Four-Season Growing in Wisconsin

Let's look at some ideas for growing year round in Wisconsin. These can be as simple as insulated covers for cold-hardy greens to in-ground greenhouses with passive and active heating.

Scott A. J. Johnson

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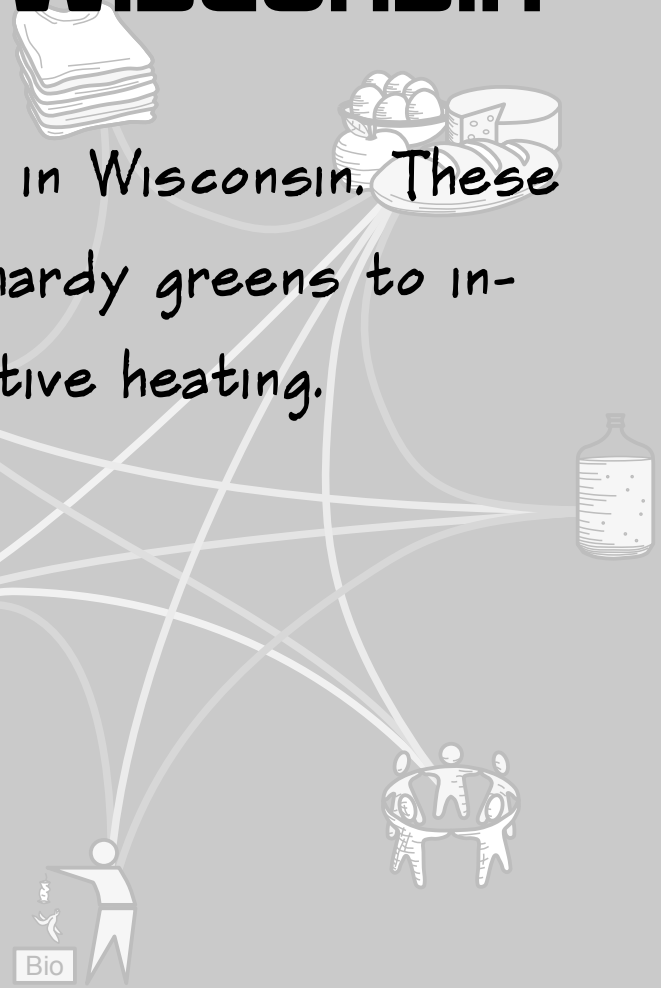

Four-Season Growing in Wisconsin

Today's Topics

Baseline & Assumptions

Biological Adaptations

Methodological Adaptations

Infrastructure

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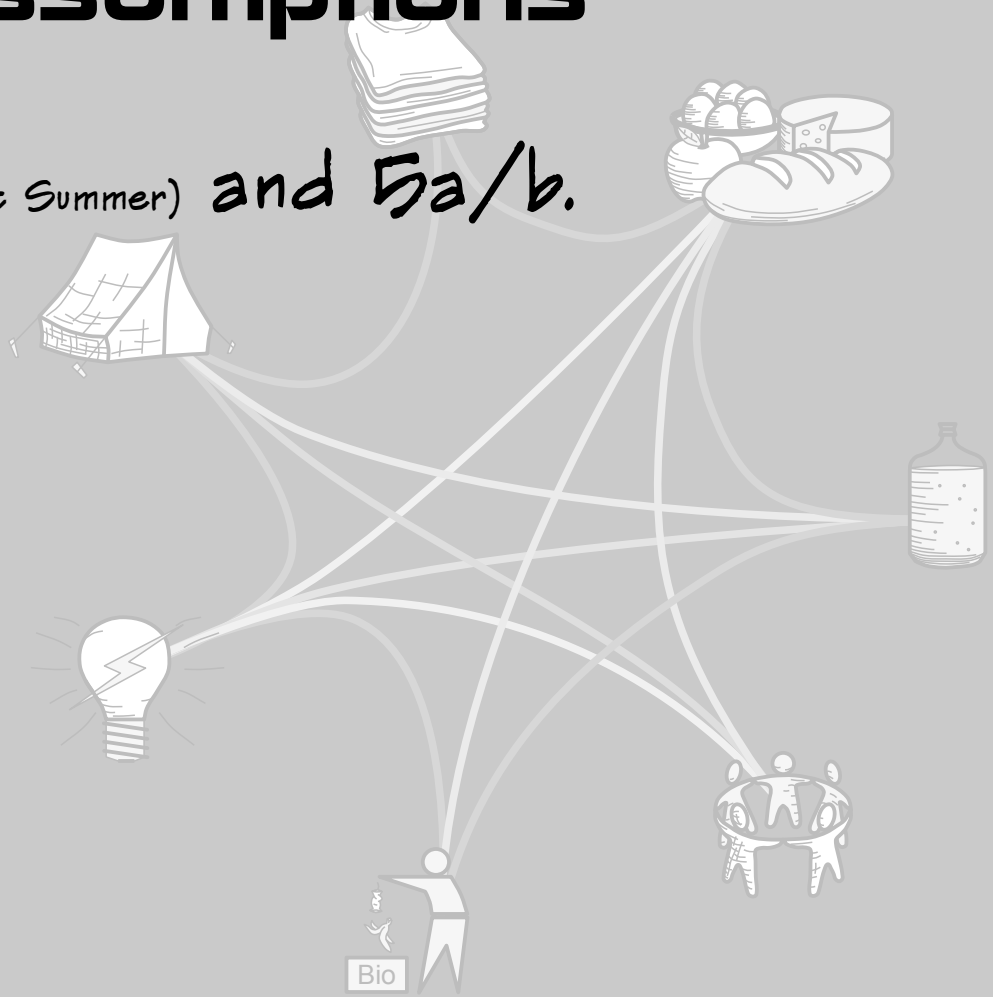
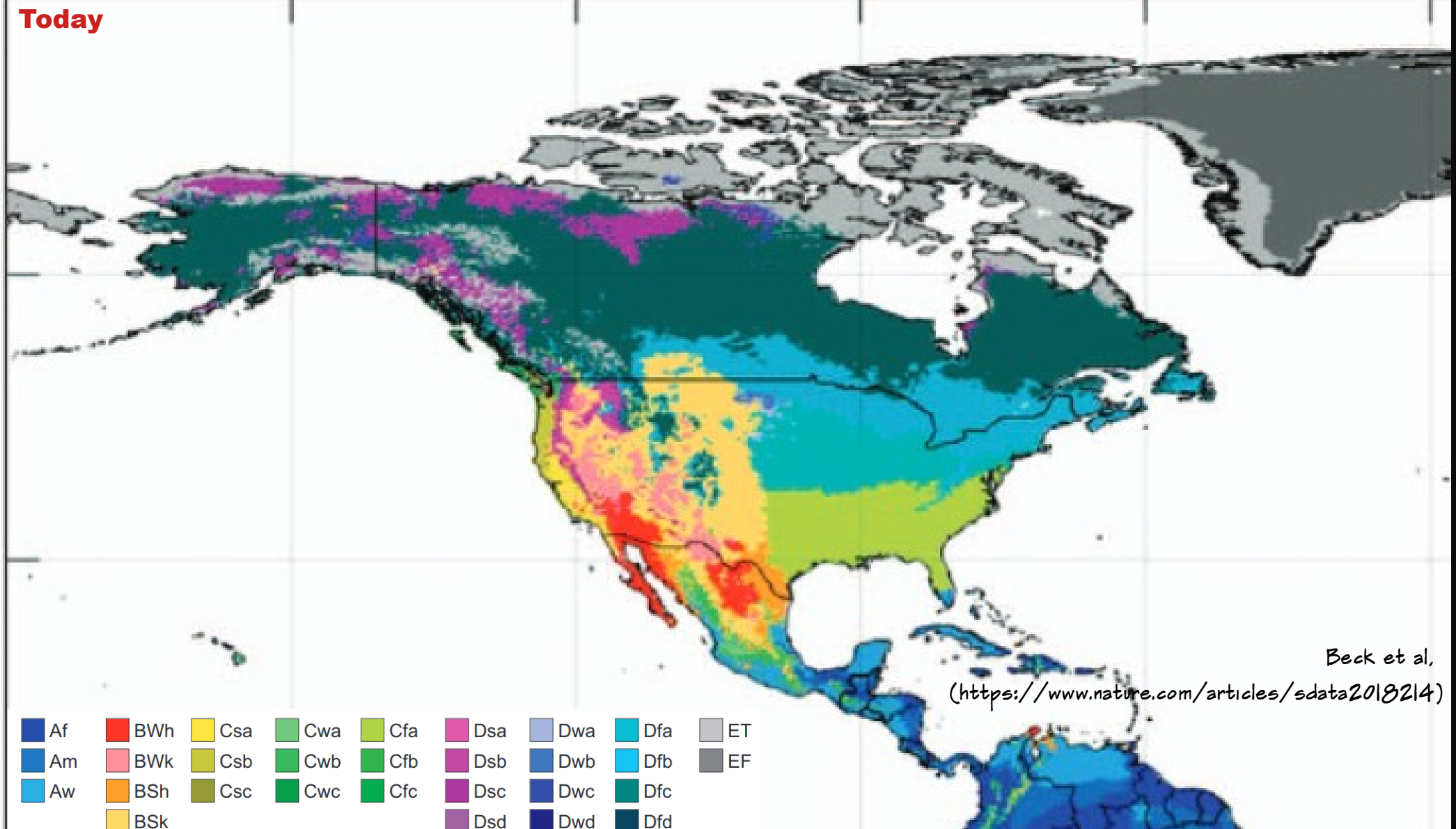
Baseline & Assumptions

- Today's Dfa (Continental, Humid, Hot Summer) and 5a/b.
- Assumptions




Today
Af
Am
Aw
BWh
BWk
BSh
BSk
Csa
Csb
Csc
Cwa
Cwb
Cwc
Cfa
Cfb
Cfc
Dsa
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Dsc
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Dwa
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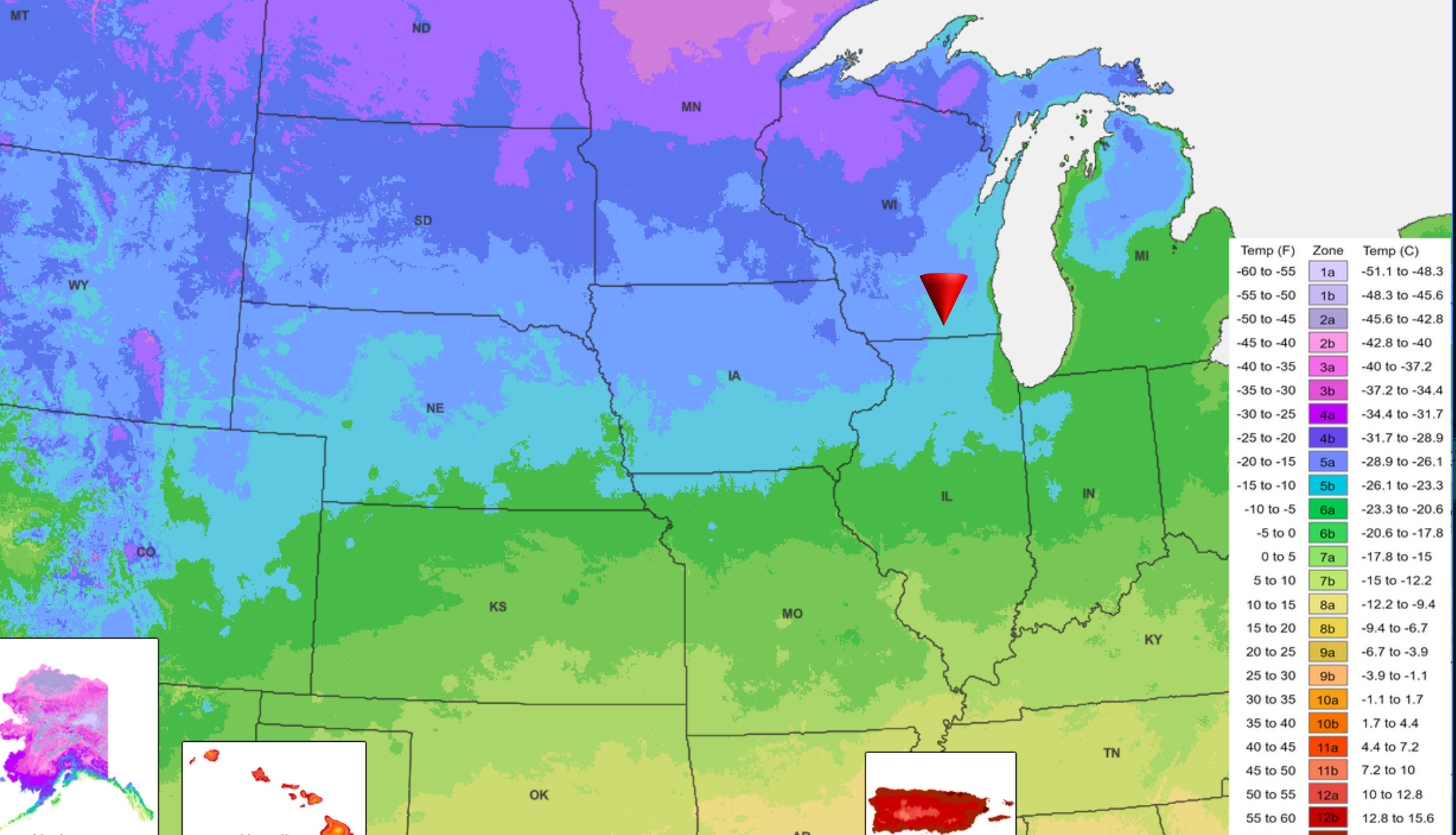
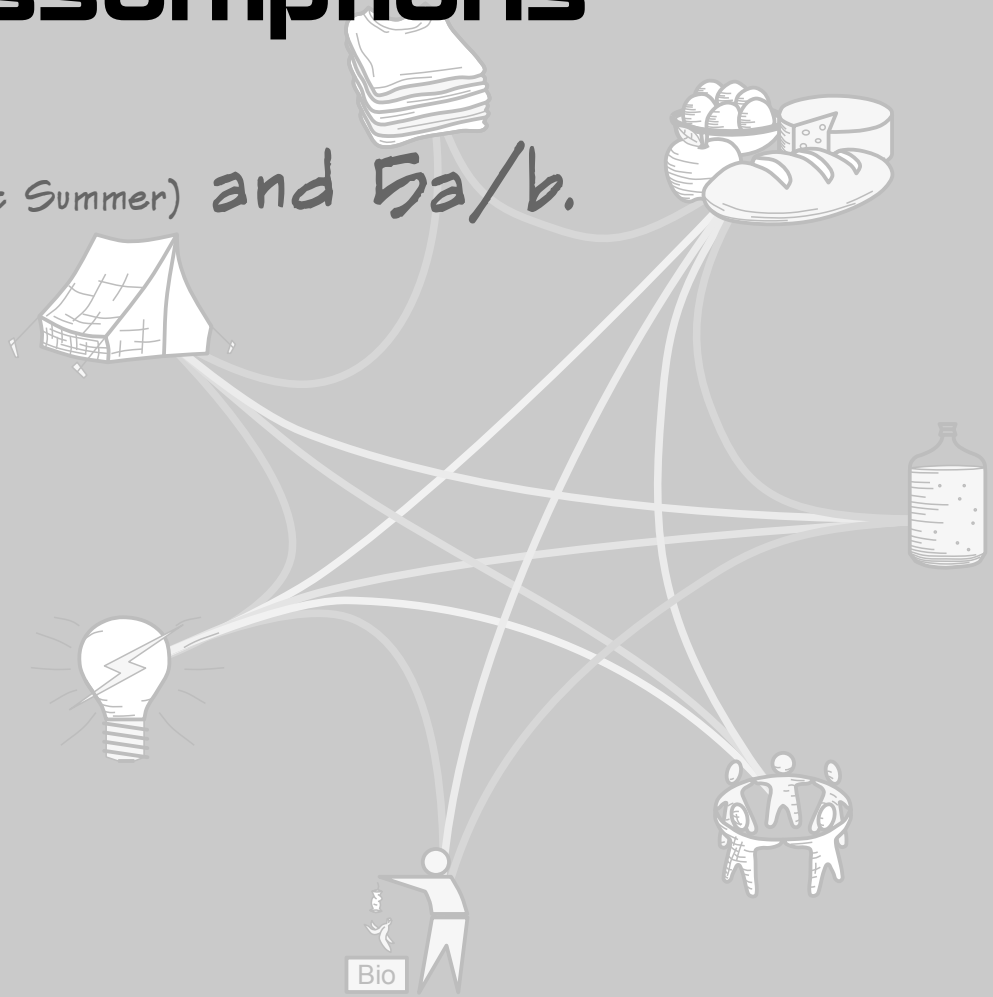
Dfc
Dfd
ET
EF
Beck et al,
(https://www.nature.com/articles/sdata2018214)



Temp (F)	Zone	Temp (C)
-60 to -55	1a	-51.1 to -48.3
-55 to -50	1b	-48.3 to -45.6
-50 to -45	2a	-45.6 to -42.8
-45 to -40	2b	-42.8 to -40
-40 to -35	3a	-40 to -37.2
-35 to -30	3b	-37.2 to -34.4
-30 to -25	4a	-34.4 to -31.7
-25 to -20	4b	-31.7 to -28.9
-20 to -15	5a	-28.9 to -26.1
-15 to -10	5b	-26.1 to -23.3
-10 to -5	6a	-23.3 to -20.6
-5 to 0	6b	-20.6 to -17.8
0 to 5	7a	-17.8 to -15
5 to 10	7b	-15 to -12.2
10 to 15	8a	-12.2 to -9.4
15 to 20	8b	-9.4 to -6.7
20 to 25	9a	-6.7 to -3.9
25 to 30	9b	-3.9 to -1.1
30 to 35	10a	-1.1 to 1.7
35 to 40	10b	1.7 to 4.4
40 to 45	11a	4.4 to 7.2
45 to 50	11b	7.2 to 10
50 to 55	12a	10 to 12.8
55 to 60	12b	12.8 to 15.6

Baseline & Assumptions

- Today's Dfa (Continental, Humid, Hot Summer) and 5a/b.
- Assumptions

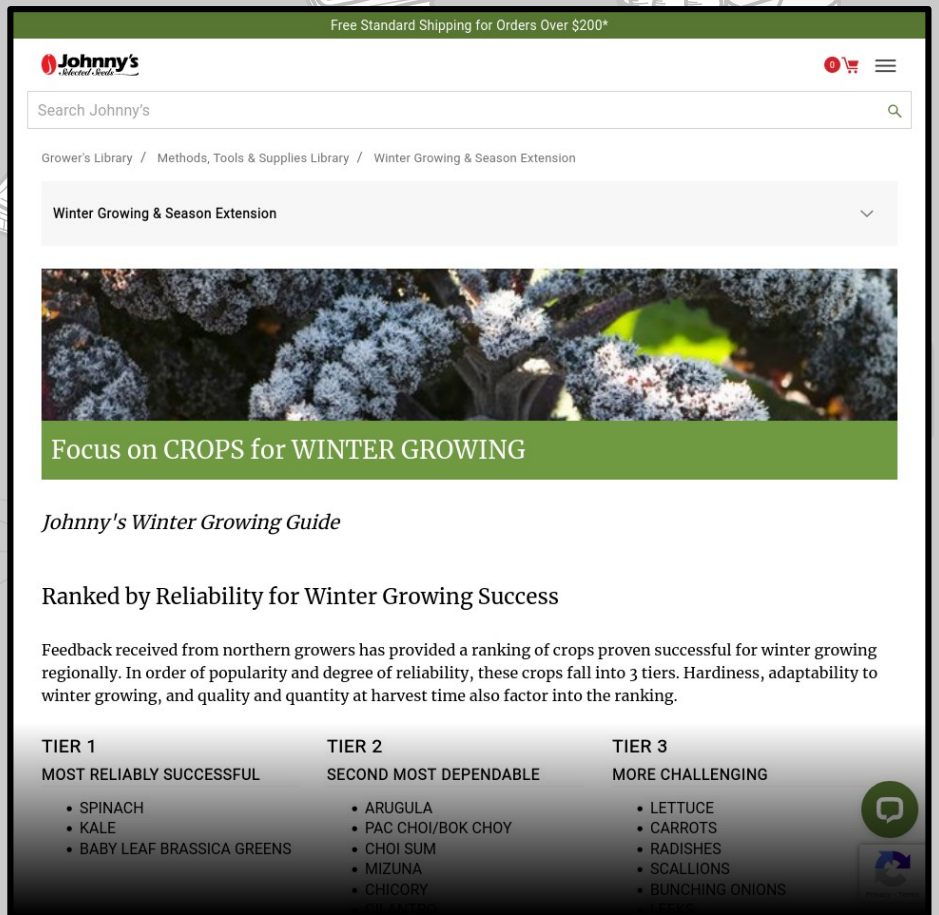


Biological Adaptations

- Caveats

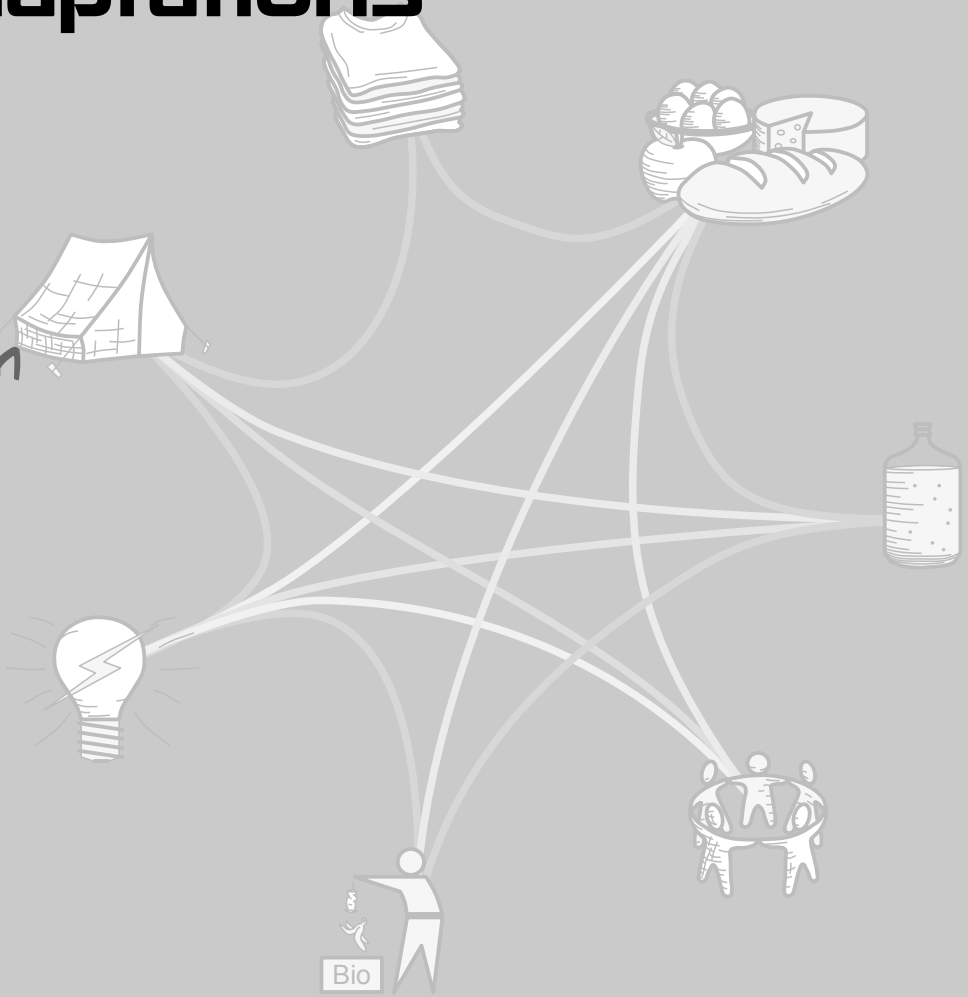
Biological Adaptations

- Caveats
- General Variety Selection
  - Slow, stubby, short, & dry
  - AB Test!
  - Save your seeds



