



**Desired Learning Outcomes**

- Individual and family goals.
- Farm and local food system goals.
- Available educational resources.
- Suitable crops and conditions necessary.
- Methods and costs of construction.
- Sources of funding for cold cellars.
- Needs to be either searched out or discovered through research.

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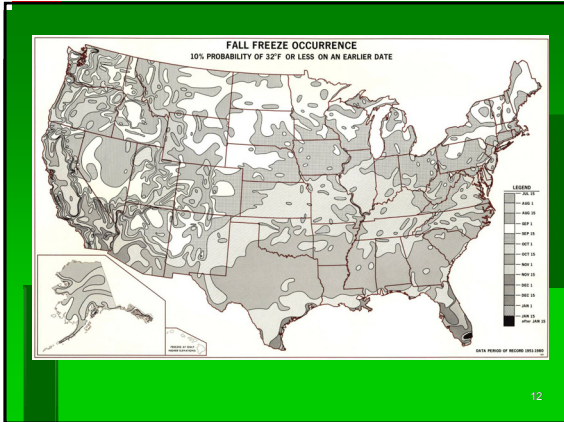
**Presentation Outline**  
See Handout – Seven C’s

1. Concepts
2. Crops
3. Conditions
4. Construction
5. Considerations
6. Containers
7. Combinations

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**Why Season Extension and Year-round Farming?**

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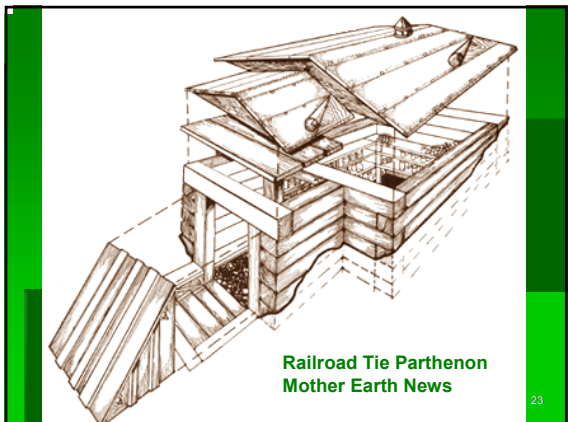
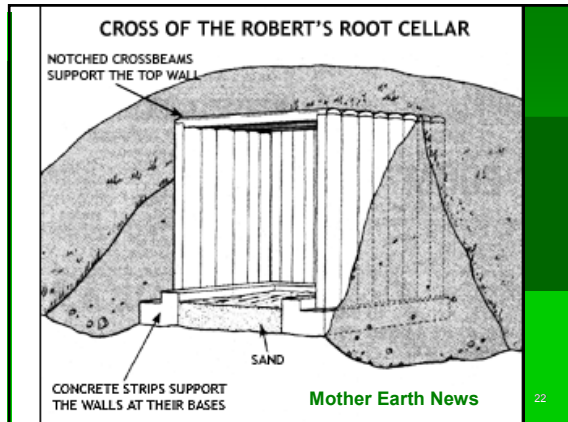
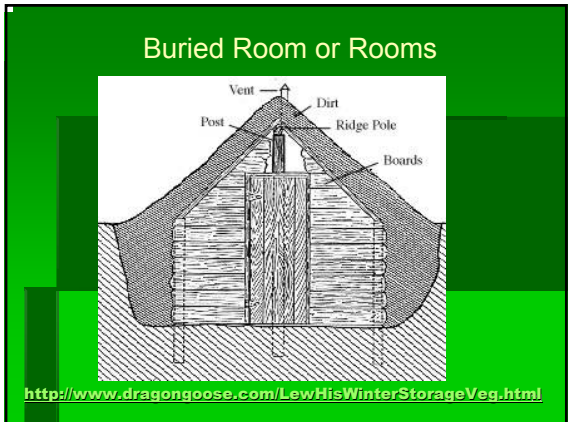
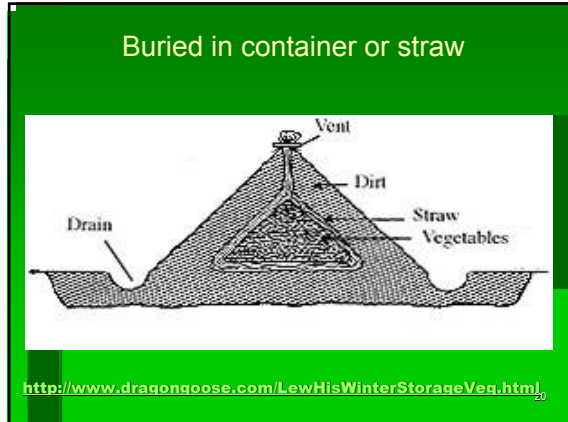


