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

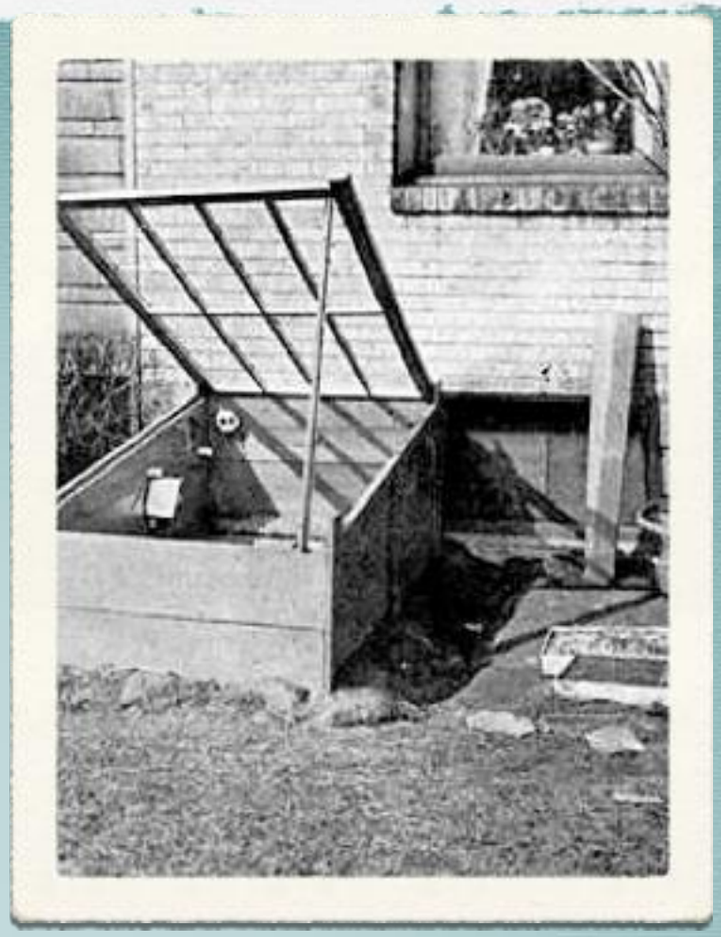
- generally arched
- provides light and temperature control
- used to overwinter hardy crops (broccoli, cabbage, etc, or start hardy spring crops
- may be covered with polyethylene film, shade fabric or have no covering during warm season
- when a supplemental heater is added, the structure is often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

