Goal:
1. Understand the postmortem interval, insect development, role of insects in decomposition and ecological succession.
2. Learn about the stages of animal decomposition and the insects associated with each stage.
3. Learn about the barriers to decomposition.

Websites:
http://www.forensic-entomology.com/
http://www.uio.no/~mostarke/forens_ent/forensic_entomology.html
http://www.key-net.net/users/swb/forensics/index.htm

I. Introduction and Definition of Forensic Entomology
Forensic entomology is the application of the study of insects and other arthropods to legal issues, especially in a court of law. The most common application of the medicocriminal category related to death investigations. Key elements in these investigations, such as time since death (that is the time between death and corpse discovery, which is generally referred to as the postmortem interval or PMI), movement of the corpse, manner and cause of death, associated of suspects with the death scene, as well as detection of toxins or drugs through analysis of insect larvae, may all relate to arthropod occurrence and activities.

Although forensic entomology includes several categories, the type that we will be talking about is medicolegal forensic entomology. It deals with arthropod involvement in events surrounding felonies, usually violent crimes such as murder, suicide, and rape but also includes other violations such as physical abuse and contraband trafficking. A more accurate name for this category is medicocriminal forensic entomology.

II. History of Forensic Entomology

The most common application of the medicocriminal category related to death investigations. Key elements in these investigations, such as time since death (that is the time between death and corpse discovery, which is generally referred to as the postmortem interval or PMI), movement of the corpse, manner and cause of death, associated of suspects with the death scene, as well as detection of toxins or drugs through analysis of insect larvae, may all relate to arthropod occurrence and activities.
III. Basis for Use of Insects in Determining Postmortem Intervals

IV. Types of Insect Development

A. Ametabolous metamorphosis - without change- spring tails

B. Gradual metamorphosis - gradual change from immature to adult. Cockroaches, predatory bugs

C. Complete metamorphosis - egg-larvae-pupa-adult-larvae different from adult, example maggot and fly. Probably the most common stage encountered in crime investigations -- important to collect both adults and immatures.

V. Ecological Role of Insects in Decomposition

1. Necrophages - the species feeding on corpse tissue. Include most rue flies (Diptera) and beetles (Coleoptera). Age determination of these insects usually basis for making PMI estimations.

2. Omnivores - species such as ants, wasps, and some beetles that feed on both the corpse and associated fauna. Large populations of these may retard the rate of corpse decomposition by depleting populations of necrophagous species.

3. Parasites and Predators - many beetles, true flies and wasps that parasitize immature flies.

4. Incidials - arthropods that use the corpse as a concentrated resource extension of their normal habitat, eg. Eprintails, spiders, centipides, pill bugs, and some mites.

VI. Concept of Ecological Succession as Applied to Insects Being Used to Determine PMI

Estimates of postmortem intervals based on insects present on the remains may be based on.

A. The period of time required for a given species to reach a particular stage of development.

B. Comparisons of assemblages of insects present on the remains at the time of examination.

C. A combination of both - the preferable situation.

The basic concept of ecological succession is that any unexploited habitat, in this case, a corpse, will be invaded by a series of different organisms. The initial invasion will be by colonizing forms which will alter the habitat in some form by their activities. This alteration will serve to make the habitat attractive to a second wave of organisms which will, in turn, alter the habitat for use by yet another organisms.
VII. Stages of Human Decomposition and Associated Anthropods

Studies of decay rates of 150 human corpses in the Anthropological Facility in Tennessee revealed that the three most important environment factors in corpse decay: temperature, access by insects, and depth of burial.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Stiffness</th>
<th>Time of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm</td>
<td>Not stiff</td>
<td>Not dead more than three hours</td>
</tr>
<tr>
<td>Warm</td>
<td>Stiff</td>
<td>Dead between 3 to 8 hours</td>
</tr>
<tr>
<td>Cold</td>
<td>Stiff</td>
<td>Dead between 8 to 36 hours</td>
</tr>
<tr>
<td>Cold</td>
<td>Not stiff</td>
<td>Dead in more than 36 hours</td>
</tr>
</tbody>
</table>

VII. Stages of Human Decomposition and Associated Anthropods

Five stages of human decomposition have been recognized:

**Fresh Stage** - Initial decay (Days 1-2) -- Commences at moment of death and ends when bloating is first evident. Autolysis, the breakdown of complex protein and carbohydrate molecules into simpler compounds, occurs during this stage, but few gross changes. (Flesh flies, Blowflies, Ants feeding on eggs of adult flies, Wasps predatory on adult flies)

**Bloated Stage** (Days 2-6) -- Putrefaction, the principle component of the decomposition process, begins during this stage. Gasses produced by the metabolic activities of the anaerobic bacteria first cause a slight inflation of the abdomen. The carcass may later assume a fully inflated, balloon-like appearance. Adult and larval blowflies in large numbers attracted to fluids seeping from body, normal soil dwelling fauna depart soil because of seepage of fluids; some muscid flies and ants which can feed on larvae and retard maggot activity.

**Decay Stage** - Black Putrefaction (Days 5-11) -- Decay stage begins when the abdominal wall is broken, allowing gasses to escape and carcass deflates. This process is facilitated by feeding activities of larval flies present on the exposed remains. Adult flies start to leave body, mainly larval mass. Carcass begins to assume a blackened, wet appearance, and most of the flesh will be removed by the maggots. Toward end of this period, carcass will begin to dry and beetles feed on drier tissue. Flies start to pupate. Predatory beetles such as rove beetles and histerids come to feed on other insects.

**Postdecay Stage** - Butyric fermentation (Days 10-25) -- In dry habitats, remains consisted of dry skin, cartilage and bones. Site for dermestid beetles, histerids, fly pupae, immature and adult rove beetles. In wet habitats, a large quantity of wet, viscous material, termed byproducts of decomposition, was found in the soil under the remains. Site for immature and adult moth flies, sphaerocerid and muscid flies, rove beetles.
VII. Stages of Human Decomposition and Associated Anthropods

Dry Stage (Days 25+) -- This stage is reached when mainly bones and hair remain. Odor is primarily that of normal soil and litter. Some dermestid beetles, histerids, fly pupae, immature and adult rove beetles, normal soil fauna (mites) start to return. Can last several months to even years.

VIII. Barriers to Decomposition and Irregular Decomposition

A. Physical -- soil, water, caskets, antemortem and postmortem injuries

B. Chemical -- embalming agent, insecticides

C. Climatic -- heat, cold, wind, rainfall

D. Animals -- birds, mice, rodents

IX. Collection and Use of Data for Estimation of Post-Mortem Interval

Possibly the greatest potential source of error in using arthropod successional patterns lies in the collection of specimens. Must only be done correctly.

A. Slide of Collecting Insects for Homicide Investigations
B. Slide of Proper Labeling of Specimens
C. Read article I provided you on the collection and preservation of forensically important entomological materials and chapter from Entomology and Death book (order blanks with handouts)

X. Case Histories of the Use of Insects

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