Biological Adaptations

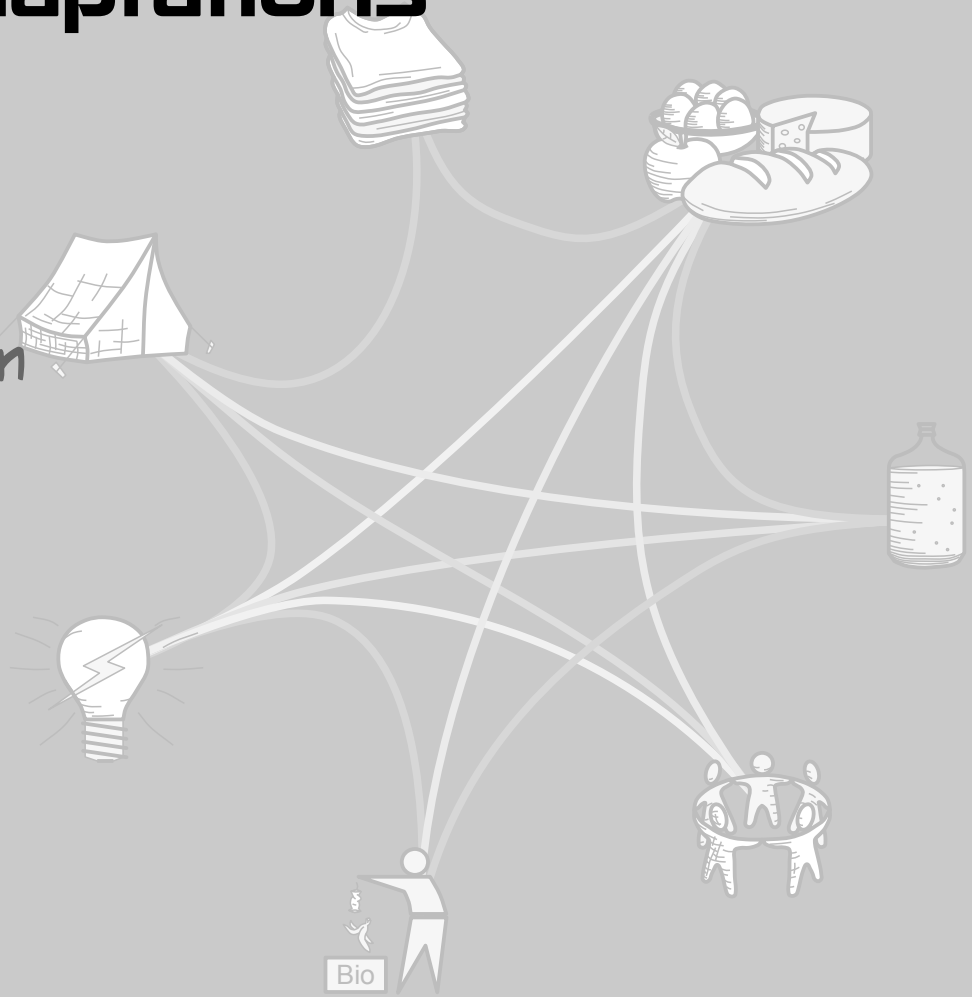
- Caveats
- General Variety Selection
- Specific Varieties
  - Available as handout.



- Beets, 15-20°F: Winterkeeper, Lutz, Rouschka, Albino, Chioggia
- Broccoli, 15°F: purple sprouting, nine star perennial
- Brussels Sprouts, 0-10°F : Long Island improved, Roodnerf, Rubine, Red Ball
- Cabbage, 25°F: Landgedijker, Glory of Enkhuizen, Christmas Drumhead, Rodyna, Kappertjes, Ormskirk, January King, Early Jersey, Tete Noir.
- Carrots, 15°F: Nantes
- Cauliflower, 32°F: English winters, Walcherines, Armado.
- Chinese Cabbage, 25°F:
- Collards,0-10°F: Vates, Champion, Georgia, Cabbage
- Kale, 10-15°F: Tall Scotch, semi-dwarf, Tall Curled, Cottagers, Thousand-Head, Tuscan.
- Kohlrabi, 10°F: Purple Vienna, Vienna, Superschmeltz
- Leeks, 20°F: Carentan, Blue de Solaise.
- Lettuce, 10-20°F: Oakleaf, Prizehead, Kwiek, Marvel of Four Seasons, Rouge d'Hiver, Pirat, Red Montpelier, Winter Density, Blushed Butter Oak, Little Gem.
- Mache/Corn Salad, 0°F:
- Mustard, 25°F: Pak/Bok Choy, Green Wave, Tendergreen, Santoh Frilled
- Radish, 10°F: China Rose, Black Spanish, Daikon
- Rutabaga, 15°F: Laurentian.
- Spinach, 20°F: Cold-resistant Savoy, Giant Winter, Winter Bloomsdale
- Swish Chard, 20°F:
- Turnip,10-15°F: Golden Ball, Orange Jelly, Golden Perfection.

Biological Adaptations

- Caveats
- General Variety Selection
- Specific Varieties



Methodological Adaptations

- Warnings

Methodological Adaptations

- Warnings
- Soil Drainage

signs of well-drained soil

- soil is loose & allows plant growth
- bright soil color
- sightings of earthworms & beneficial insects
- water drains well & soil is moist
- soil has a crumbly texture
- soil pH range is balanced

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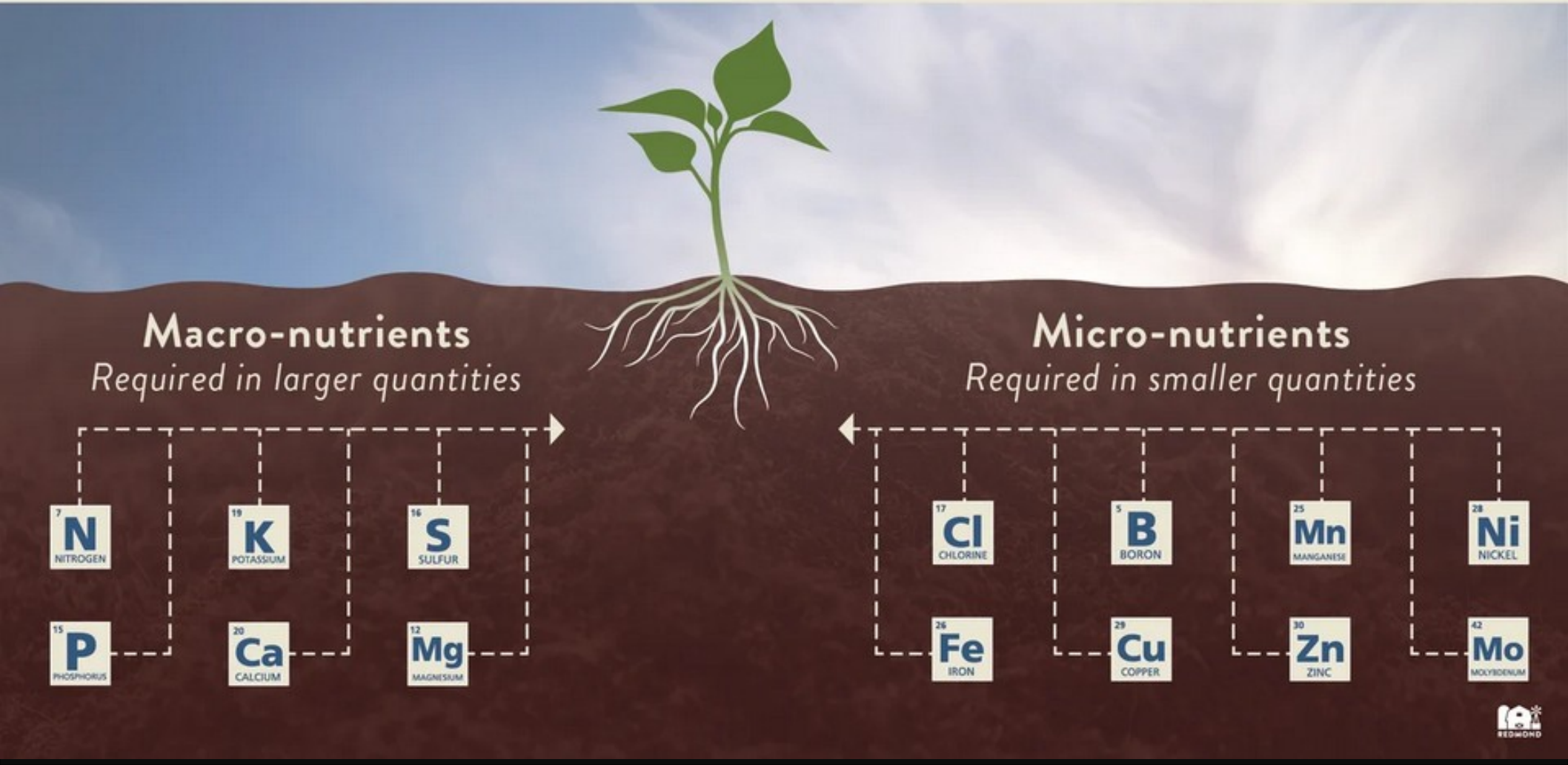
Methodological Adaptations

- Warnings
- Soil Drainage
- Soil Nutrients

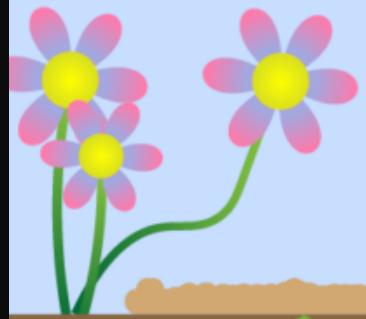
MACRO & MICRONUTRIENTS...BOTH ARE ESSENTIAL

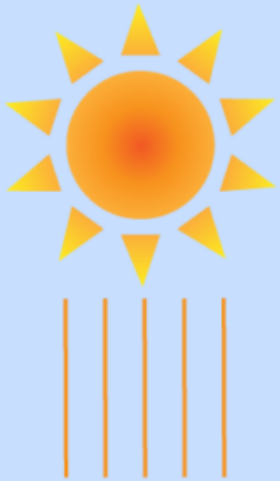


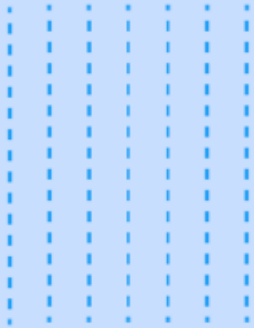
Methodological Adaptations

- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch

Benefits of Using Mulch







2" to 3" of Mulch

Nourishes Soil

As ORGANIC mulch decomposes, it nourishes your soil and feeds your plants. This happens over time.

Suppresses Weeds

Mulch cuts weed seeds off from sunlight. This prevents them from growing enough to break through the surface.

Conserves Water

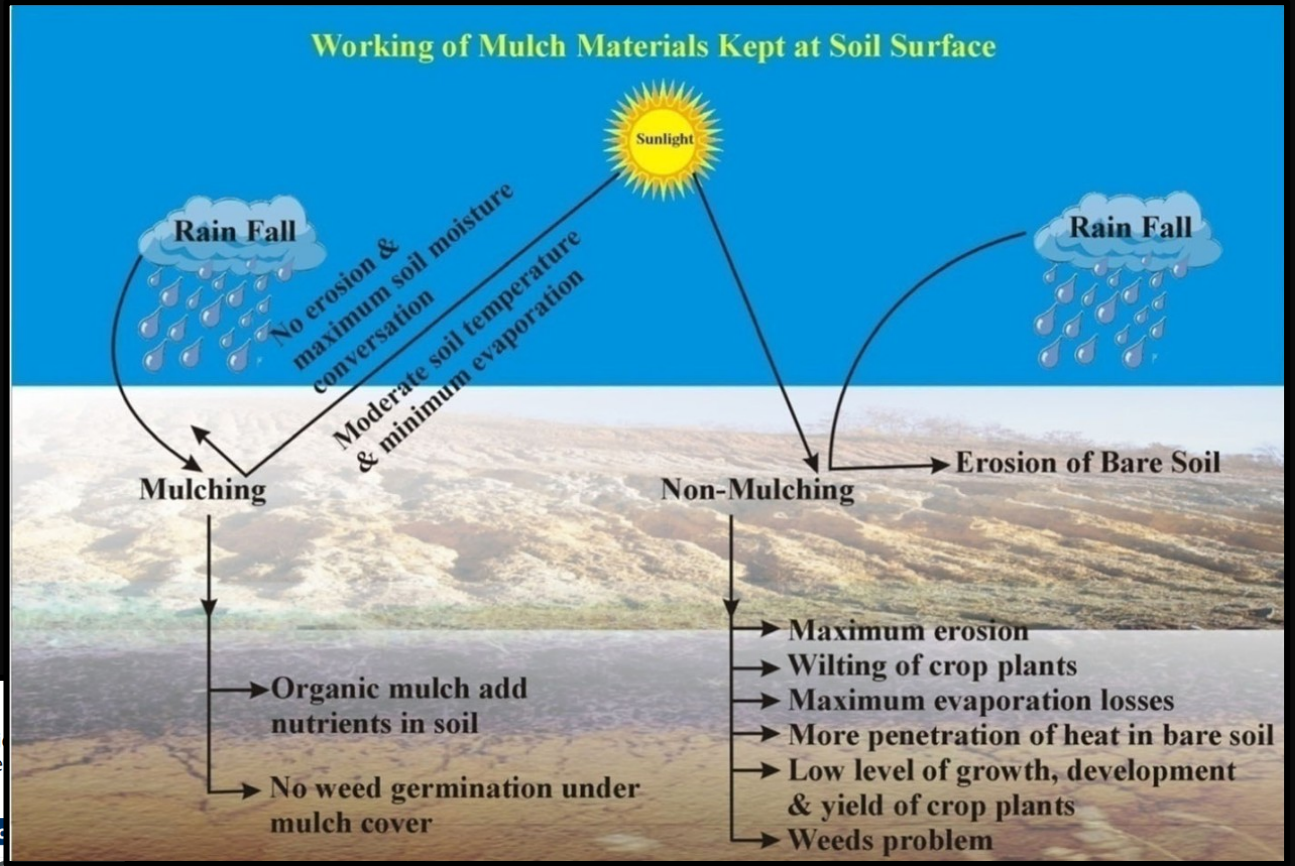
Mulch helps soil retain moisture. This lowers the amount of watering needed in your plant bed.

Regulates Temperature

Mulch insulates your plants' root systems against the sun and extreme temperature variations.

Prevents Erosion

Mulch acts as the first defense against nature's elements that threaten to wear away your soil.



Iqbal *et al. Bulletin of the National Research Centre* (2020) 44:75
https://doi.org/10.1186/s42269-020-00290-3

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REVIEW Open Acc

Potential agricultural and environmental benefits of mulches—a review

Rashid Iqbal[1], Muhammad Aown Sammar Raza[1*], Mohammad Valipour[2], Muhammad Farrukh Saleem[3], Muhammad Saqlain Zaheer[1], Salman Ahmad[1], Monika Toleikiene[4], Imran Haider[1], Muhammad Usman Aslam[1] and Muhammad Adnan Nazar[1]

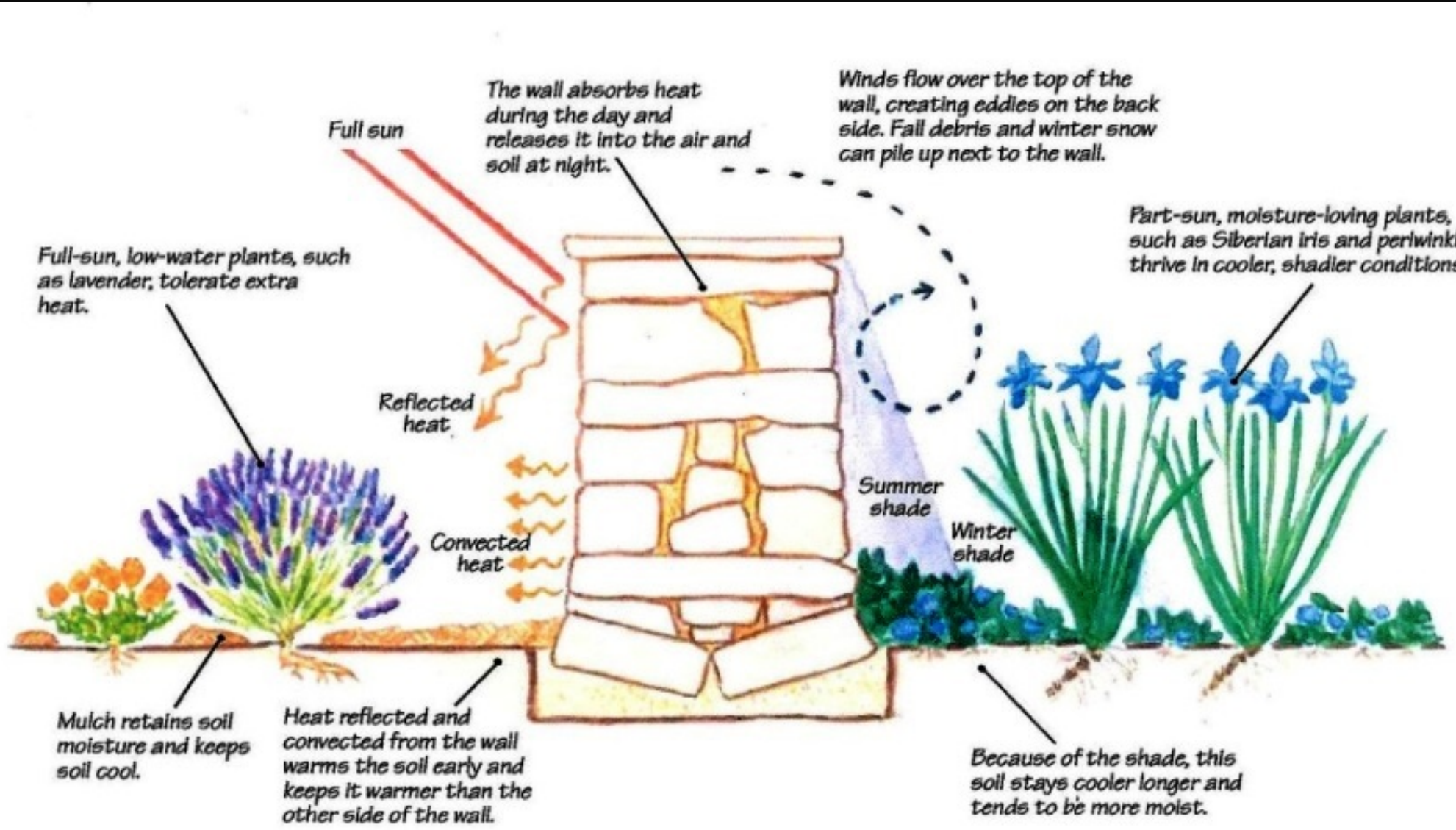
Abstract

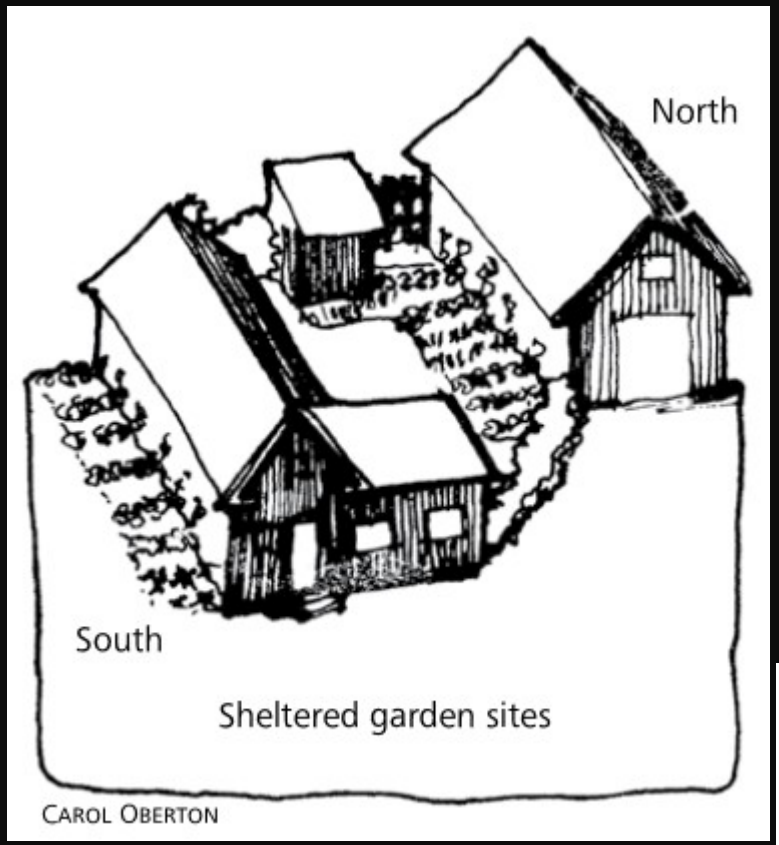
Rapid industrialization and urbanization have resulted in elevated global temperature over the years consequently disturbing the balance of agro-ecological systems worldwide. Therefore, new eco-friendly agricultural practices for sustainable food production are needed. Mulching could potentially serve the purpose by reducing soil evaporation, conserving moisture, controlling soil temperature, reducing weed growth, and improving microbial