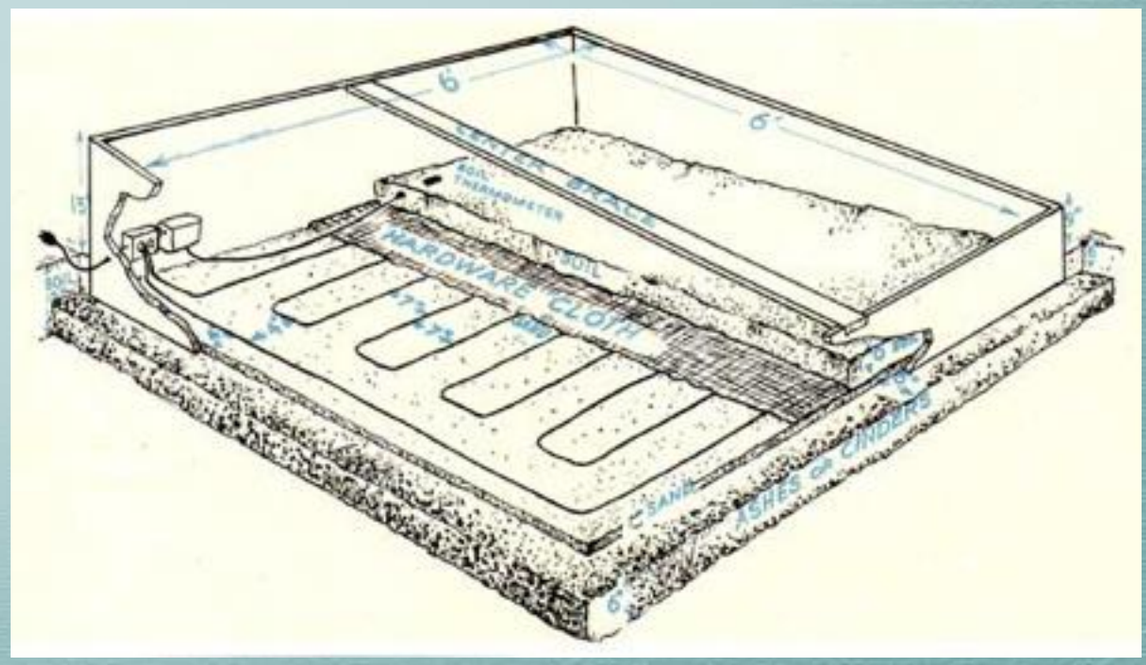
2. Cold Frames

- 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

Figure 1. Freestanding hobby greenhouse styles

Quonset

Based on arched roof.

A-Frame

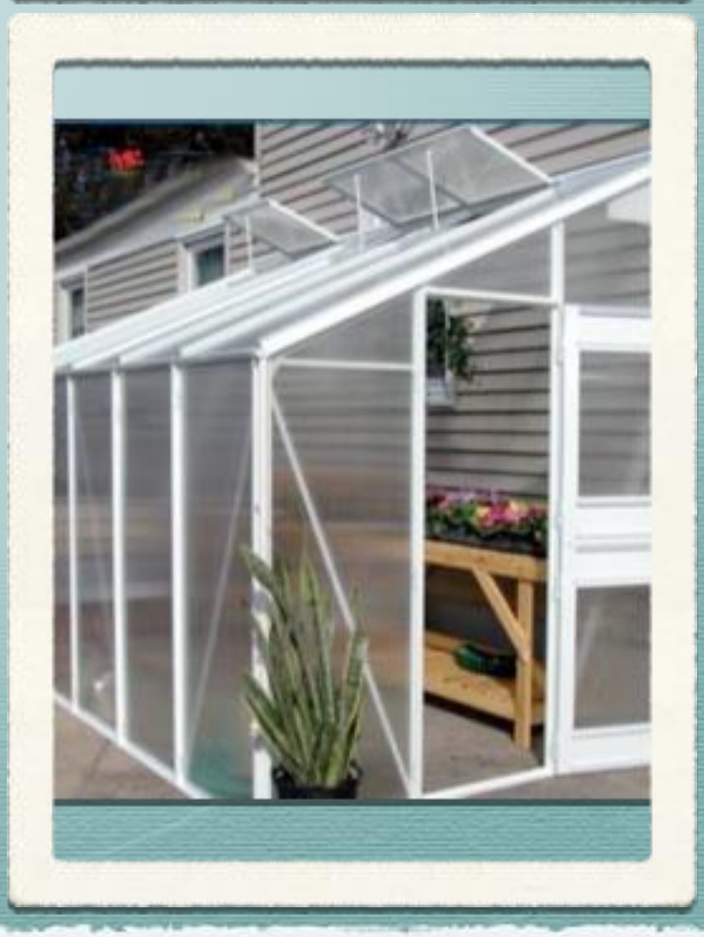
Usually a series of supporting trusses that for the roof and gables.

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

Structural Design Considerations

A structure must meet the building codes for a specific location.