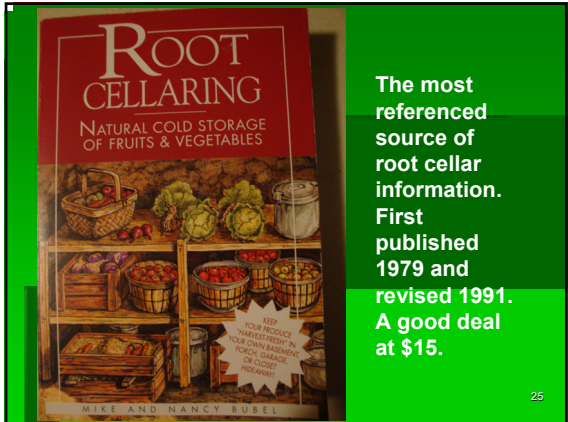


- ### Food Processing & Preservation
- Refrigeration and Cooling
  - Freezing (energy, flavor, nutrition)
  - Canning (Salsa, Tomato based products, etc)
  - Dehydration (herbs, cherries, cranberries, blueberries, etc)
  - Freeze-drying (more commercial or larger scale?)
  - Salting (osmotic conditions limit microorganisms)
  - Pickling (vinegar, acidic pH)
  - Jams and Jellies (sugar)
  - Pasteurizing (heat; impact on nutrition?)
  - Fermentation (renewed interest?, improves nutrition?)
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- ### Energy & Global Warming
- MSU Forestry class prepared a carbon budget of the Student Organic Farm.
  - Carbon from uses including electric, gasoline for tractors, tillers, mowers, trucks for transportation and employee and member miles was 2.4 tons/year.
  - Carbon for refrigeration was 200 tons/yr or 98% of the carbon.
  - An acre of trees for an offset
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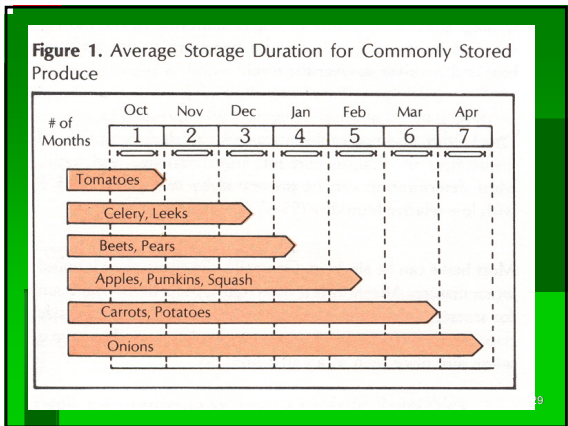
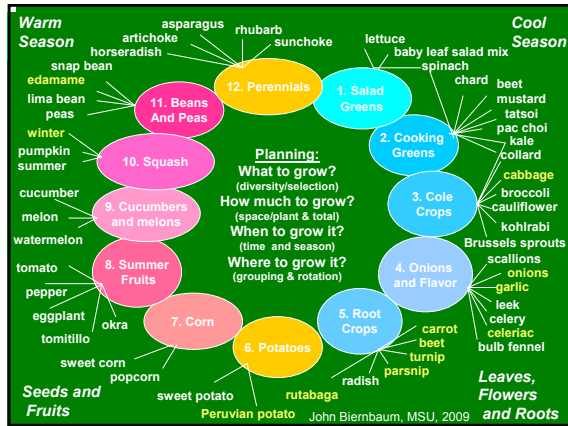
The most referenced source of root cellar information. First published 1979 and revised 1991. A good deal at \$15.