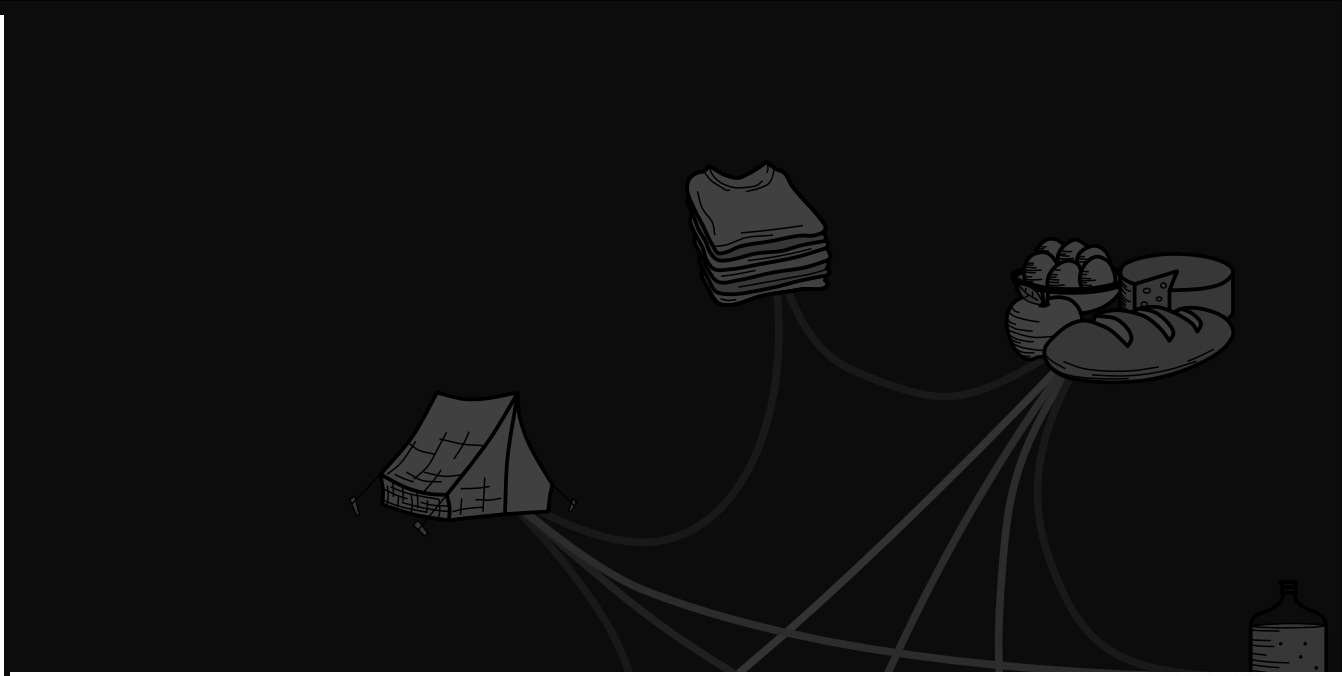
Methodological Adaptations

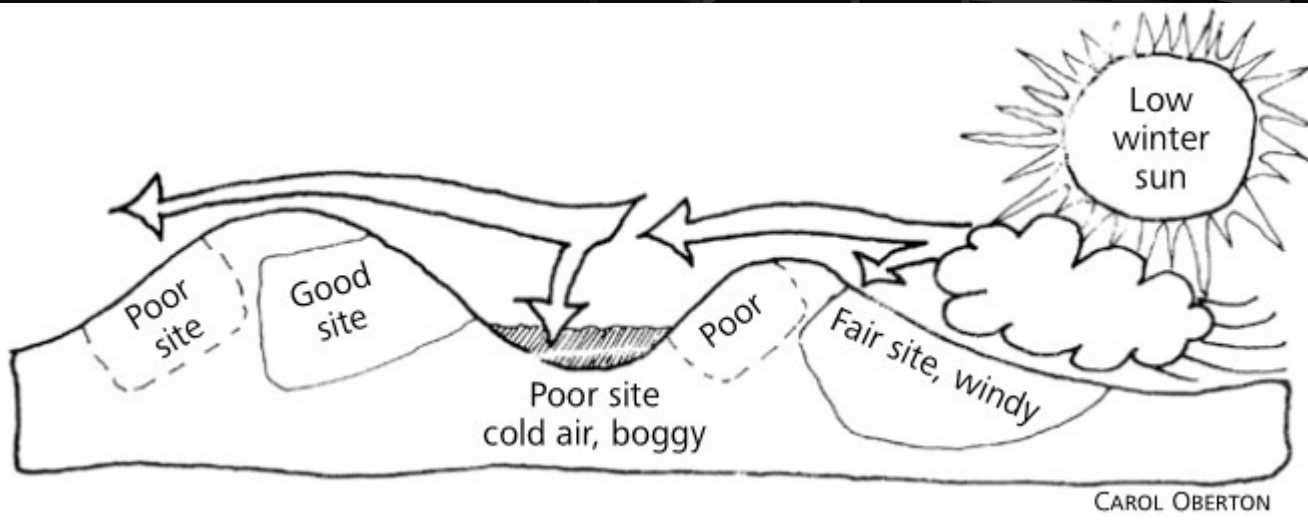
- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch
- Siting & Micro-Climates

LASER ZONE


Full sun
The wall absorbs heat during the day and releases it into the air and soil at night.
Winds flow over the top of the wall, creating eddies on the back side. Fall debris and winter snow can pile up next to the wall.
Part-sun, moisture-loving plants, such as Siberian iris and periwinkle, thrive in cooler, shadier conditions.
Full-sun, low-water plants, such as lavender, tolerate extra heat.
Reflected heat
Convected heat
Summer shade
Winter shade
Mulch retains soil moisture and keeps soil cool.
Heat reflected and convected from the wall warms the soil early and keeps it warmer than the other side of the wall.
Because of the shade, this soil stays cooler longer and tends to be more moist.


North
South
Sheltered garden sites
CAROL OBERTON

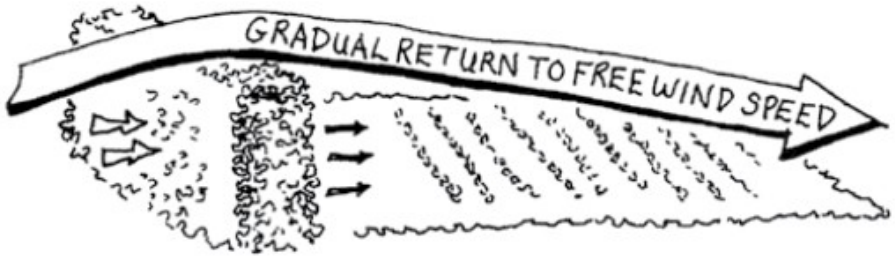



Low winter sun
Poor site
Good site
Poor
Fair site, windy
Poor site
cold air, boggy
CAROL OBERTON

Cold air is blocked by tight fence and trapped in garden.

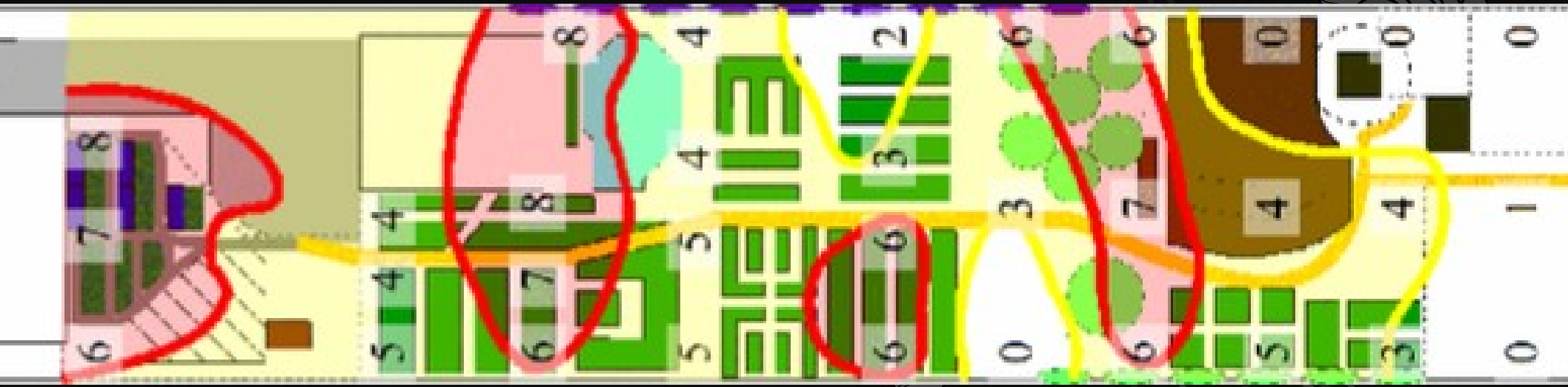
Cold air flows through open fence or hedge.

A solid barrier yields a sheltered area 8 times the height of the barrier but increases turbulence.



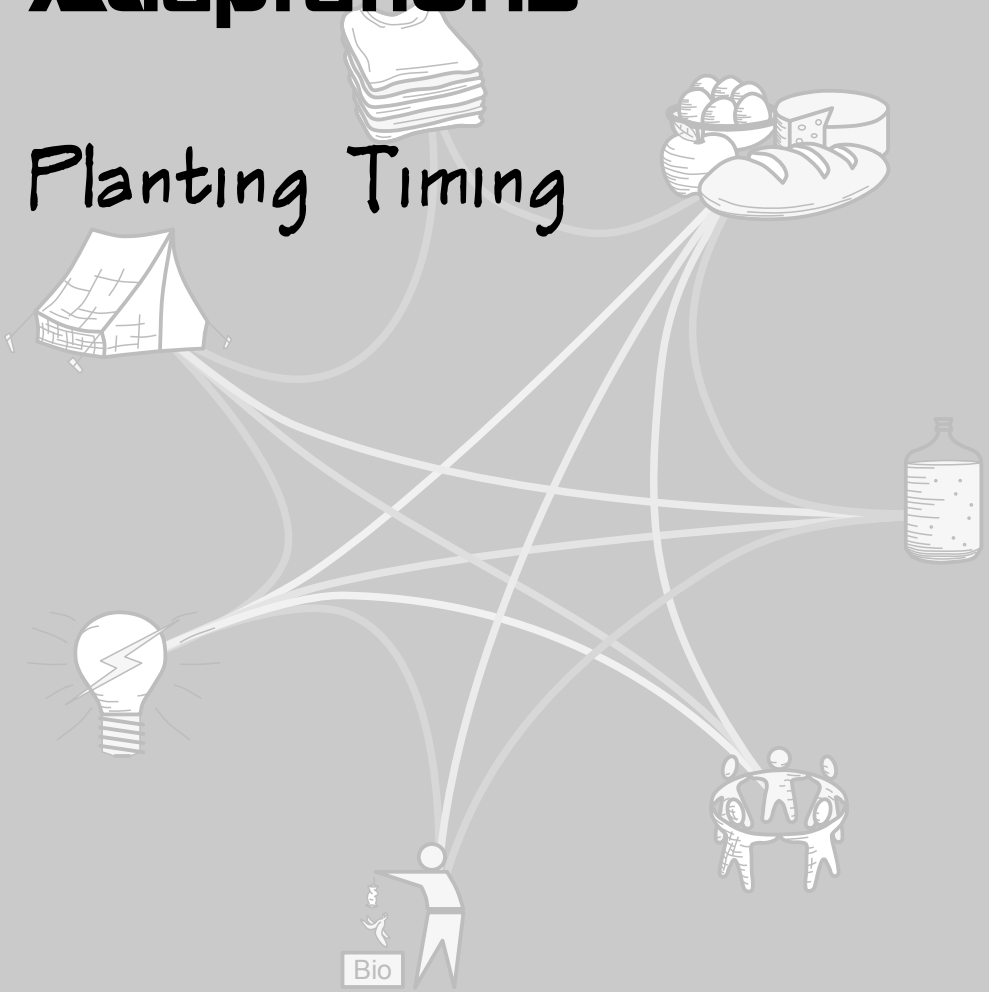
REBECCA SAMSON

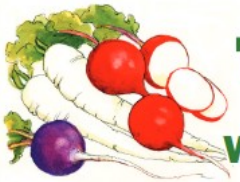
A 40 percent permeable barrier yields a sheltered area 16 times the height of the barrier.


Bio

Methodological Adaptations

- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch
- Siting & Micro-Climates
- Planting Timing





TERRITORIAL SEED COMPANY

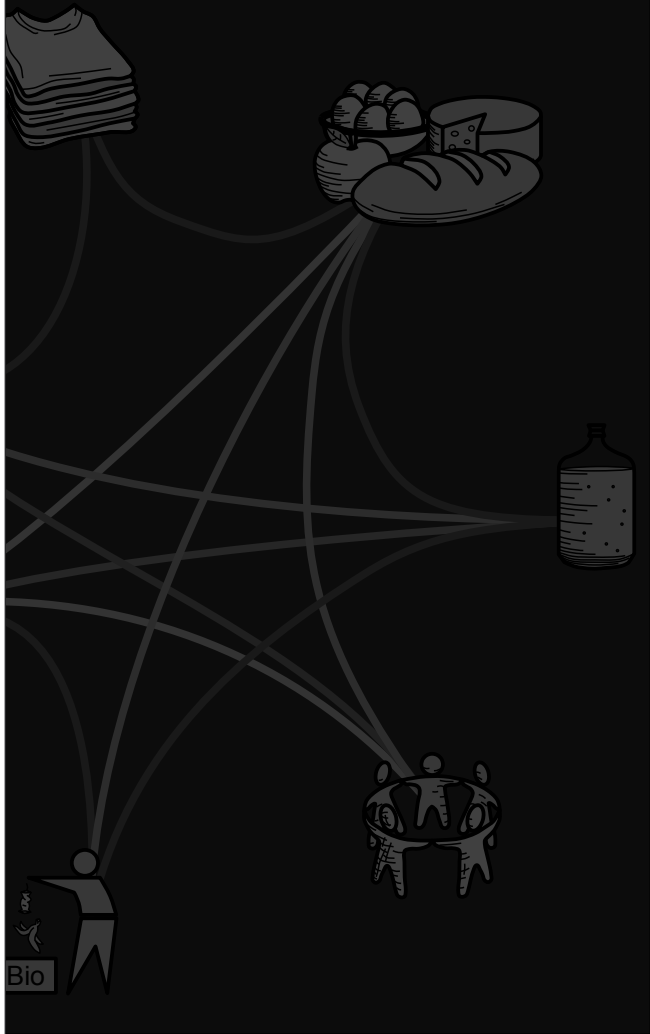
Winter Gardening Chart

Vegetable	Sowing Date Range (May / June / July / Aug. / Sept. / Oct.)	Harvest	Max Storage Time	Storage Temp	Storage Humidity	Freeze Out Temp
Arugula		Winter-Spring	1 week	34–40°F	90–95%	5–10°F
Beets		All Winter	4-5 mo	34–40°F	90–95%	15–20°F
Beans, Fava		Spring-Summer	2 wks	34–40°F	Dry	10–20°F
Broccoli - Autumn Harvest		Autumn	2 wks	34–40°F	90–100%	Before Severe Frost
Broccoli - Sprouting		Spring	2 wks	34–40°F	90–100%	15–20°F
Brussels Sprouts - Autumn Harvest		Autumn	3-5 wks	34–40°F	90–100%	After Severe Frost
Brussels Sprouts - Winter Harvest		Winter	3-5 wks	34–40°F	90–100%	After Severe Frost
Cabbage - Late Summer Harvest		Late Summer	3-6 wks	34–40°F	90–100%	Before Heavy Freeze
Cabbage - Autumn/Winter Harvest		Autumn-Winter	5-6 mo	34–40°F	90–100%	Before Heavy Freeze
Cabbage - Winter Harvest		Winter	5-6 mo	34–40°F	90–100%	Before Heavy Freeze
Carrots		Winter-Spring	4-5 mo	34–40°F	90–95%	5°F
Cauliflower - Summer Harvest		Late Summer	3-4 wks	34–40°F	90–95%	10–15°F
Cauliflower - Autumn Harvest		Autumn	3-4 wks	34–40°F	90–95%	10–15°F
Cauliflower - Spring Harvest		Spring	3-4 wks	34–40°F	90–95%	10–15°F
Chinese Cabbage		Late Fall	2-3 wks	34–40°F	90–95%	20°F
Collards		Winter-Spring	1 week	34–40°F	90–95%	5–10°F
Corn Salad		Spring	1 week	35–40°F	90–95%	5°F
Endive		Winter	2 wks	34–40°F	90–95%	Before Heavy Freeze
Fennel		Autumn-Spring	2-3 wks	33–40°F	90–95%	Before Heavy Freeze
Garlic & Shallot Bulbs		Summer	5-8 mo	34–50°F	60–70%	15°F
Kale		Winter-Spring	2-3 wks	34–40°F	90–95%	5–10°F
Kohlrabi		Winter-Spring	2-3 wks	34–40°F	90–95%	5°F
Leeks - Autumn Harvest		Fall-Winter	8 wks	34–40°F	90–95%	5°F
Leeks - Winter Harvest		Winter-Spring	8 wks	34–40°F	90–95%	5°F
Lettuce		Fall-Winter	2 wks	34–40°F	90–95%	5–10°F
Mustard Greens		Winter	2 wks	34–40°F	90–95%	5°F
Onion - Bunching		Winter-Spring	3 wks	34–40°F	90–95%	5–10°F
Onion - Overwintering & Shallots		Spring-Summer	4-8 mo	55–65°F	60–70%	5–10°F
Parsnips		Winter	4-6 mo	34–40°F	90–95%	5°F
Peas - Autumn		Fall	2 wks	33–40°F	90–95%	15°F
Peas - Overwintering		Spring	2 wks	33–40°F	90–95%	15°F
Radicchio		Fall-Winter	3-4 wks	33–40°F	90–95%	15–20°F
Radishes		Winter-Spring	2-4 mo	33–40°F	90–100%	15–20°F
Rutabagas		Winter-Spring	4-6 mo	33–40°F	90–95%	20°F
Spinach		Fall-Winter	1-2 wks	33–40°F	90–95%	5–10°F
Swiss Chard		Fall-Winter	1-2 wks	33–40°F	90–95%	5°F
Turnips		Winter-Spring	4-5 mo	34–40°F	90–95%	20°F

Sow seeds during this time period. See cultural information in the catalog.

