, squash; cole crops: broccoli, cabbage, Brussels sprouts, cauliflower mustards radish; Alliums: garlic, leek, onion, nuts almonds, cashew macadamia encephalitis

- Natural enemies (predatory and parasitic insects)
a. Predators, often generalists consume many prey; many predaceous as both immatures and adults
b. Parasitoid usually specialists require 1 host for egg-to-adult development parasitic as immatures free-living adults (vs parasite) weed biocontrol agents
- Decomposers and scavengers in forensic entomology
- Wildlife food (esp. fish, amphibians, reptiles, birds, small mammals (processed feeds for pets & domestic animals)
- Scientific/biological experimental animals (genetics, behavior, evolutionary biology, toxicology)- Example the fruit fly Drosophila melanogaster (Diptera: Drosophilidae).

Biodiversity: Variations in organisms and functions at all ecological levels
Genetic diversity: Variations in genes at different ecological levels
Species diversity: Variety of species within a community
Ecosystem diversity: Region-specific community of organisms
Functional diversity: Various processes in an ecological system

Definitions:
Population: Individuals of the same species within a described area
Community: Populations of different species in the same described area interacting through spatial and trophic relations
Ecosystem: An ecological unit including community of organisms interacting with and within their environment

Insect richness is reflected in the number of known species, estimated number of species and comparative biodiversity of insects (in relation to other taxa)

Richness in plant species and ecological niches can contribute to insect species richness

Ecological niche is defined by both occupied space by and functional role of the species.

Ecological relationships involving insects:
Decomposers (detritivory, saprophagy)?
Predation?
➢ Herbivory
➢ Carnivory
Parasitism?
➢ Parasite: Negative fitness effects on host but do not kill the host
➢ Parasitoids: Parasitic at the larval stage but not as adults
Symbiosis?
Competition?