### Root Cellaring Topics

- Growing the right crops for storage.
  - Variety selection
  - Scheduling for late harvest
- Harvesting high quality produce and preparing it for storage.
  - Recommended stage of development and harvest methods.
  - Pratreatment to insure maturity of squash, onions, potatoes, garlic.
- Specific crop storage recommendations or uses.
  - Vegetables
  - Fruits (ethylene considerations)
  - Other: eggs, pickled or fermented foods, mushroom production, root media for transplants.
- Construction
  - Small buried containers
  - Basement root closets
  - Excavated cold cellars
- Personal experiences
- Recipes

### Crops and Conditions

- What Crops?
- How Long?
- What Conditions?
  - Temperature
  - Humidity
  - Ventilation - ethylene



### Multiple Environments

Humidity	Dry	Moist
Temperature	(<70% RH)	(80-90% RH)
Cold Temp (33-40F)	onions garlic	potatoes cabbage
Cool Temp (50-60F)	winter squash sweet potato	cucumbers tomato

### Multiple Environments

Humidity	Dry (<70% RH)	Moist (80-90% RH)
Cold Temp (33-40F)	onions garlic	potatoes cabbage (first choice)
Cool Temp (50-60F)	winter squash sweet potato (second choice)	cucumbers tomato

### Multiple Environments

Humidity	Dry (<70% RH)	Moist (80-90% RH)
Cold Temp (33-40F)	onions garlic	potatoes cabbage
Cool Temp (50-60F)	winter squash sweet potato	cucumbers tomato

- ### Example Crop Categories
- Low temp (32F) low humid (<60%)
    - onions and garlic
  - Low temp (32F) high humid (90%)
    - carrots, beets, turnips, rutabagas, leeks
  - Cold Temp (35-45F) high humid (90%)
    - potato, cabbage,
  - Cool temp (50-60F) low humid (<60%)
    - winter squash, sweet potato
  - Cool temp (50-60F) and high humidity(90%+)
    - Cucumber, summer squash, tomato, pepper, eggplant

- ### Ventilation is important
- Produce is alive and "breathing" – using oxygen and producing carbon dioxide.
  - Ventilation is important to bring in fresh air, for cooling and for humidity control.
  - When moisture is to high, fresh dry air is brought into the cellar.
  - Can be on a timer or managed with a thermostat.
  - Outside air temperature must also be taken into consideration.

- ### Construction Options
- Buried direct or in container
  - Insulated room in basement or building
  - Buried Room or Rooms
    - Would not recommend wood?
    - Stone or block cemented together
    - Formed and poured cement walls
    - Precast sections assembled
    - Precast vaults or culverts





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[http://www.stonestructures.org/html/root\\_cellars.html#NewLondon](http://www.stonestructures.org/html/root_cellars.html#NewLondon)  
 built ~ 1918

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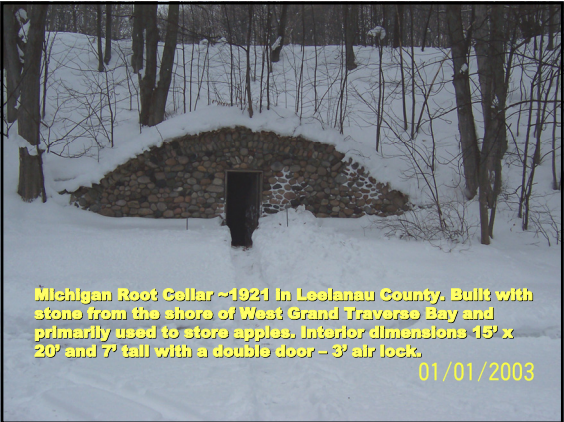


[http://www.stonestructures.org/html/root\\_cellars.html#NewLondon](http://www.stonestructures.org/html/root_cellars.html#NewLondon)

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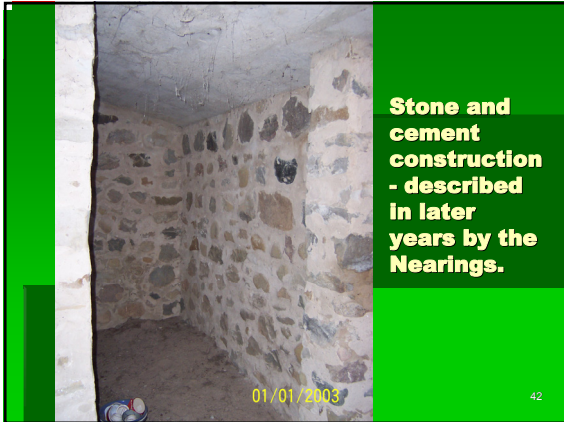


[http://www.stonestructures.org/html/root\\_cellars.html#NewLondon](http://www.stonestructures.org/html/root_cellars.html#NewLondon)



Michigan Root Cellar ~1921 in Leelanau County. Built with stone from the shore of West Grand Traverse Bay and primarily used to store apples. Interior dimensions 15' x 20' and 7' tall with a double door - 3' air lock.