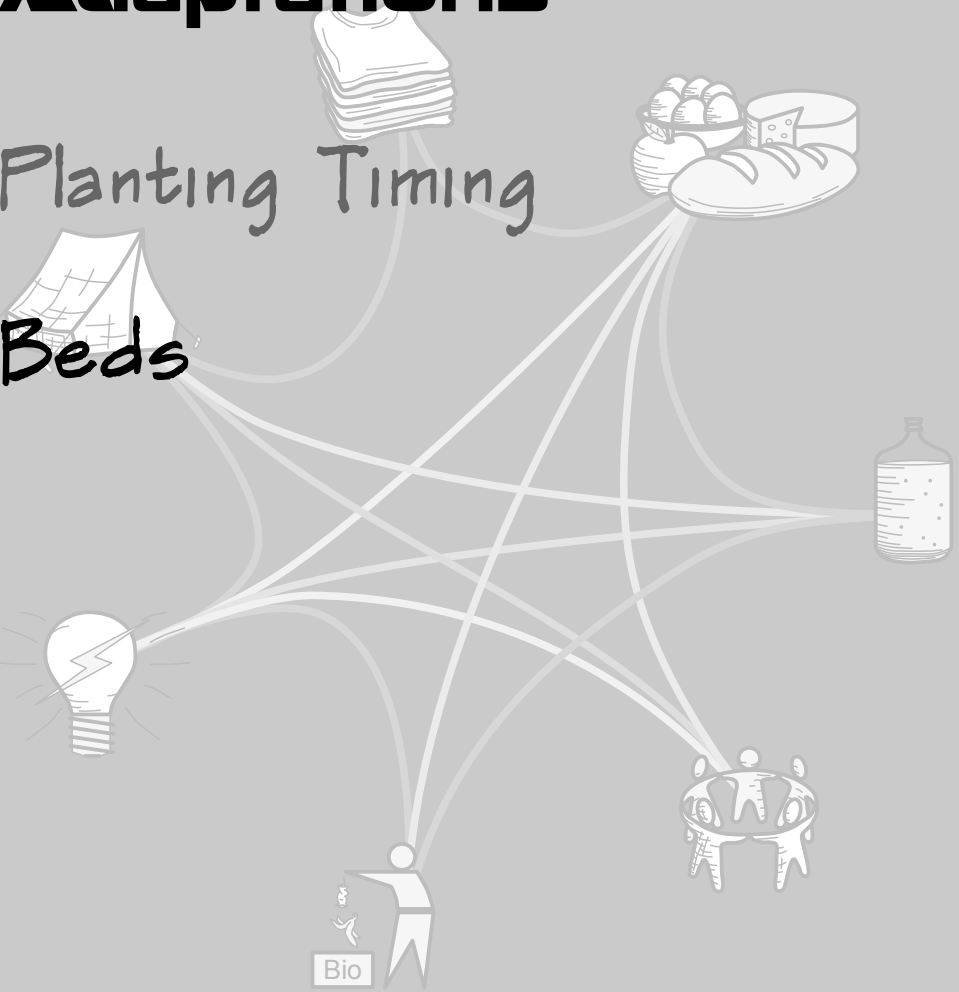
Transplant: These seedlings benefit from transplanting. Move at six weeks to a permanent well-limed location.

Covering or cloching these varieties will lengthen the harvest period.



Methodological Adaptations

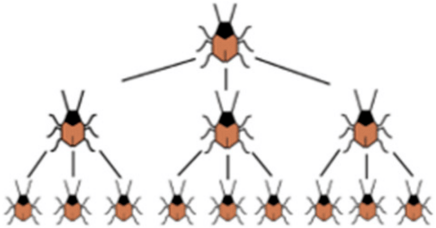
- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch
- Siting & Micro-Climates
- Planting Timing
- Beds



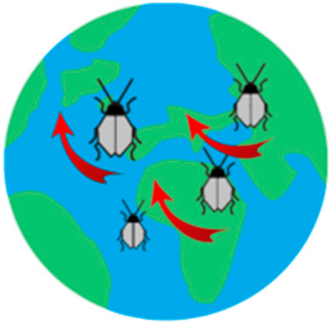
Methodological Adaptations

- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch
- Siting & Micro-Climates
- Planting Timing
- Beds
- Weeds and Pests

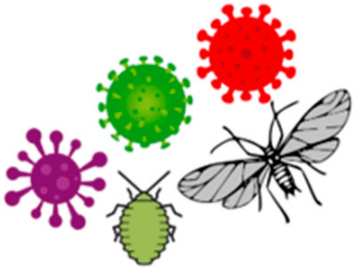
HOW DOES TEMPERATURE INCREASE AFFECTS INSECT PESTS?



Increased number of generations

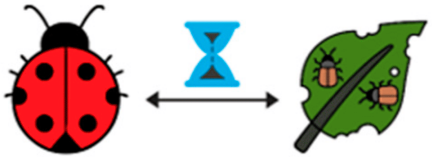


Expansion of geographic range



Outbreak of plant diseases transmitted by insects

Increased overwintering survival

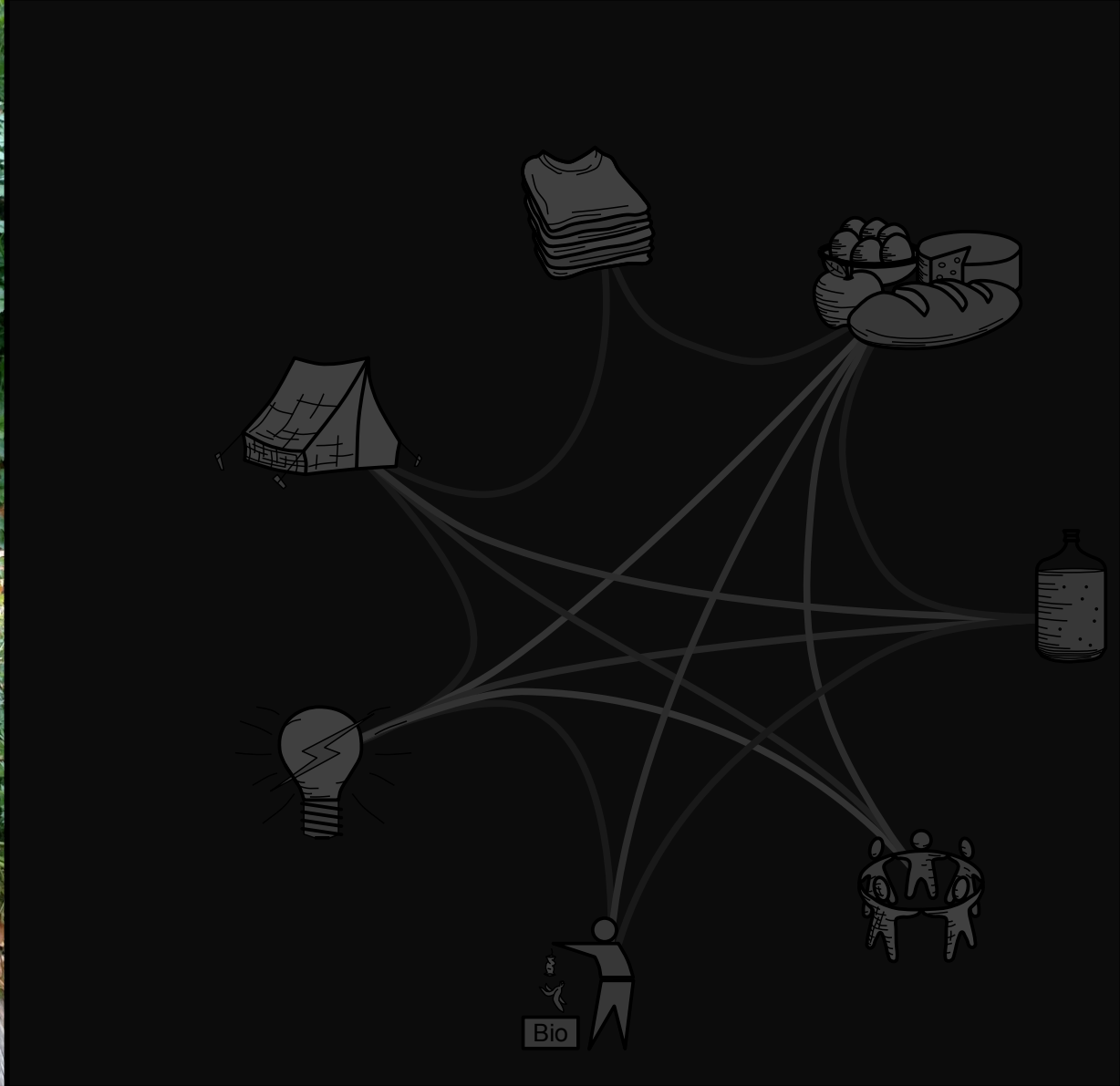


Desynchronization of insects and their natural enemies

Loss of synchrony with the host plant

Methodological Adaptations

- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch
- Siting & Micro-Climates
- Planting Timing
- Beds
- Weeds and Pests
- Harvesting

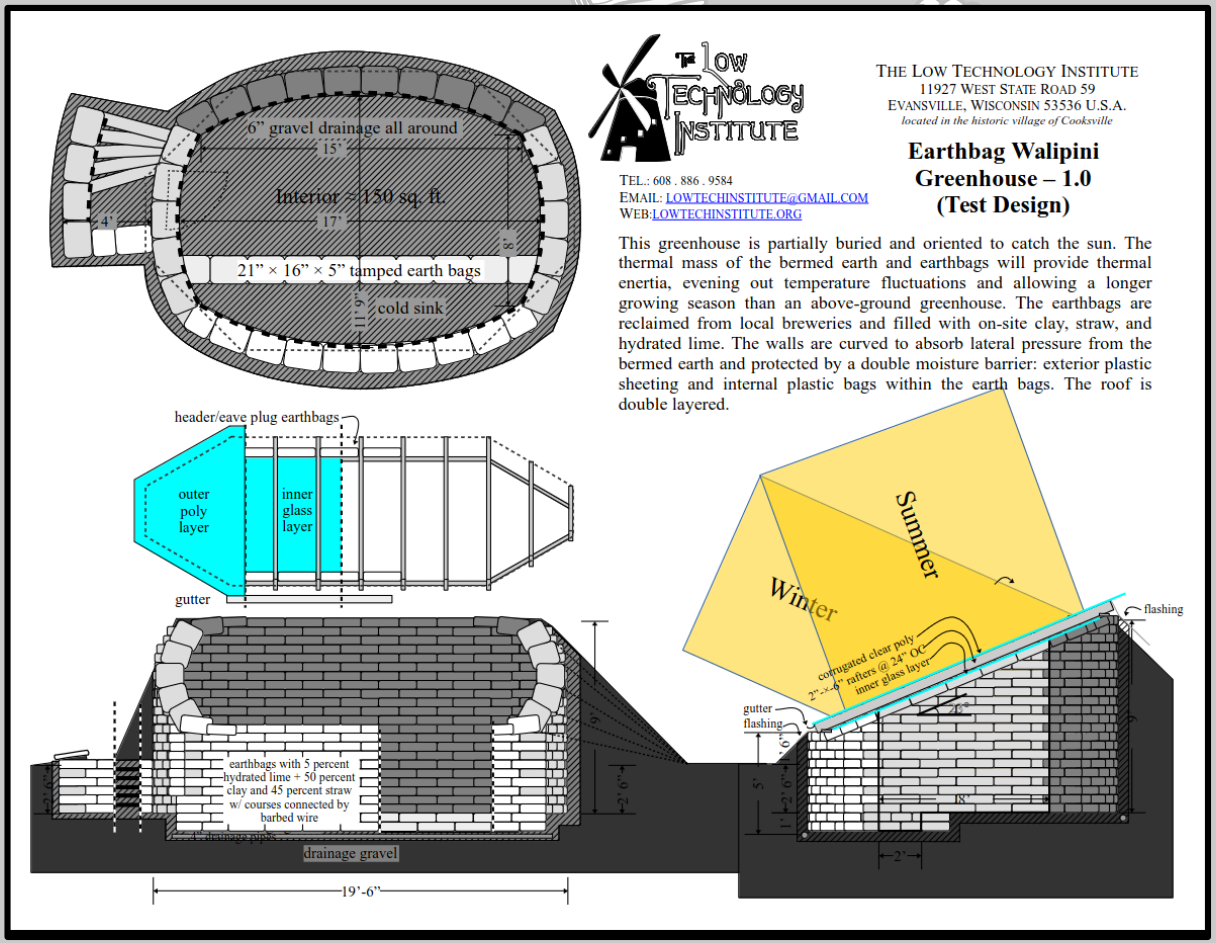

Bio

Methodological Adaptations

- Warnings
- Soil Drainage
- Soil Nutrients
- Mulch
- Siting & Micro-Climates
- Planting Timing
- Beds
- Weeds and Pests
- Harvesting
- Stay Positive!

Infrastructure

- Warnings



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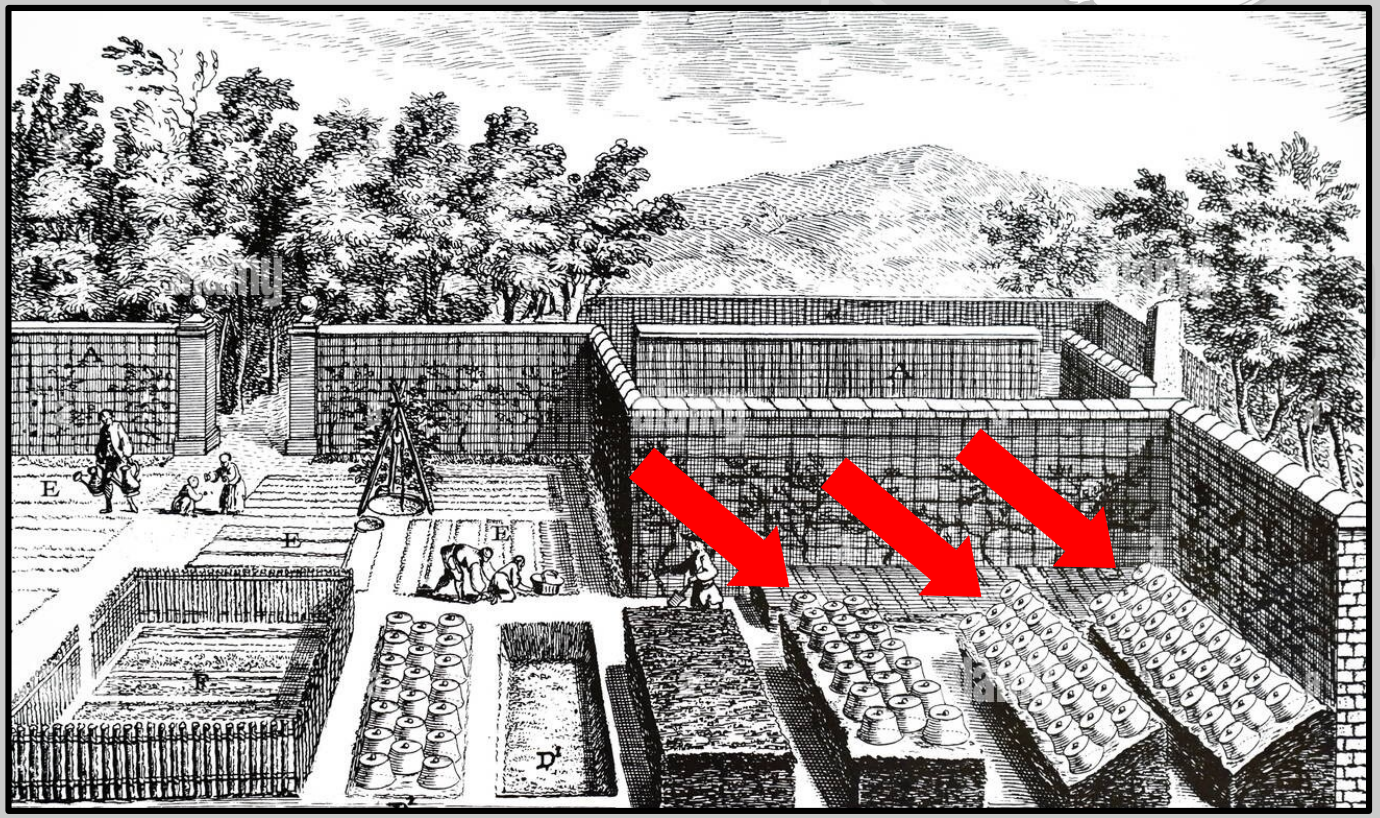
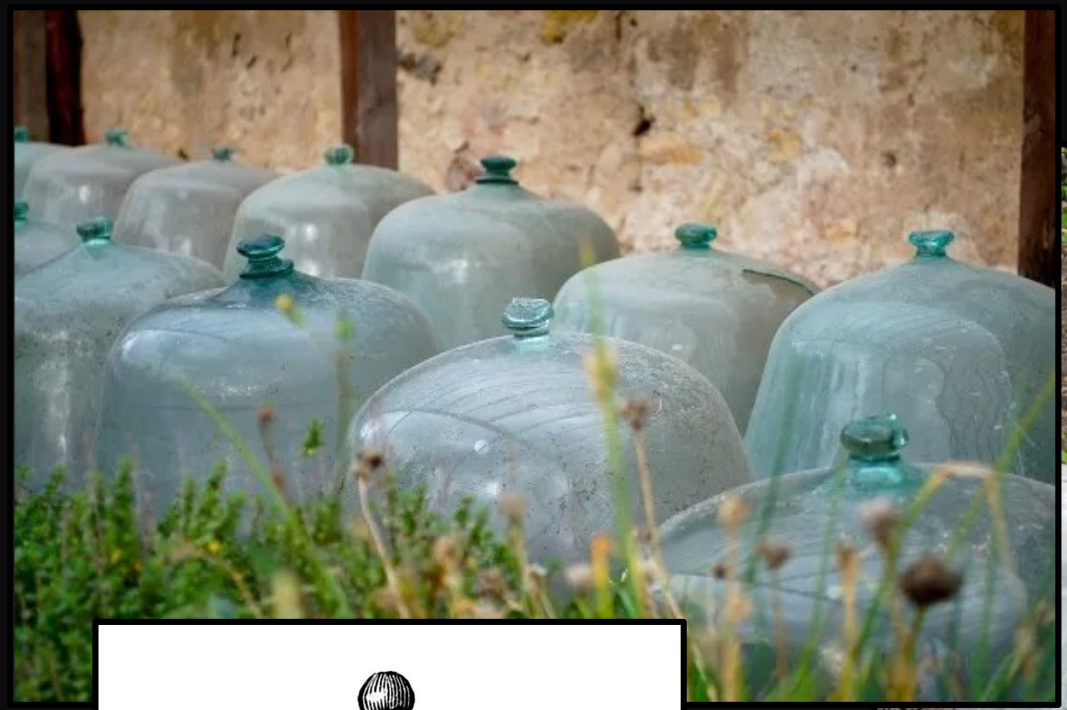
Infrastructure

