Greenhouses
Objectives

Students will learn...

Differences between different types of greenhouse structures

How to design a greenhouse that fits their production needs and fits into a particular farming plan.

Basic techniques for managing and growing in greenhouses (organic and permaculture approaches)
Definitions

greenhouse: a glass or plastic-covered building which protects plants from cold weather

hoop house: an unheated greenhouse

cold frame: a small version of a hoop house; plants are often accessed from outside the structure

hot bed: a cold frame with supplemental heat
Different options
1. **Hoop House**

- generally arched
- provides light and temperature control
- used to overwinter hardy crops (broccoli, cabbage, etc., or start hardy spring crops)
- may be covered with polyethylene film, shade fabric or have no covering during warm season
- when a supplemental heater is added, the structure is often referred to as a "greenhouse"
2. Cold Frames

• Similar to a hoop house. May be partially set into ground.
• Typically not as tall
• Generally used for overwintering hardy spring crops or provide protection to bulb crops
• No heating or cooling systems.
3. Hot Beds

• some type of heat source provides more control over temperature
• heat source: boiler, electrical, incandescent light bulbs, composting manure
• mostly used for starting plants in early spring
4. Shade Houses

- Structures covered with fabric made of polypropylene, cotton, plastic or other material to partially exclude light.
- Some materials are aluminized so that the light is actually reflected away from the structure.
- Typically shading materials exclude 20-60% of light.
- Typically do not have heating or cooling systems.
- Used for cut flowers, foliage plants and nursery stock.
5. Typical Greenhouse Designs
Quonset

Based on arched roof.
A-Frame

Usually a series of supporting trusses that forms the roof and gables.
Ridge and furrow or Gutter Connected

- Two or more greenhouses built side by side and connected to each other.
- Most commercial greenhouses use a gutter connected design.
- Allows for larger, unobstructed interior than stand-alone houses.
Added on to a building

• Can be added to the south side of an existing structure.
• Can utilize heat from the structure when needed.
• May provide seasonal heat the building to which it is connected.
• Commonly added to barns, outbuildings our houses.
Roll-up Walls

• Allow for more precise temperature control.
• Used to mitigate heat build-up on sunny days.
• Can be useful in providing
A structure must meet the building codes for a specific location. Make sure you talk to your local inspectors.
Structural Design Considerations: Load

- Dead load includes: weight of structure, framing, glazing, permanent equipment, heating and cooling units, vents, etc.
- Live load includes: weight of people working on roof, hanging plants, snow loads, wind loads.
- Most greenhouses are required to support an 80 mph wind.
- Required snow load is based on expected accumulation, roof slope and on greenhouse design.
Structural Design Consideration: Light

• The objective is to maximize light transmission. Thus, material usage and the framing should be take this into account.

• Greenhouses should be built far away from trees or other structures that could shade the greenhouse.
Structural Design Consideration: Water

- Irrigation should be thought about before construction begins.
- Consider plumbing in a frost-free hydrant within the structure.
- Water-catchment systems can catch and store water for later use in areas with low rainfall.

http://www.youtube.com/watch?feature=player_detailpage&v=3j09zP84boM
Choose a greenhouse for your needs

Seed starting for home garden? **Cold frame or hot bed**

Seed starting for a small farm? A small, heated **greenhouse**

Winter vegetable production? A large heated **greenhouse or unheated hoop house**

Season extension? **Unheated hoop house**
Greenhouse growing tips: Spring crops

Common greenhouse crops: Carrots, radishes, turnips, spinach, kale, lettuce, arugula

Not usually grown in greenhouse: new potatoes (too slow), peas (grow too tall)
Greenhouse growing tips: Spring crops

Seeding schedule for Northern climates:

- Carrots: mid-Dec to March
- Turnips and kale: March
- Radishes, lettuce, spinach, arugula: Jan-April
Greenhouse growing tips: Spring crops

Tip: Because of close spacing, overhead irrigation is recommended.

Tip: On nights that will get below freezing, suspend a mid-weight row-cover one foot above crops.
Greenhouse growing tips: Summer crops

Common greenhouse crops for summer production: peppers, tomatoes, cucumber, eggplant, basil
Greenhouse growing tips: Summer crops

Transplant schedule for Northern climates (6 to 8 weeks from seeding):

**peppers/eggplant:** April (heated greenhouse), May 15 (unheated greenhouse)

**tomatoes:** March 15 (heated), April 15 (unheated)

**cucumber/basil:** May 1 (heated), May 15 (unheated)
Greenhouse growing tips: Summer crops

Tip: crops will grow taller in greenhouses, so consider trellising them to rafters in the greenhouse

Tip: Summer crops often do not like wet leaves, so irrigate with drip tapes
Greenhouse growing tips: Fall/winter crops

Common crops for Fall/winter greenhouse: carrots, pac choi, spinach, lettuce, turnips, radish, arugula, kale
Greenhouse growing tips: Fall/winter crops

Seeding schedule for Northern climates:

**Carrots:** late-July
**Turnips, pac choi, kale:** late-July to late-August
**Radishes, lettuce, spinach, arugula:** Sept 15-Oct 30
Greenhouse growing tips: Fall/winter crops

Tip: In heated greenhouses, set heaters to 32 degrees F

Tip: In unheated greenhouses, suspend mid-weight row covers one foot above crops

Tip: Water less in the winter to avoid mildew and mold
Self-Review Questions

- What types of structures for growing plants are best for season extension?
- What plants are best in an unheated hoop house in the spring? And in the summer?
- What types of load on the structure need to be taken into account?
Resources

http://faculty.yc.edu/ycfaculty/ags250/week04/greenhouse_types_and_structures/Greenhouse_types_and_structures_print.html

Eliot Coleman, *Four-Season Harvest*, 1999