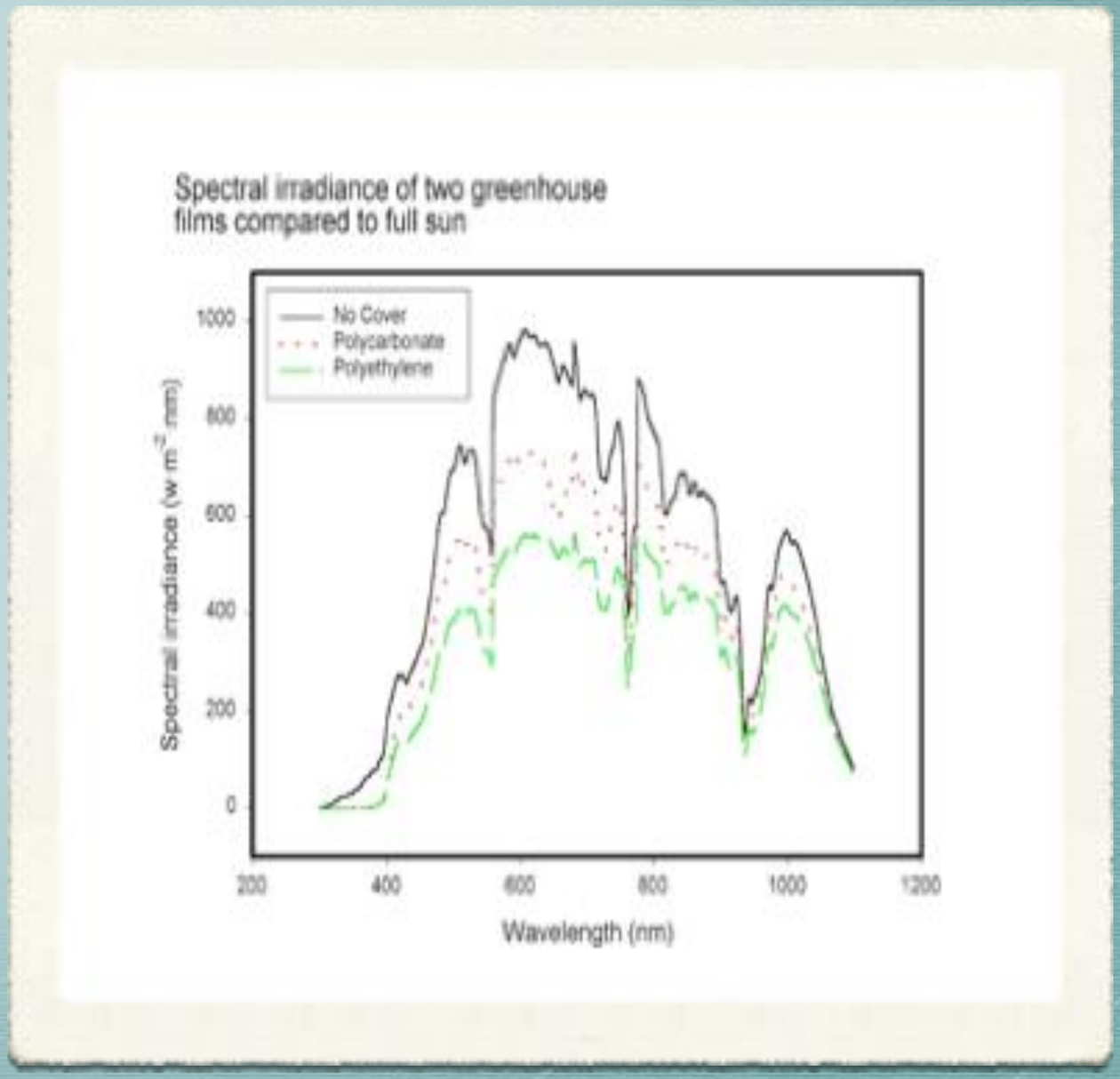
Make sure you talk to your local inspectors.

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

PLAY!

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, *Winter Harvest Manual*, 2012

Eliot Coleman, Four-Season Harvest, 1999

The Hoophouse Handbook, Growing for Market, 2006