- Warnings
- Cloche

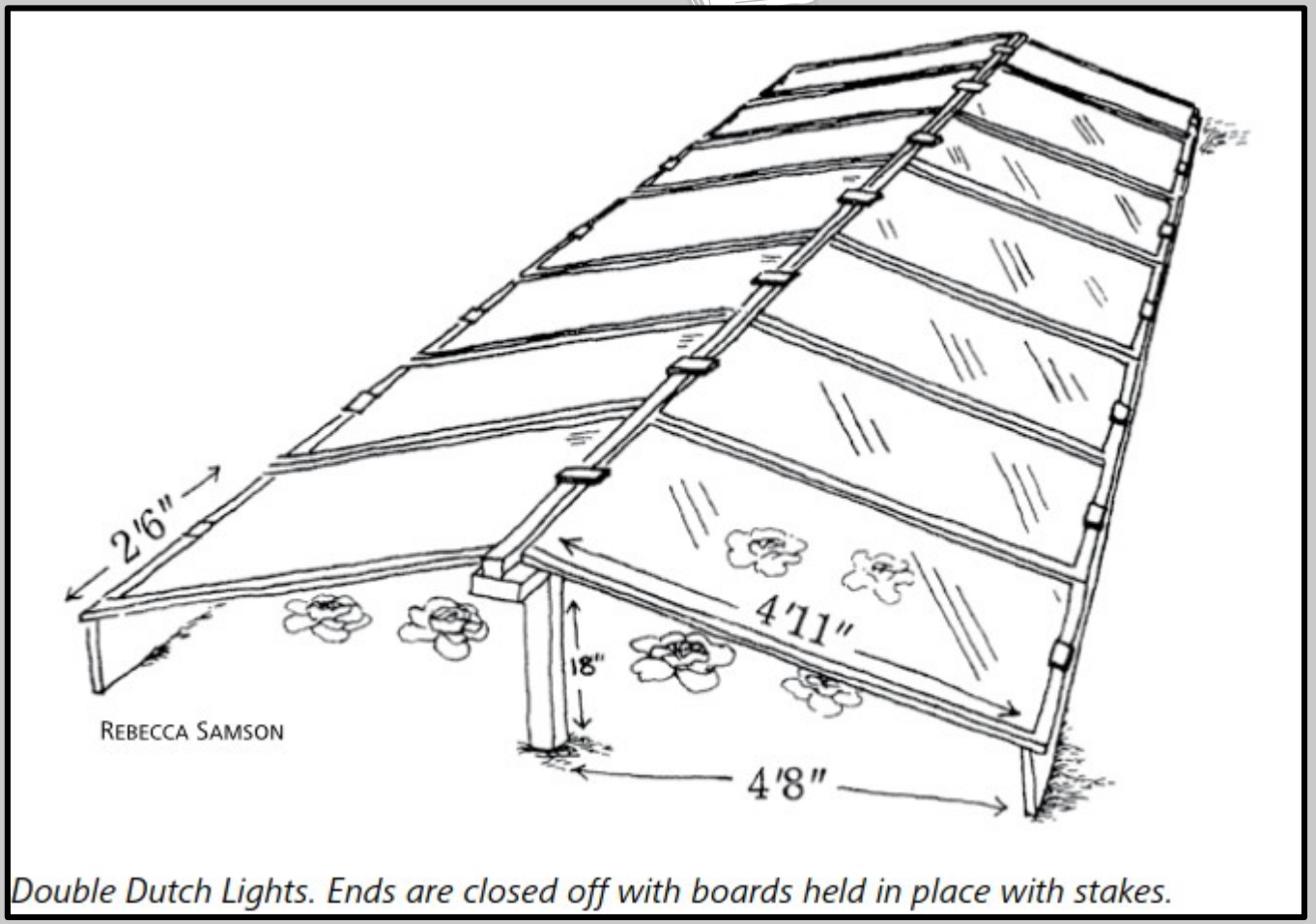




Bio

Infrastructure

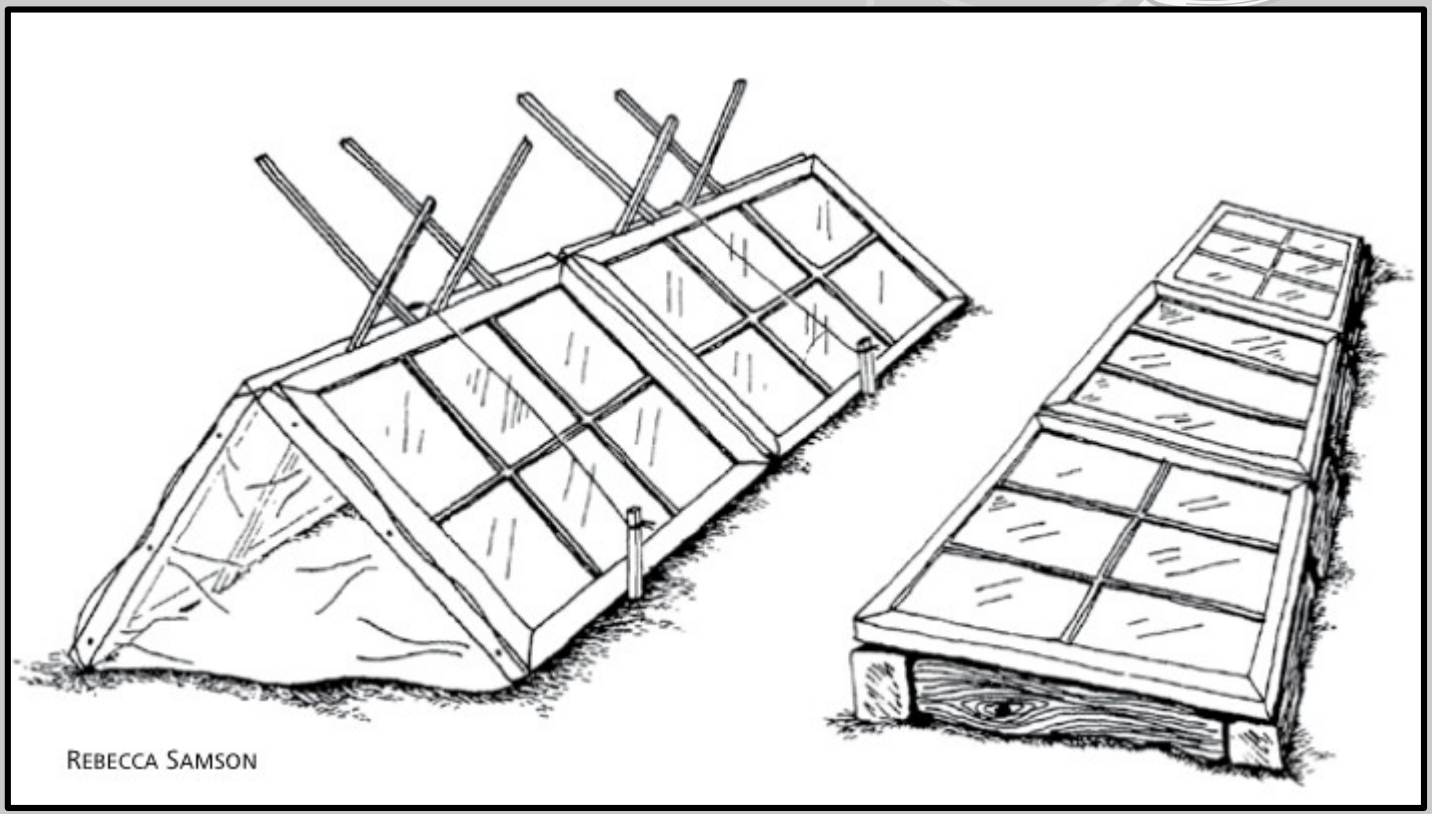
- Warnings
- Cloche
- Dutch Lights



Double Dutch Lights. Ends are closed off with boards held in place with stakes.

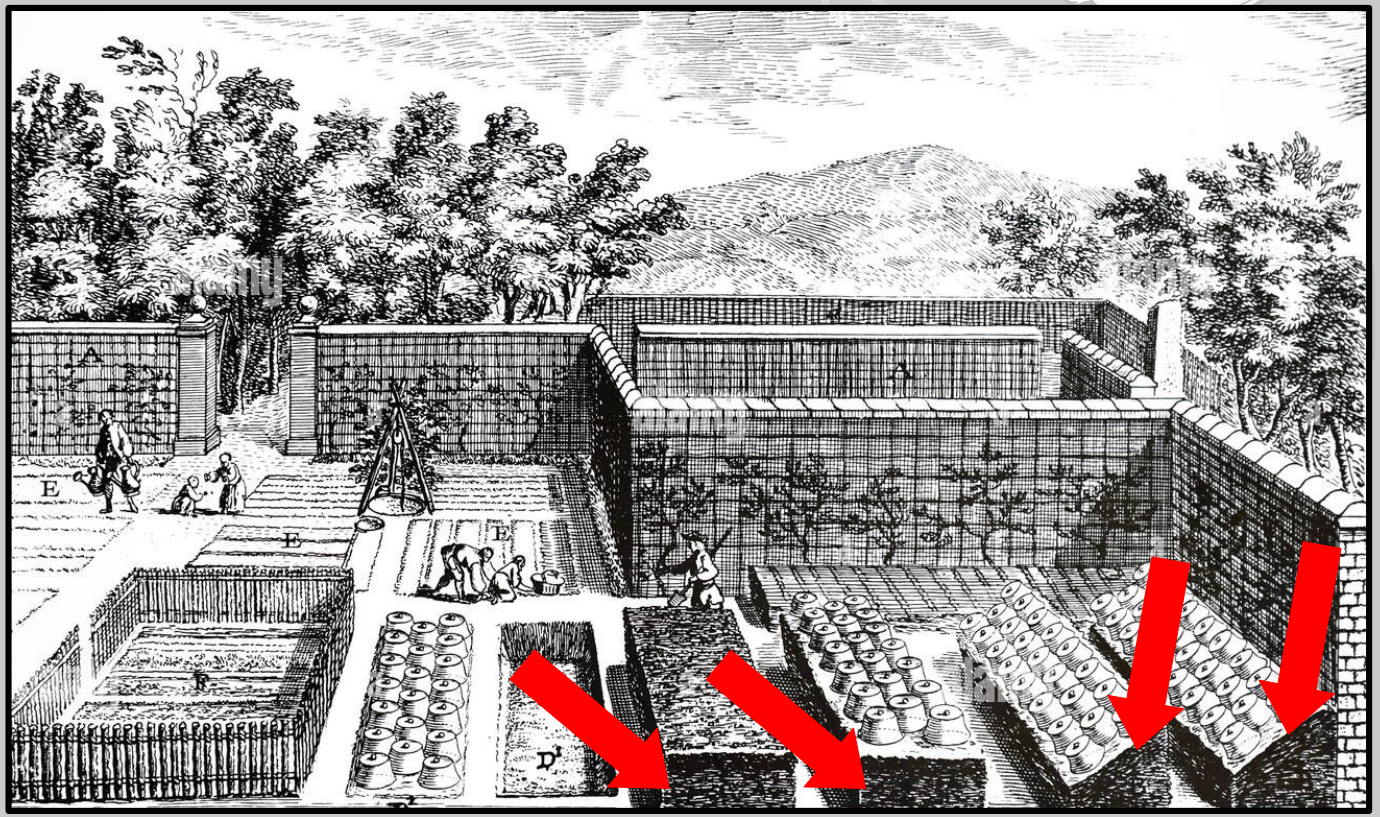
Infrastructure

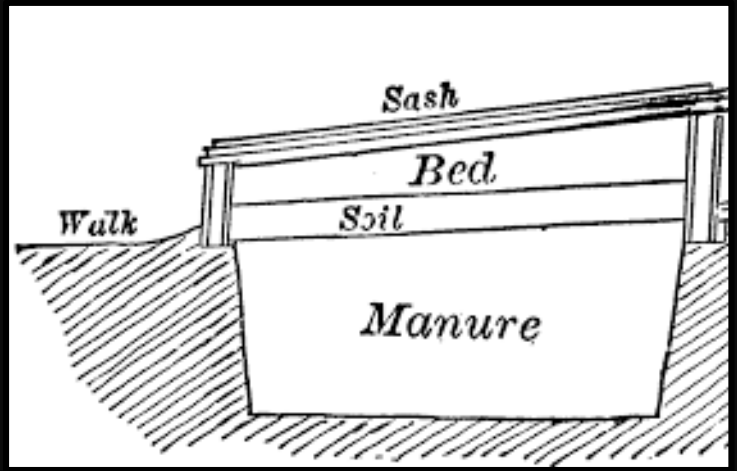
- Warnings
- Cloche
- Dutch Lights
- Cold Frames



Infrastructure

- Warnings
- Cloche
- Dutch Lights
- Cold Frames
- Hot Beds

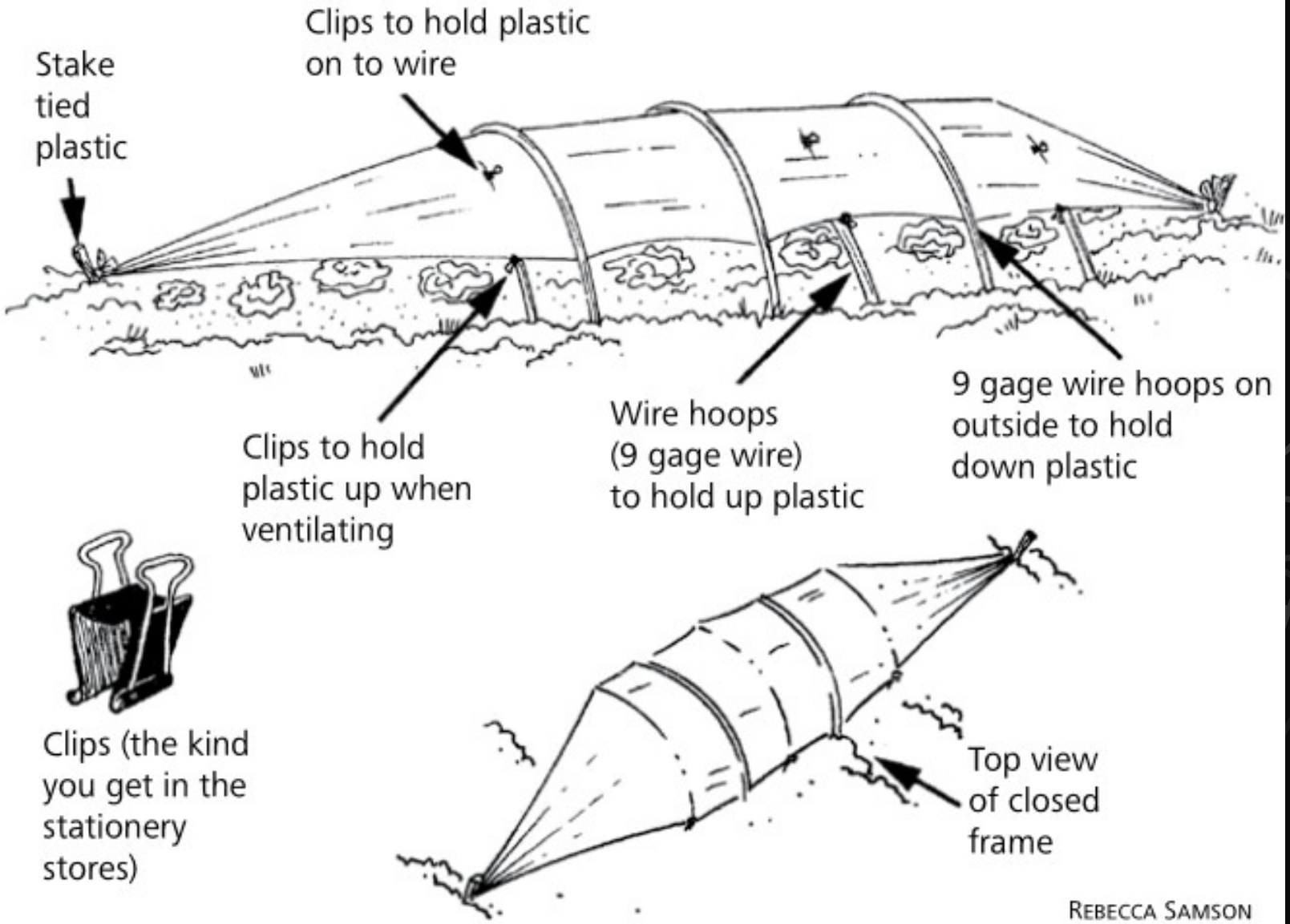



Sash
Bed
Walk
Soil
Manure

Infrastructure

- Warnings
- Cloche
- Dutch Lights
- Cold Frames
- Hot Beds

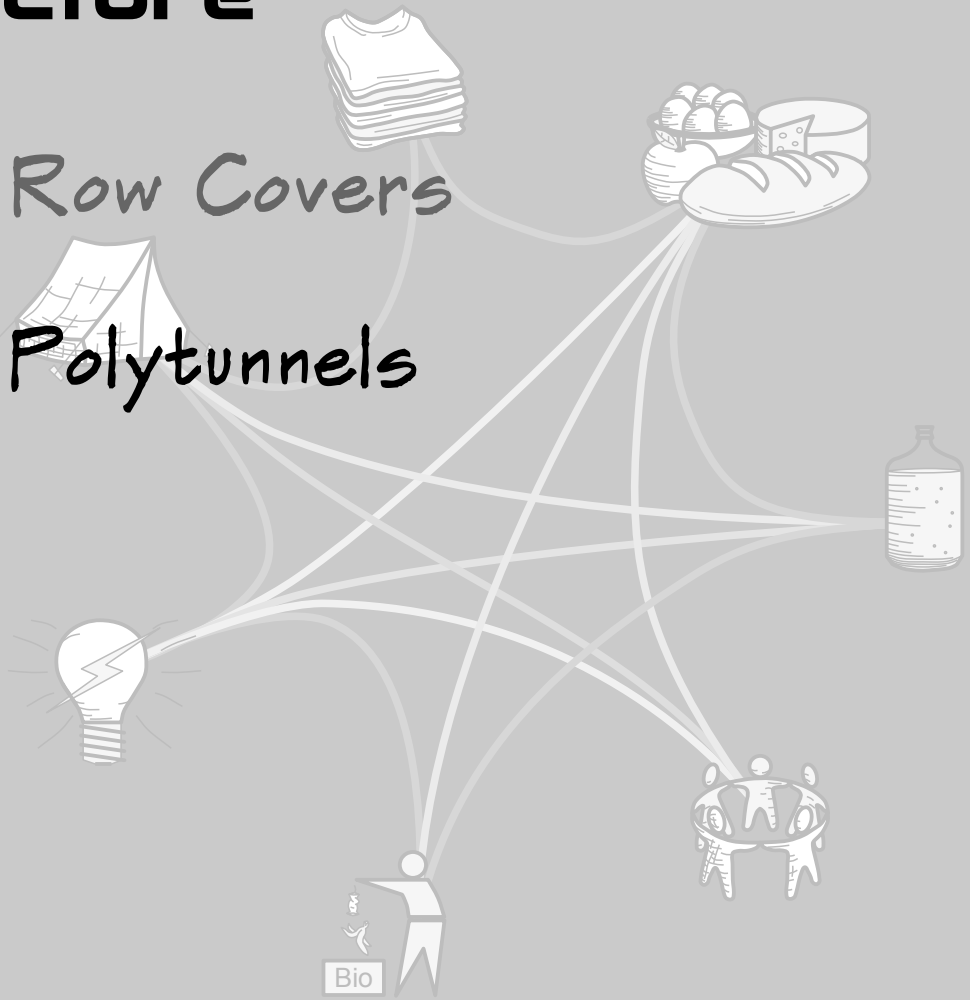
- Row Covers


Stake tied plastic
Clips to hold plastic on to wire
Clips to hold plastic up when ventilating
Wire hoops (9 gage wire) to hold up plastic
9 gage wire hoops on outside to hold down plastic
Clips (the kind you get in the stationery stores)
Top view of closed frame
Rebecca Samson