01/01/2003



**Stone and cement construction - described in later years by the Nearings.**

01/01/2003

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## Root Cellar Finished



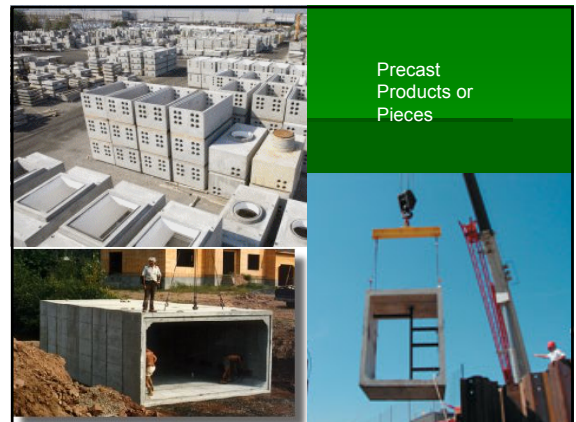
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## Root Cellar Landscaped



Basic Costs about \$3000 total  
Hole excavation - \$200  
Cement for footer - \$200  
Block \$1 each - \$600  
Block \$2 each - \$1200  
Roof materials - \$600  
Vents and Elec materials - \$100

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### Considerations and Containers

- Temperature
  - Rate of cooling in fall
  - Addition of refrigeration?
- Humidity
  - Reduce by ventilation
  - Increase by wetting floor or walls
- Ventilation- Ethylene

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### MSU-SOF 40F Cooler

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### Beets in Wood Shavings

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### Cabbage that got too wet?

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### Celeriac or Celery Root

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**Potatoes in Bulb Crates**



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**Harvesting and Storage Containers**



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**Bulk Bins – wood or plastic**



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**Second Cooler – Warmer and Drier**



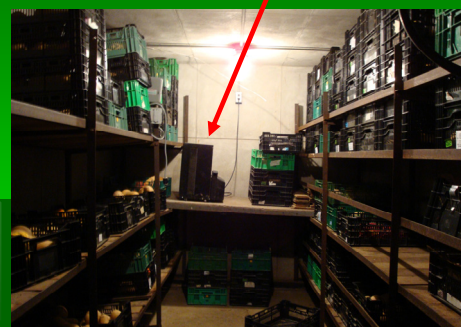
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**Butternut Squash**

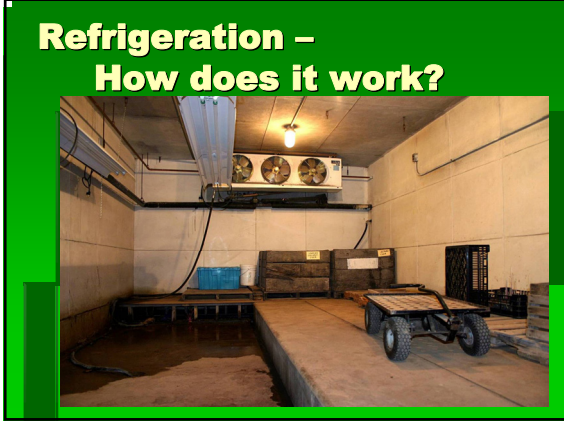


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**Dehumidifier**



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### Combinations

- Foundation for a building above
- Mushrooms
- Fermentation
- Geothermal heat for hoopouses
- Seed germination medium

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### Integral Agriculture

*Friends and Families  
 Using Facts and Feelings to  
 Faithfully, Physically and Fearlessly  
 Farm  
 Front-yards, Forests, and Fields For Food,  
 Feed, Fodder, Fiber, Fuel, Flowers, Fertility,  
 Fun, Freedom, Fairness and the Future*

John Biernbaum