Infrastructure

- Warnings
- Cloche
- Dutch Lights
- Cold Frames
- Hot Beds

- Row Covers
- Polytunnels

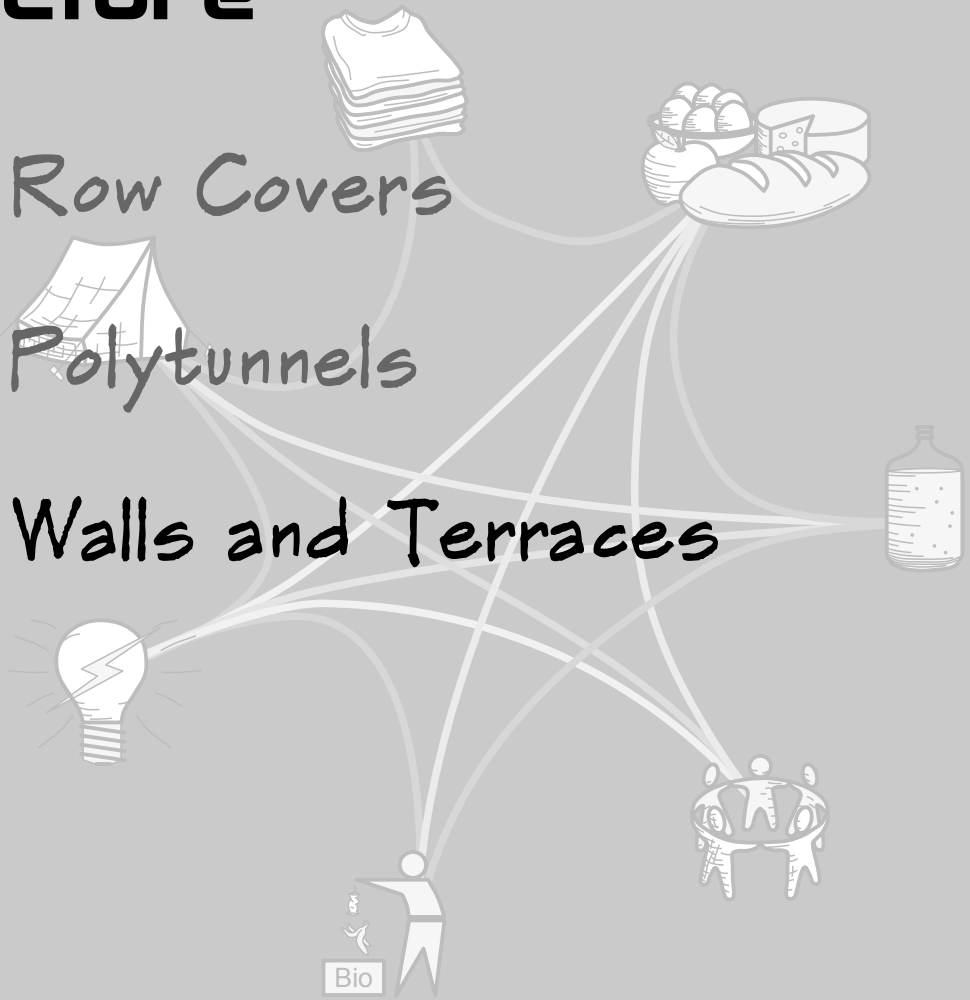


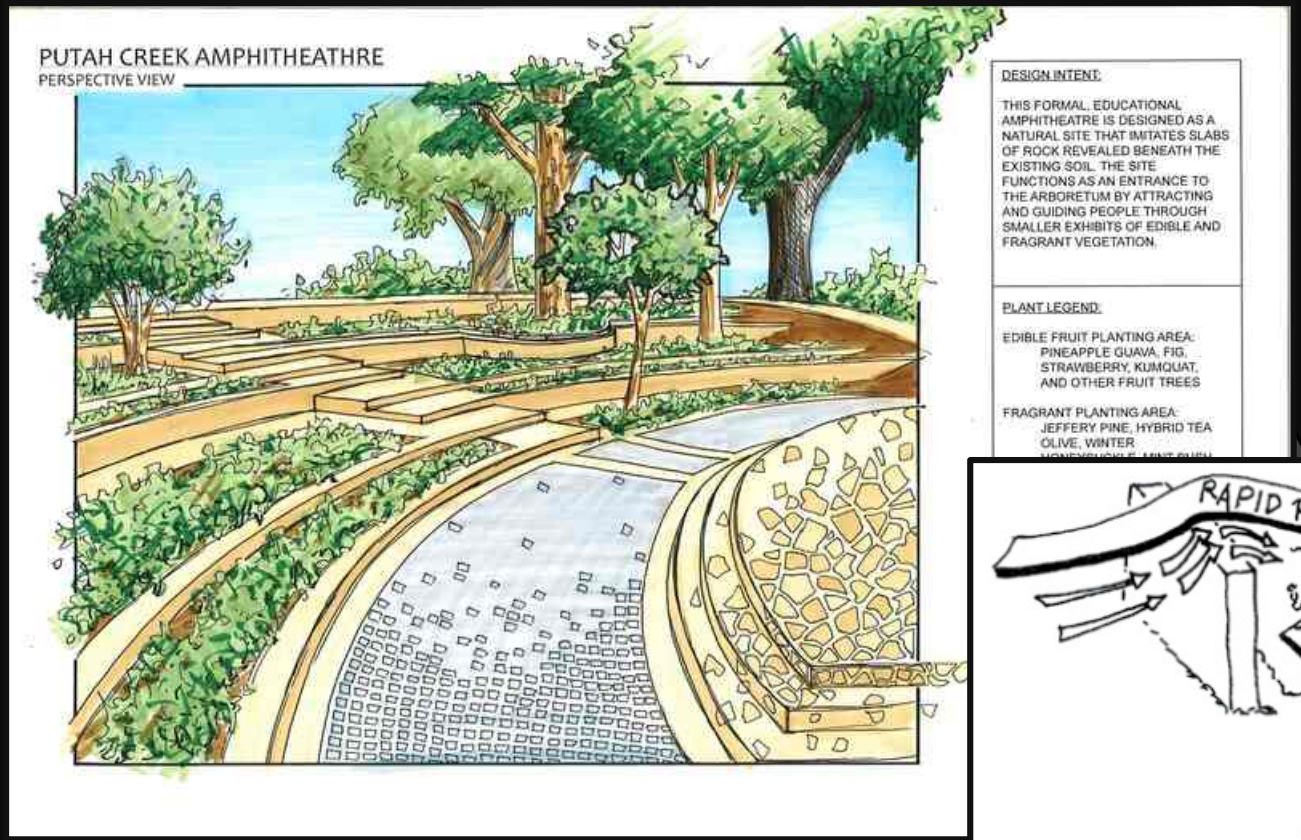

www.myfoododyssey.com

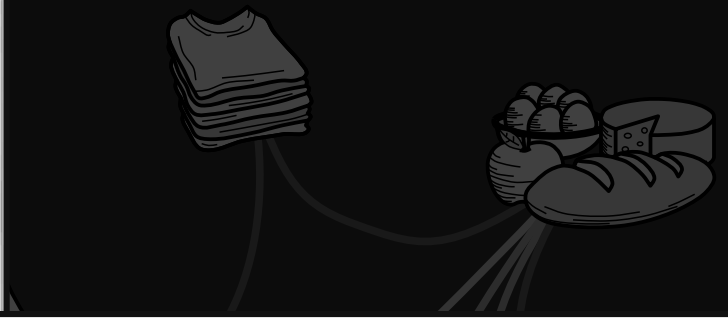
Infrastructure

- Warnings
- Cloche
- Dutch Lights
- Cold Frames
- Hot Beds

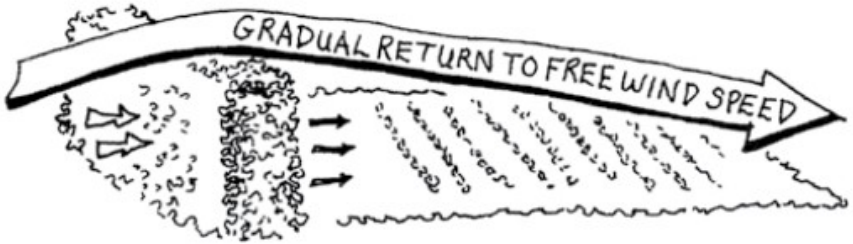
- Row Covers
- Polytunnels
- Walls and Terraces







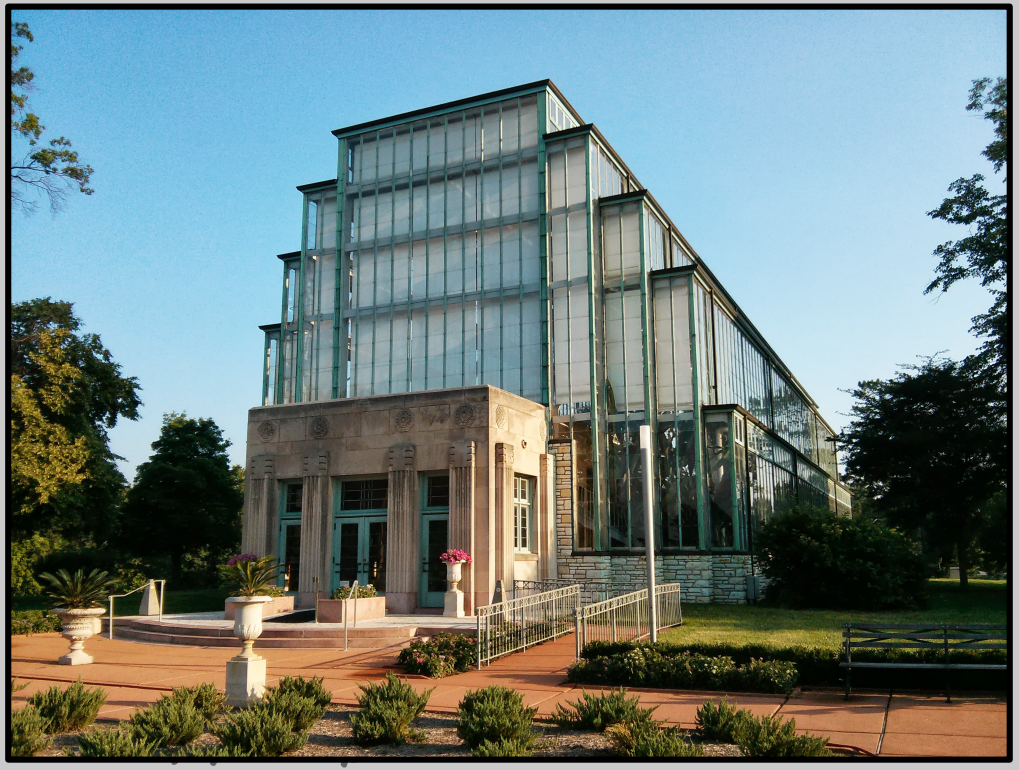
A solid barrier yields a sheltered area 8 times the height of the barrier but increases turbulence.



A 40 percent permeable barrier yields a sheltered area 16 times the height of the barrier.

Rebecca
Samson

Infrastructure



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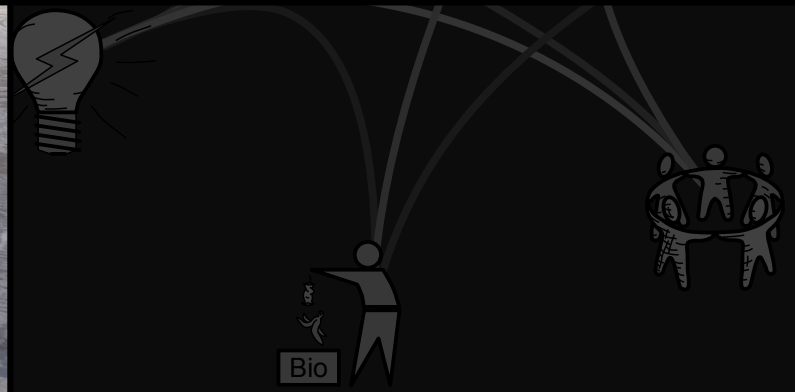
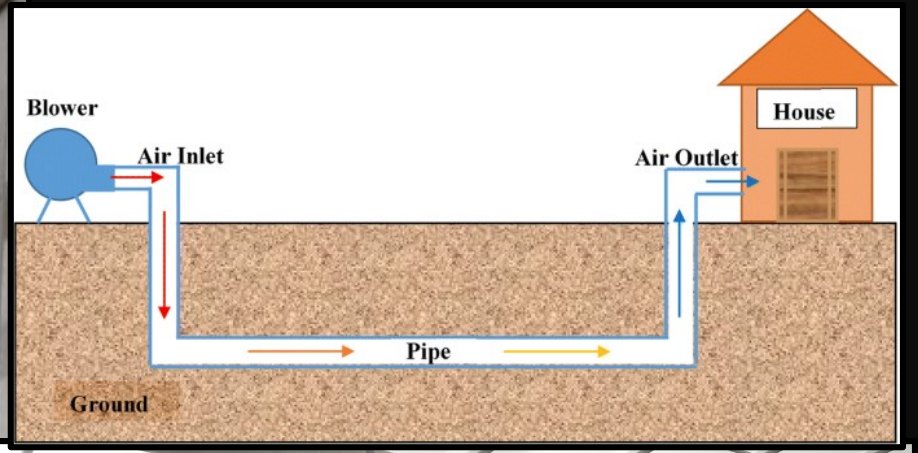
- Row Covers
- Polytunnels
- Walls and Terraces
- Greenhouse


Bio

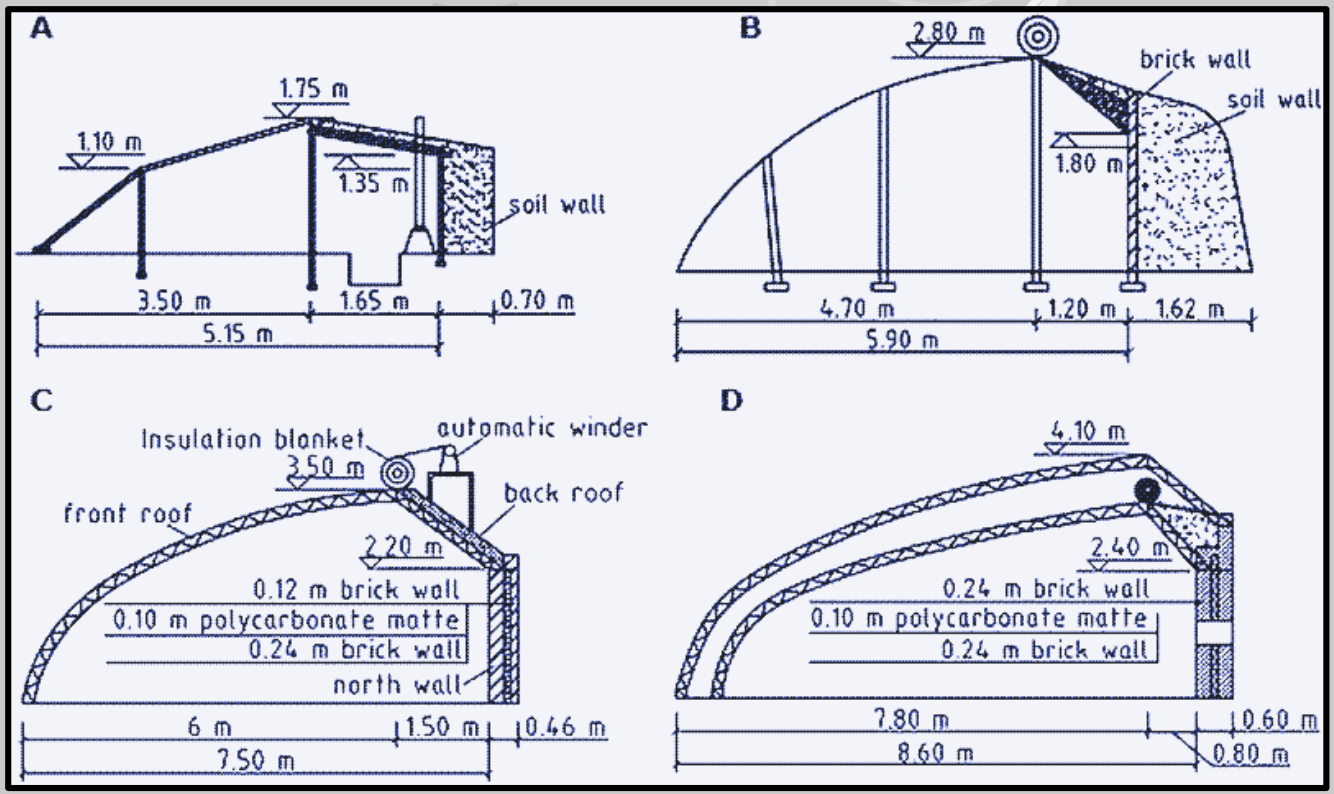

Blower
Air Inlet
House
Air Outlet
Pipe
Ground

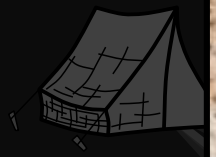
Infrastructure

- Warnings
- Cloche
- Dutch Lights
- Cold Frames
- Hot Beds
- Row Covers
- Polytunnels
- Walls and Terraces
- Greenhouse
- Grow Indoors

Case Studies

- Chinese Greenhouses





Chinese Greenhouse Design for Winter Gardening

By **Kris De Decker**

This woman is able to grow vegetables long into the winter in her passive solar greenhouse located in Ladakh, India, even when the outside temperature falls to negative 13 degrees Fahrenheit.

Unlock the sun's full potential with passive solar greenhouse designs for an energy-efficient Chinese greenhouse design to grow warm-season plants year-round with little to no extra heating.

University of Minnesota Extension

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Deep Winter Greenhouses

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Farm-scale deep winter greenhouse partnership opportunity

RSDP is seeking applications from farmers in each of the five RSDP regions in Greater Minnesota to partner in the development of a farm-scale deep winter greenhouse (FSDWG). Farmer partners will be selected through a competitive process to build a UMN-designed FSDWG and will receive $25,000 toward their commitment and partnership on research, outreach and educational activities over the next three years.

Farmers located in Greater Minnesota are eligible. (The 11 metro counties of Hennepin, Ramsey, Scott, Carver, Dakota, Washington, Anoka, Isanti, Chisago, Wright and Sherburne are excluded at this time).

Apply for farm scale deep winter greenhouse

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Reinventing the Greenhouse

Contrary to its fully glazed counterpart, a passive solar greenhouse is designed to retain as much warmth as possible.

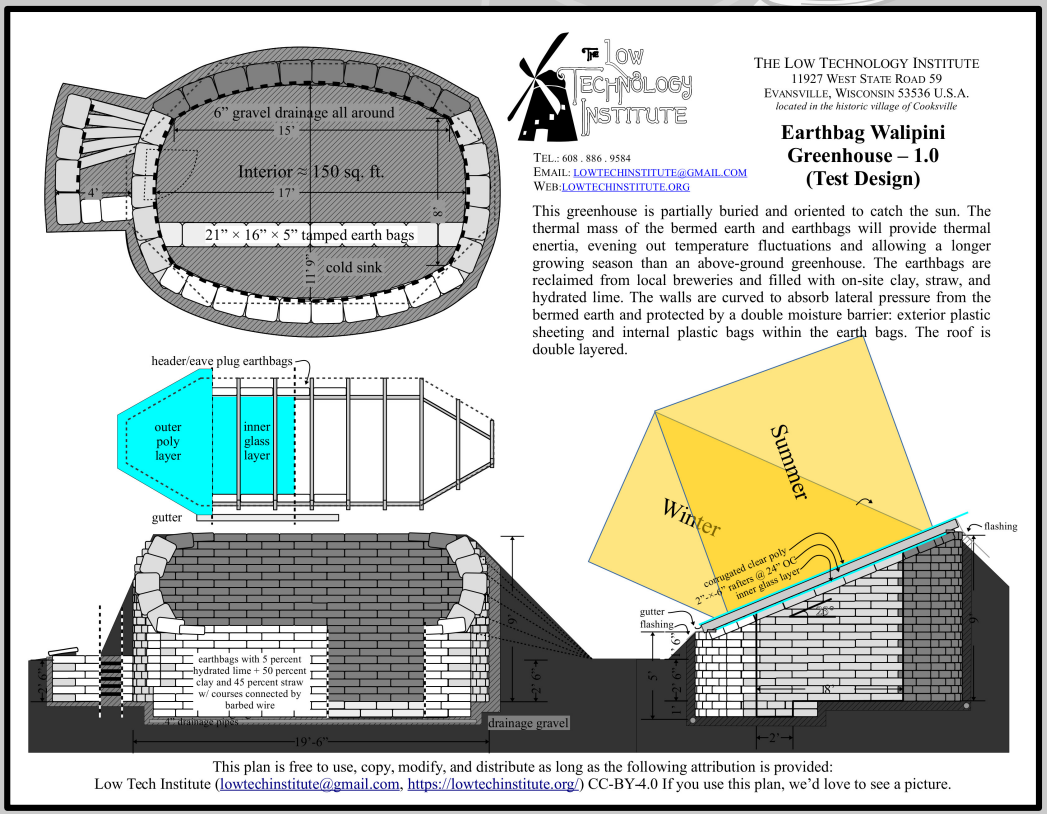
December 24, 2015 written by Kris De Decker Translations fr nl es pl

A Chinese greenhouse. Picture: Chris Buhler, Indoor Garden HQ

738.96KB

Case Studies

- Chinese Greenhouses
- LTI Walipini



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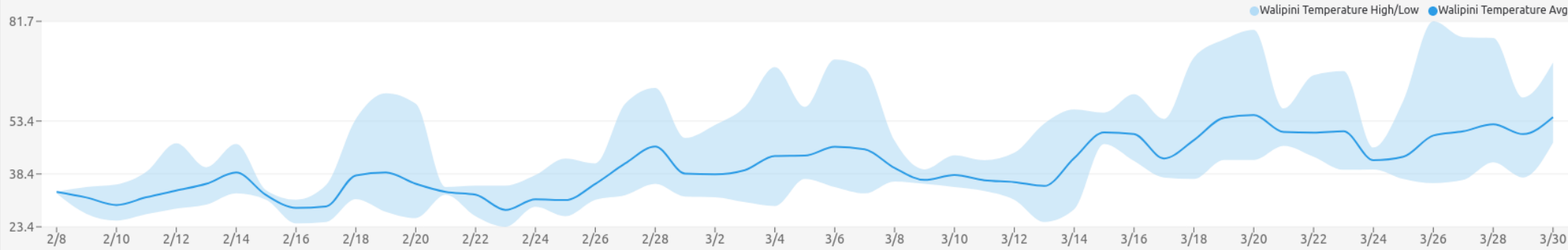
HOP HAUS
BREWING
COMPANY


WHEAT MALT


Walipini Temperature High/Low
Walipini Temperature Avg
81.7
53.4
38.4
23.4
2/8
2/10
2/12
2/14
2/16
2/18
2/20
2/22
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Walipini Earthbag Greenhouse — Foundation and Bags

Posted on November 6, 2017 by lowtechinstitute

We've been working hard on the earthbag walipini greenhouse. Although our weekend workshop got rained out, we've still managed to get the foundation trenches dug, the rubble trench poured in, and the first layer of bags laid. Here's the details.

Foundation

In all, we've excavated approximately 48 tons of soil. This has taken about 40 hours of work. Each trench is about 2 ft wide. The outside wall is 3 ft 6 in deep. The slightly lower cold sink area is 4 ft 6 in deep. Each trench bottom is filled with 6 in of gravel for drainage and a perforated 4-in drainage pipe around the exterior.

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Walipini Update

Posted on December 18, 2019 by lowtechinstitute

It has been a while since I've written about the walipini, but it has been getting steady work over the last year. A walipini is an in-ground greenhouse. It uses the thermal mass of the earth to help keep its internal temperature from fluctuating too quickly in the winter. It is essentially a pit with a retaining wall of earthbags (which I call "engineered sand bags" full of clay, hydrated lime, and straw and/or woodchips, at a 7:1:2 ratio, held together by barbed wire between the layers) with a post-supported roof over it.

For those who want a quick refresher, check out this post describing the planning

YouTube Search

Walipini: Underground Greenhouse, Part I -- Low Tech Video, No. 23

Low Technology Institute
4.35K subscribers

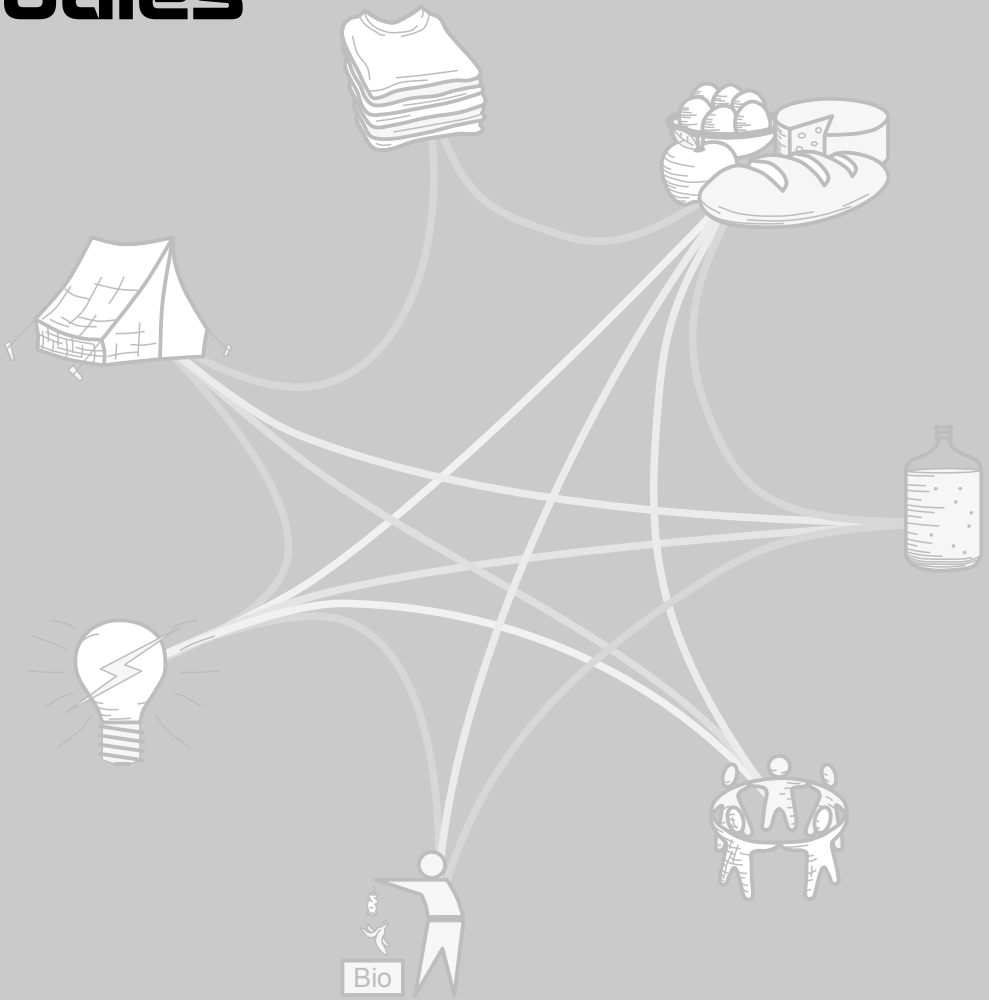
Analytics Edit video 454 Share Promote

28K views 2 years ago
ATTENTION: I cannot change the music. I'm sorry. Please forgive the error.

We've been working on an in-ground greenhouse, called a walipini, since 2017. We are slowly nearing completion and this video outlines ... more

Case Studies

- Chinese Greenhouses
- LTI Walipini
- Oranges in Kansas

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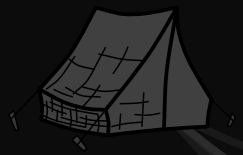

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Greenhouse in the Snow

Greenhouse in the Snow
Geothermal Greenhouse Kit

Geothermal Greenhouse Kit

- All kits are 17' wide
- The smallest kit offered is 54' long & we increase in 6' increments in length
- 96' and 102' long are the most efficient sizes

$199/lineal foot

Cross Members & Attachments for
Engineered Retaining Wall

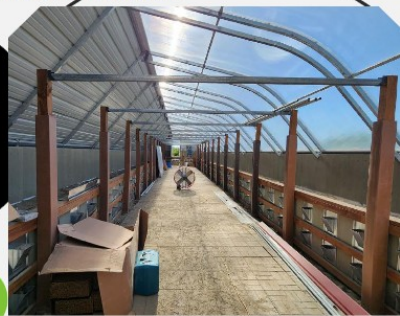
Engineered Retaining Wall Sets

- Set includes cross member & two hangers to attach them to retaining wall posts
- Cross members offered in bare steel or galvanized steel
- Composite and wood posts (as pictured) are not included

$119.58/set for Non-Galvanized

$132.25/set for Galvanized

*NOTE: Does not include shipping. Shipping is calculated at time of shipment.



*Prices Subject to Change at Any Time

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Check Out These Oranges And Lemons Grown In The Midwest

KCUR | By Grant Gerlock
Published January 21, 2016 at 4:41 PM CST

Grant Gerlock / Harvest Public Media

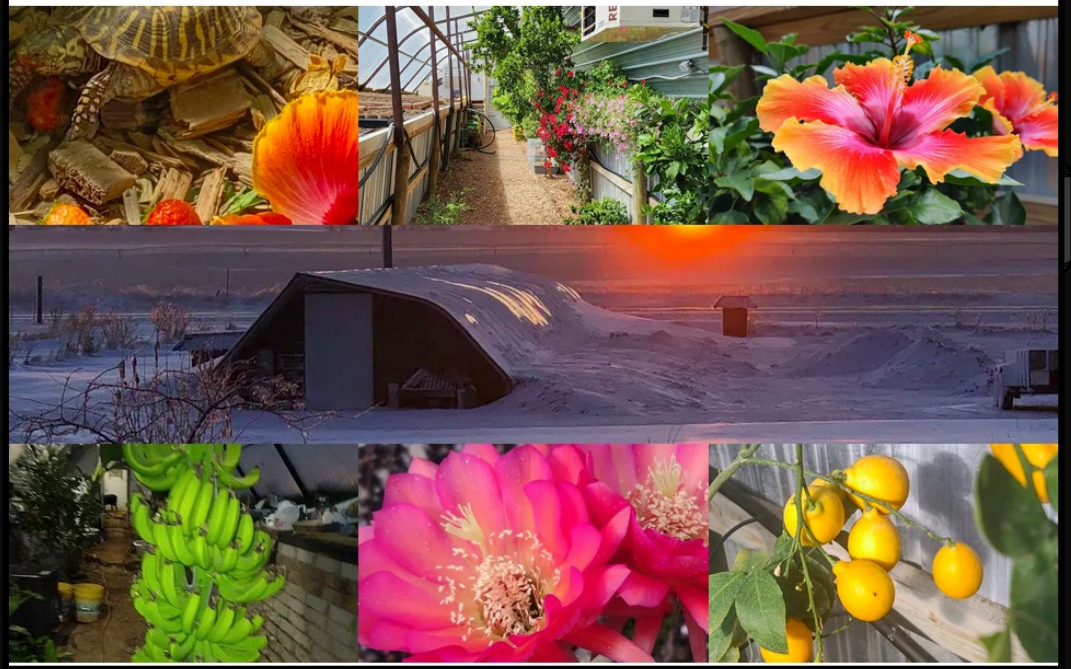
Russ Finch holds up half of a Cara Cara orange grown in his geothermal greenhouse in Alliance, Neb.

High on the Nebraska plains, there's a citrus grove with trees holding up a canopy of lemons, grapefruit-sized oranges, green figs, and bunches of grapes

Order your Greenhouse in the Snow kit today!

Greenhouse in the Snow

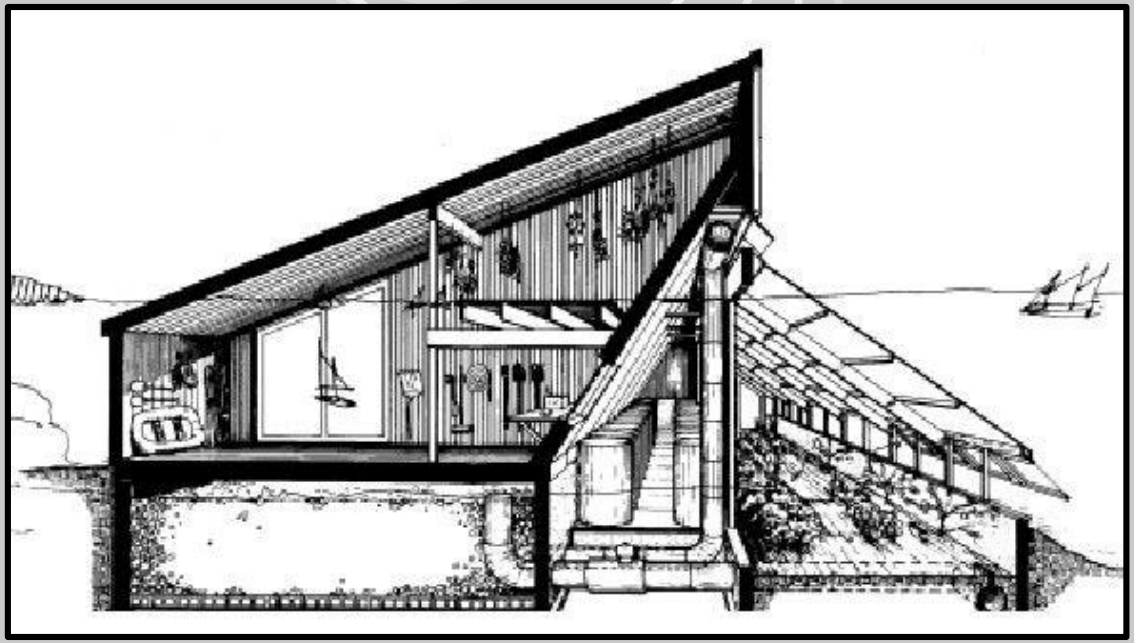
Welcome to Greenhouse in the Snow located in Alliance, Nebraska!

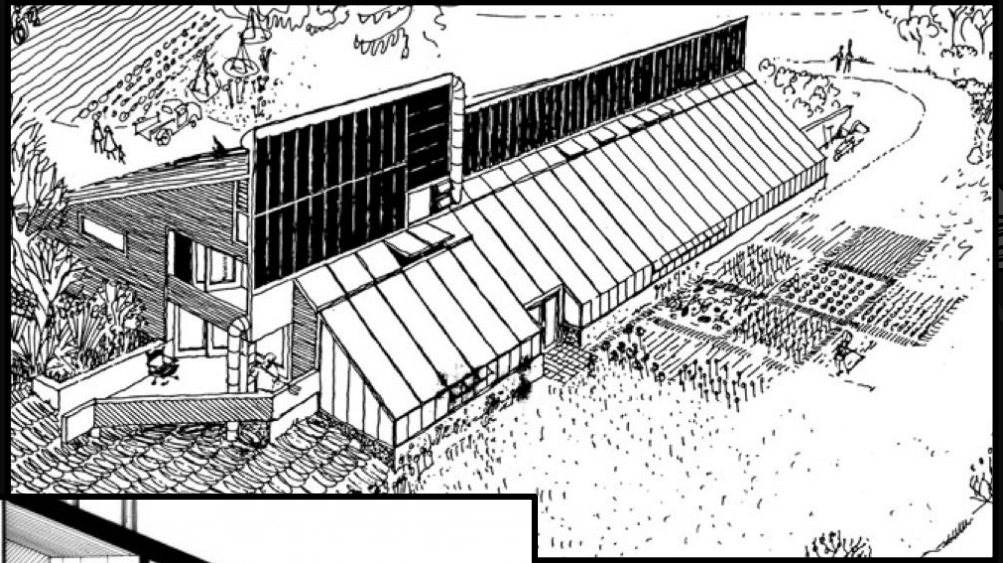


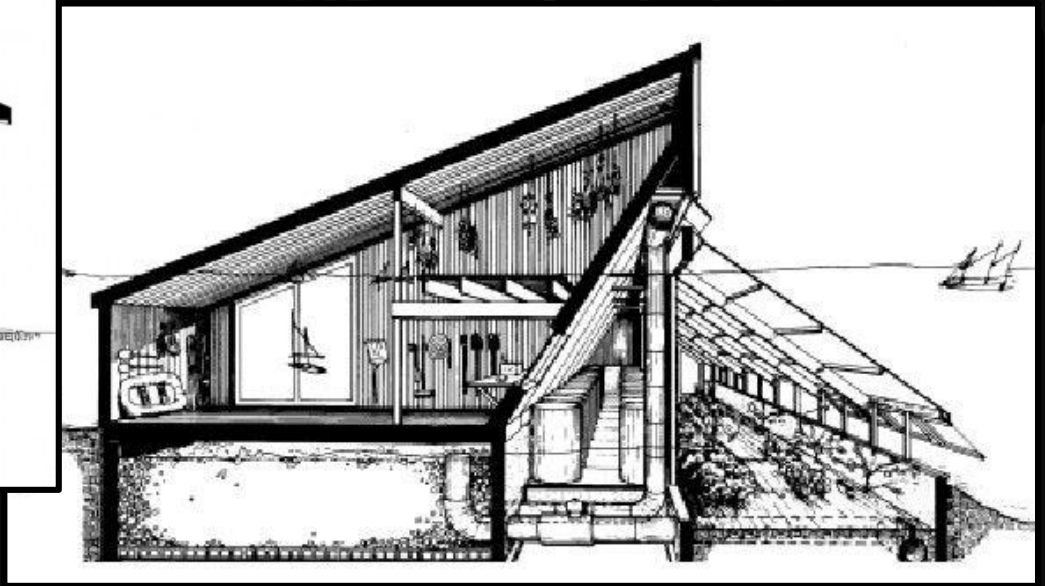
Bio

Case Studies

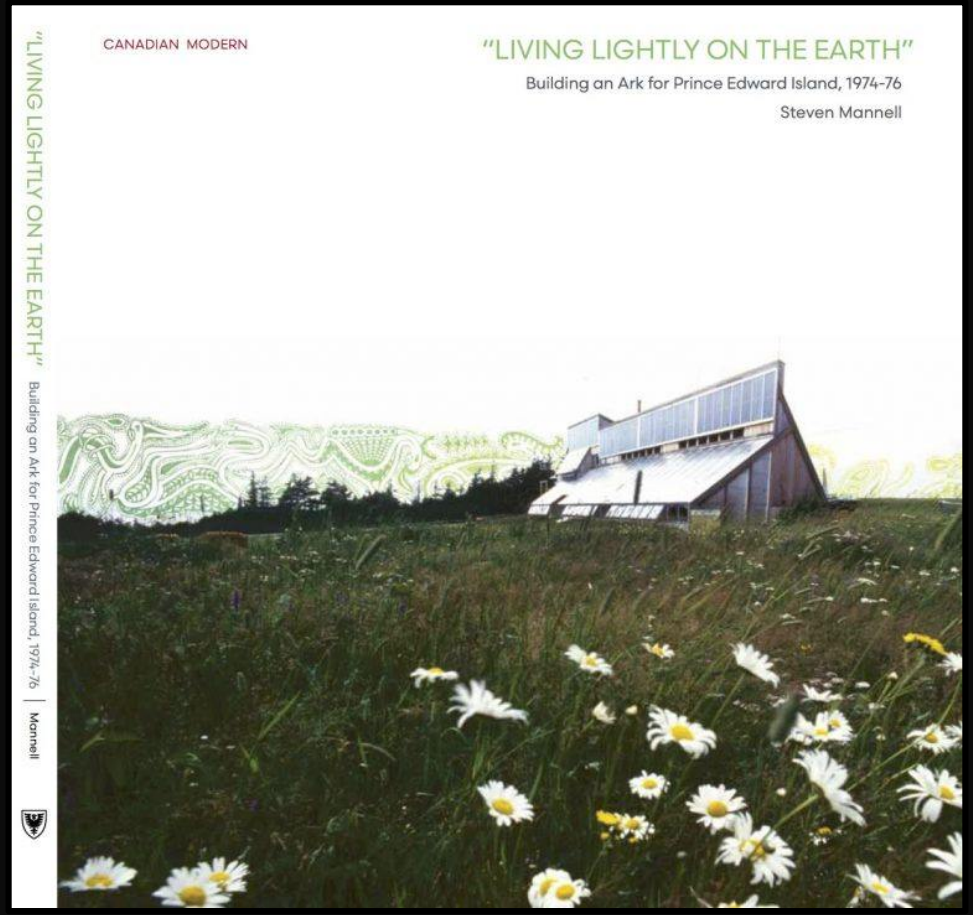
- Chinese Greenhouses
- LTI Walipini
- Oranges in Kansas
- NAI Bioshelter Arks








Bio



The PEI Ark Catalogue

"Living lightly on the earth:" building an Ark for Prince Edward Island, 1974-76

Built in 1976 by Solsearch Architects and the New Alchemy Institute as "an early exploration in weaving together the sun, wind, biology and architecture for the benefit of humanity," the PEI Ark was conceived as a "bioshelter" integrating ecological design features to provide autonomous life support for a family. Opening day mixed counterculture together with official culture: Prime Minister Pierre Trudeau, Premier Alex Campbell, Whole Earth Catalog compiler Stewart Brand, and hundreds from PEI's counterculture settlements, and the neighboring traditional communities. Thousands more would visit the Ark over its short life. This website, along with the accompanying book and exhibition, explores the story of the Ark for PEI, and its architectural vision of life led in collaboration with nature.

The PEI Ark Catalogue offers a selection of documents and research materials about the Ark – its conception, development, and operation – along with stories about the research process. It also offers the opportunity for anyone who experienced the Ark to share their stories, photographs, and other materials, through the "Share Your Story" page and the gallery. We invite you to take part in celebrating the 40th anniversary of this visionary project.

Exhibition: October 2016 – April 2017 at the Confederation Centre Art Gallery, Charlottetown PE; September – December 2019 at the Beaverbrook Art Gallery, Fredericton NB; **04 March – 17 April 2022 at the Dalhousie Art Gallery, Halifax NS.**

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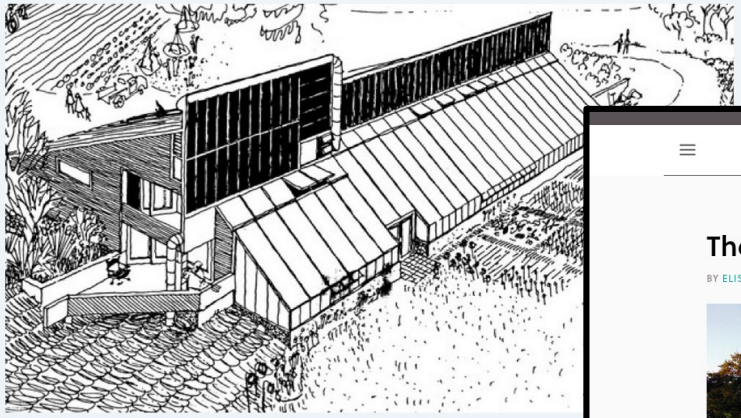
Bioshelter Arks



edible CAPE COD

The Cape Cod Ark

BY ELISE HUGUS / PHOTOGRAPHY BY DANIEL COJANU | DECEMBER 16, 2014

A Study in Self-Sufficiency

The snow is shin deep, the mercury well below freezing. In the stunning clarity of winter sunshine, a complex triangle of glass rises from among the dazzling white drifts. A layer of condensation obscures the details of the verdant world inside, but as I draw closer, the green takes shape: a forest of kale, hanging baskets of alyssum, beguiling arch of pole beans. Hyacinths float atop vats of greenish water, as catfish swim in lazy circles.

In contrast with the cold, white world I just stepped out of, this winter landscape feels like paradise. As I quickly shed layers, my muscles release their frigid tension and my face relaxes into a smile. The air is humid, teeming with the sweet smell of soil, of respiring plants, of life. I take a seat at a table next to a sandbox filled with toys. A faint

YouTube new alchemy institute

0:46 / 7:55

The Cape Cod Ark

Green Center
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The Cape Cod Ark is a solar greenhouse developed by the New Alchemy Institute to grow fresh food in the winter without fossil fuels. It grows salad greens and vegetables in soil beds and grows fish and lettuce in aquaponics ponds. The Ark is attached to an energy-efficient and nutrient recycling house and provides a model for ecological living in a post-petroleum future. These ideas for a single-family home hav ...more

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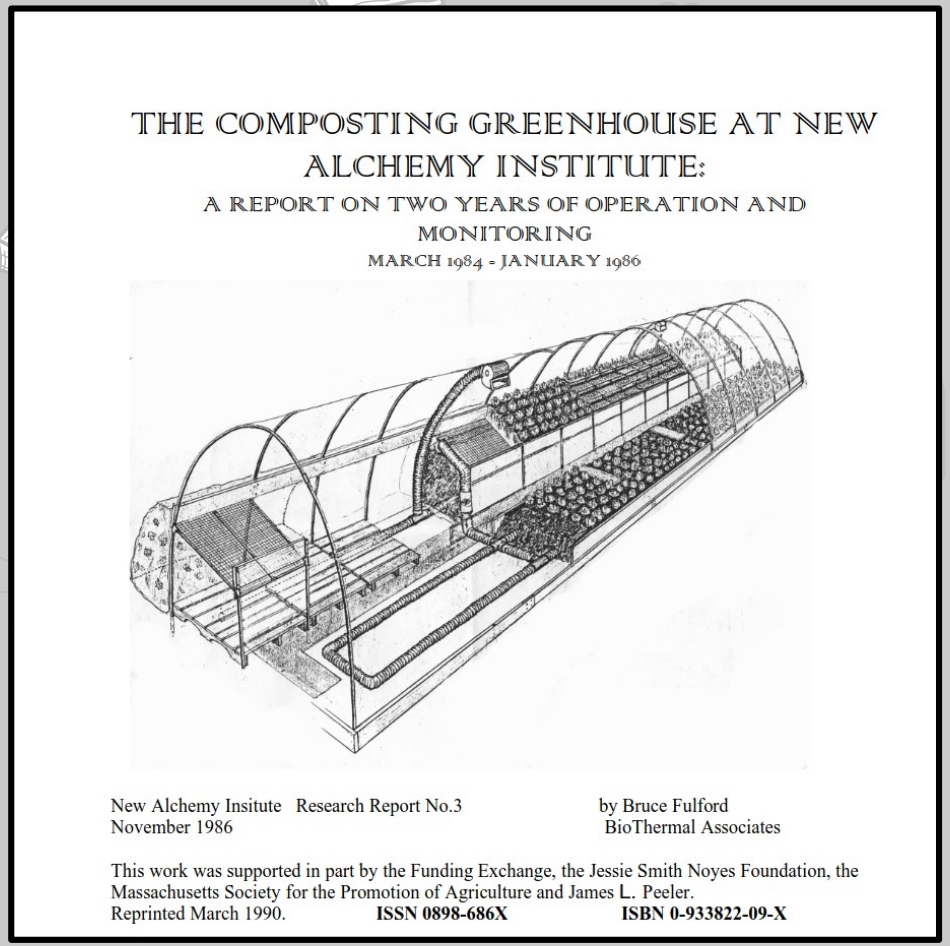
Case Studies

- Chinese Greenhouses
- LTI Walipini
- Oranges in Kansas
- NAI Bioshelter Arks
- NAI Compost Greenhouse



THE COMPOSTING GREENHOUSE AT NEW ALCHEMY INSTITUTE:

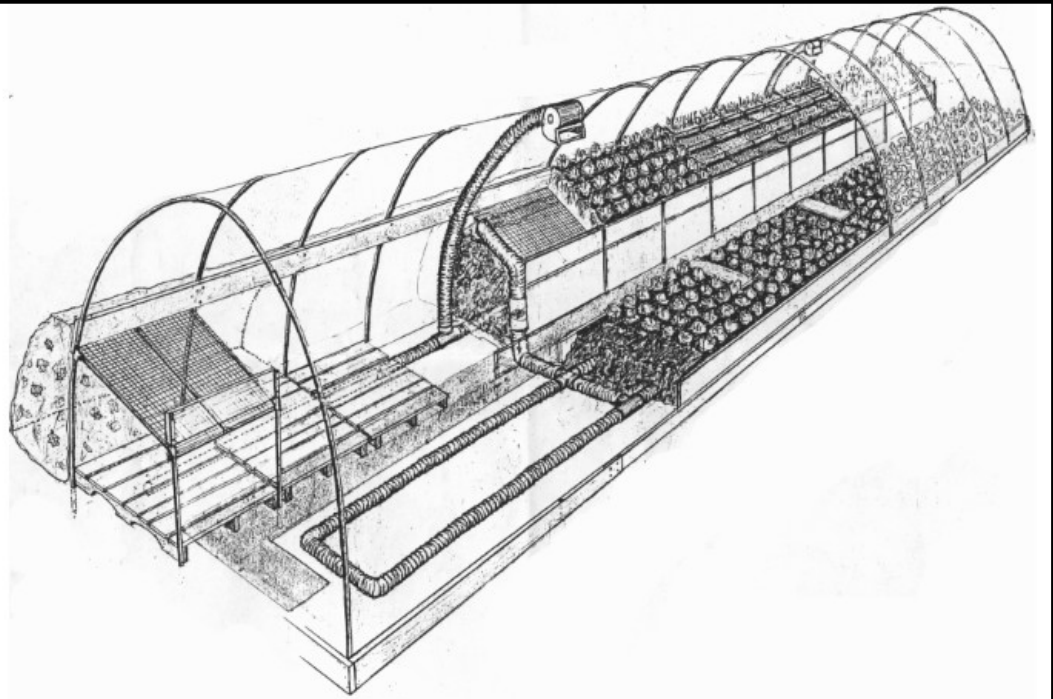
A REPORT ON TWO YEARS OF OPERATION AND MONITORING

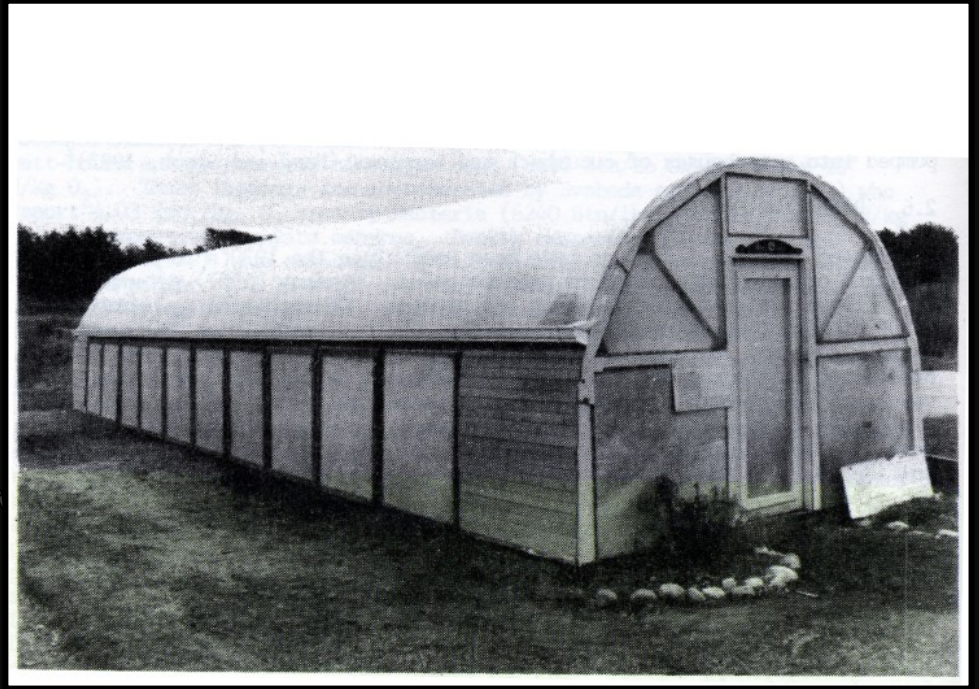
MARCH 1984 - JANUARY 1986

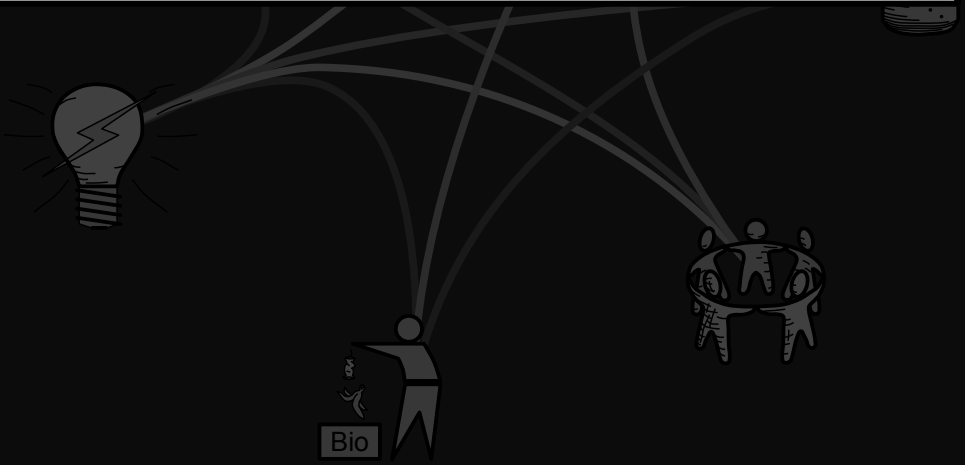
New Alchemy Insitute Research Report No.3
November 1986

by Bruce Fulford
BioThermal Associates

This work was supported in part by the Funding Exchange, the Jessie Smith Noyes Foundation, the Massachusetts Society for the Promotion of Agriculture and James L. Peeler.
Reprinted March 1990. **ISSN 0898-686X** **ISBN 0-933822-09-X**






Bio

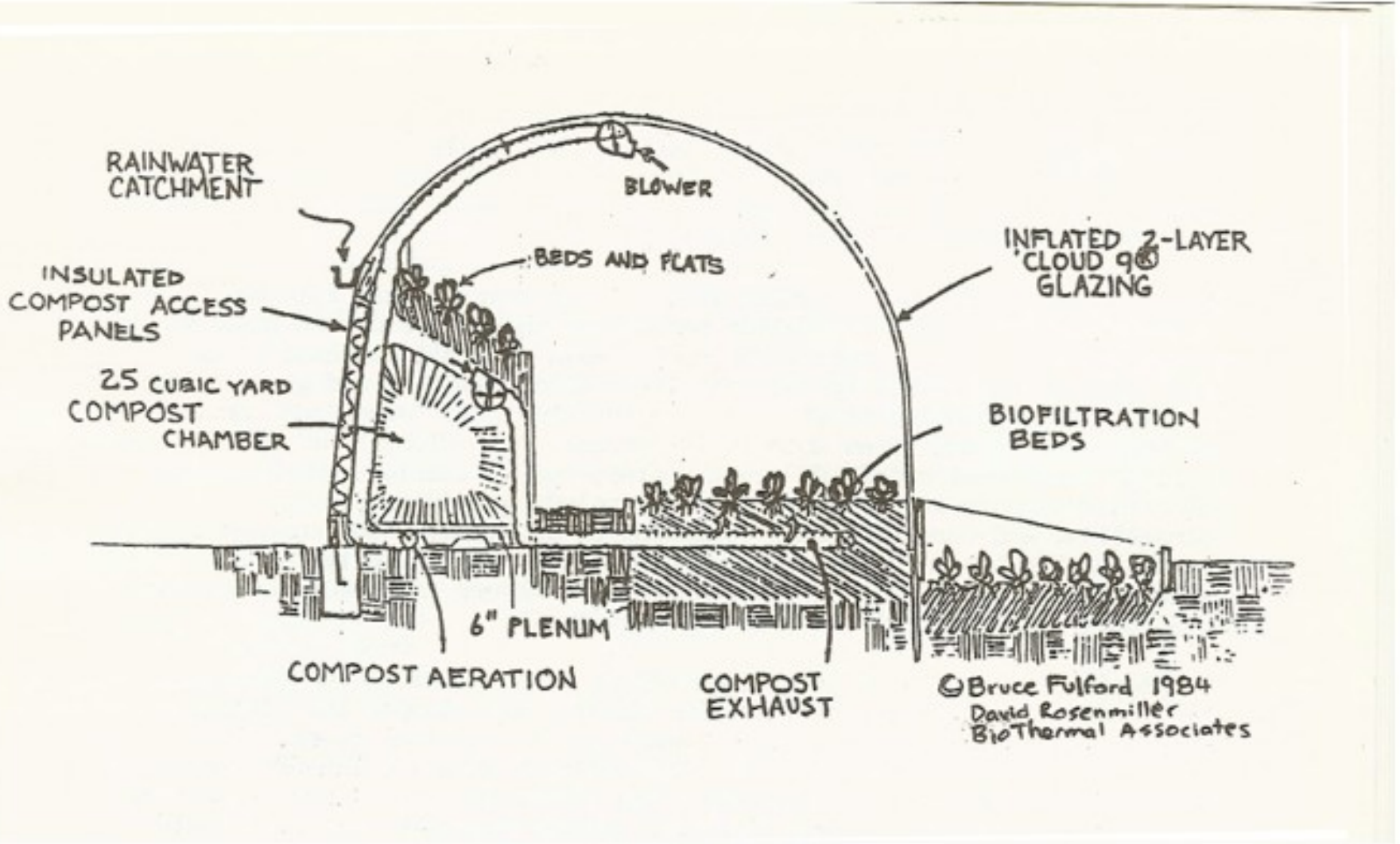


Figure 2 Cross Section of Composting Greenhouse

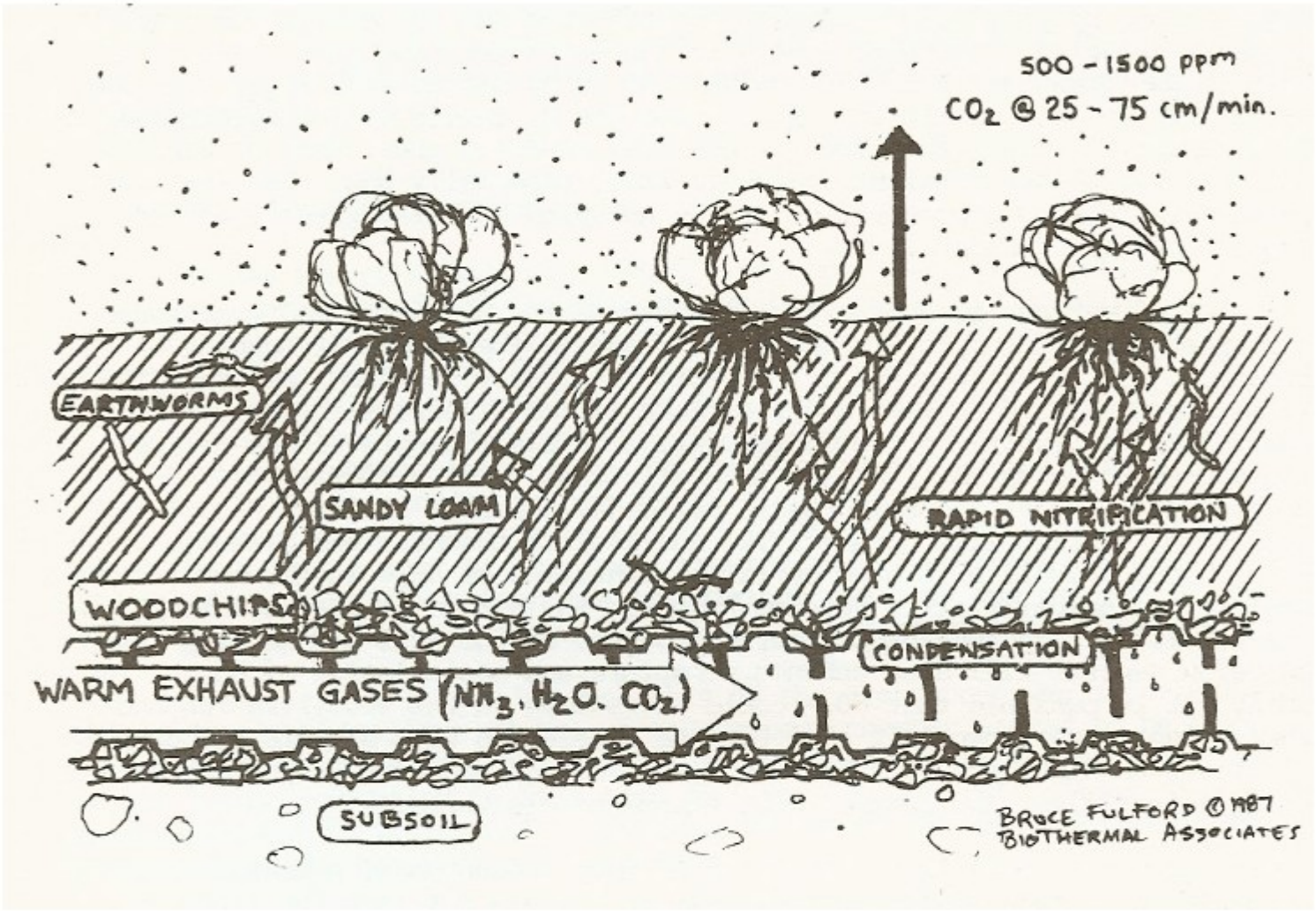
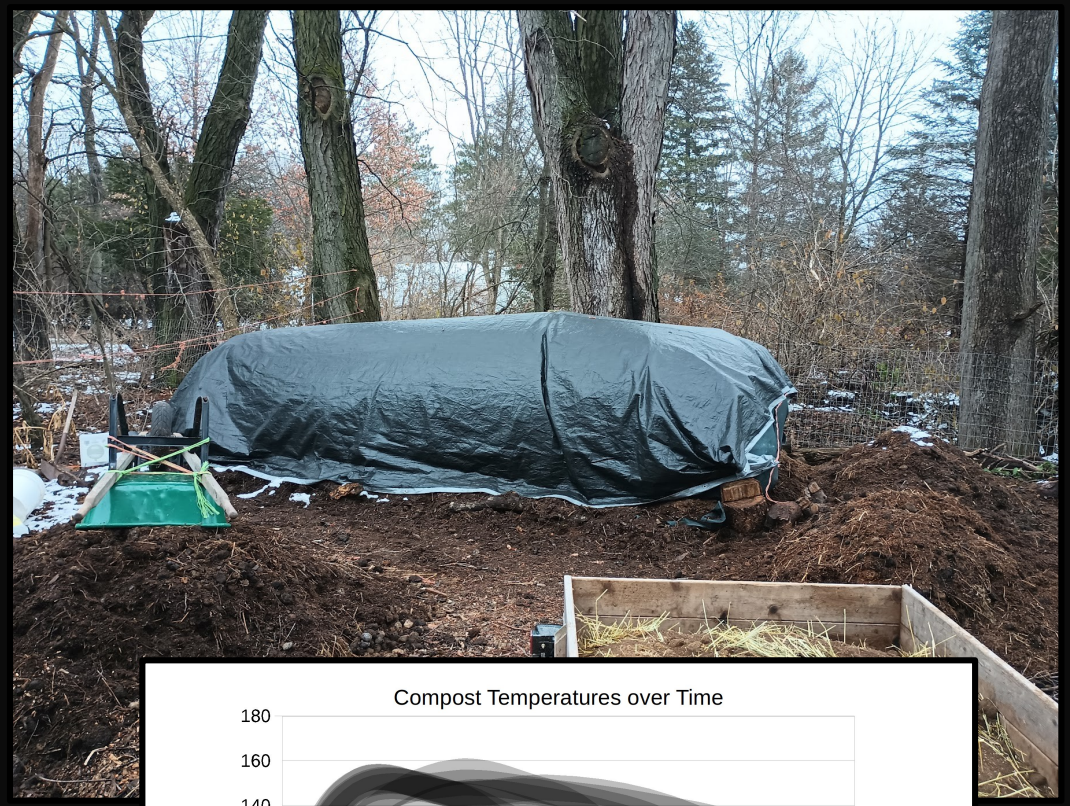
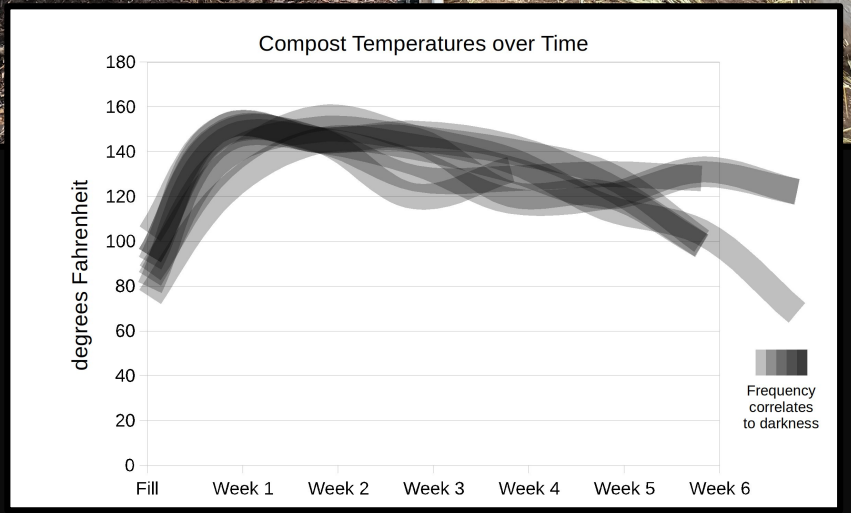


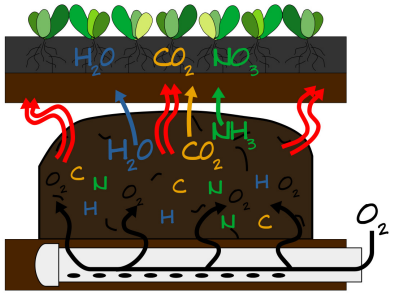
Figure 5 Biofilter Cross-Section





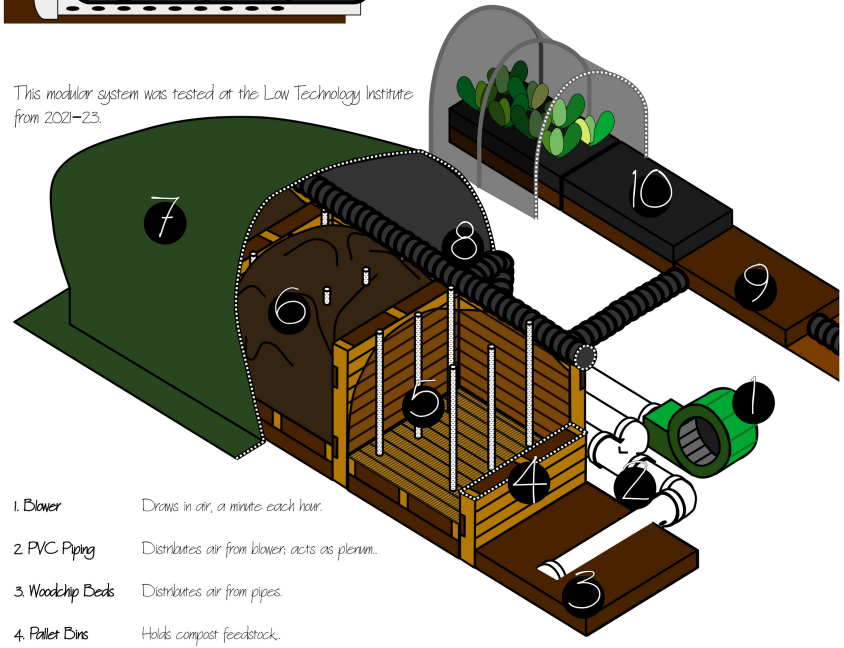
Full-Circle Compost System

Low Technology Institute / S. Johnson



4. Plants enjoy an environment rich in CO_2, NO_3, H_2O, and HEAT directly in their grow bed.
3. NH_3 is converted to NO_3 in a biofilter.
2. CO_2, NH_3, H_2O, and HEAT are given off.
1. H, C, and N, combine with O_2 as the compost breaks down.

This modular system was tested at the Low Technology Institute from 2021–23.



1. **Blower** — Draws in air, a minute each hour.
2. **PVC Piping** — Distributes air from blower; acts as plenum.
3. **Woodchip Beds** — Distributes air from pipes.
4. **Pallet Bins** — Holds compost feedstock.
5. **Perforated Pipes** — Exhausts gasses from compost pile.
6. **Compost** — Provides organic materials to create heat, moisture, and CO_2.
7. **Bladder** — Impermeable tarp captures compost off gasses
8. **Drain Tile** — Accepts compost off-gasses and transmits it to grow beds.
9. **Woodchip Biofilter** — Distributes air and holds nitrogen-friendly bacteria.
10. **Grow Beds** — Holds plants, which benefit from heat, moisture, and CO_2 from below.

More about this study: lowtechinstitute.org/category/research/no-7-hot-box-compost/

Study funded through USDA's Sustainable Agriculture Research and Education program: sare.org

Four-Season Growing in Wisconsin

Low Technology Institute

lowtechinstitute.org

Scott A. J. Johnson

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