

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under agreement number 2021-38640-34714 through the North Central Region SARE program under project number LNC21-446. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.



Instructor Guide

Lesson Title/Topic: Greenhouse

Length: 30 minute presentation/lecture

Description: Introduce the basic concepts of starting vegetable transplants in a greenhouse, this course primarily covers: What you need for starting transplants, reading a crop calendar, knowing which plants to start in the greenhouse and which ones to direct seed, and using a planting log to record planting information. As well as maintaining crops by thinning and potting up. Finally the process of hardening off completes the lesson.

Objectives

Participants will be able to...

1. Choose appropriate materials for planting in the greenhouse
2. Know which crops should be direct seeded vs started as transplants in the greenhouse
3. Explain warm vs cool season
4. Understand how to thin plants in greenhouse
5. Know how to pot up
6. Explain the concept/process of Hardening off

Materials/Resources:

- Farm Production Booklet
- Crop Calendar
- Veggie Flash Cards set for each small group
- GH trays and pots for activity
- All Farm Production plans and group plans

Vocabulary:

- Greenhouse – a building to grow plants that need protection from cold weather
- A Transplant – a young plant
- TO Transplant (transplanting) – planting young plants outside
- Direct Seed – sowing seeds into the soil
- Germination - plant growing from a seed



- Thinning (plants) - removing some plants that are growing too close together
- Potting up – re-planting transplants into larger containers or pots
- Hardening Off- process of slowly introducing GH plants to the outdoors
- Rootbound – transplant roots are tight and tangled, NO space to grow

References/Continued Learning:

Course Content

I. Warm-Up Reflection on previous greenhouse experiences...

Returning Farmers: What crop did best in the greenhouse last year? Why?

First Year Farmers: Please share your farming experiences. Have you used a greenhouse?

II. Vocabulary Instruction

III. Main Content

Materials needed for planting in a greenhouse.

1. Seeds- save seed packets
2. Soil mix- provides texture and nutrients for plant growth
3. Trays or pots- trays are many, pots are just one
4. Labels- water proof is best
5. Planting Log- for record keeping

GH provides heat, light, and air flow. Farmer adds water, seeds and soil.

Heat- 2 heaters

Light- plastic/ glass construction

LIGHT --Young plants need full sun. Very short, dense and bright green growth is good.

"Leggy" plants that are too tall. These fall over, and don't grow well. BAD. Not enough light.

Air- circulating fans and vents



Spacing: Slide shows too many plants, germinated too close together. BAD. Next photo shows seedlings spaced one in each cell... or space. Starting on the left is ok. NEED to pot up or thin so each can grow bigger.

Roots of each plant need their own space. Roots have limited soil in GH pots. Limited water and nutrients. Need access without competition.

Water- just the right amounts. Plants have different needs. Their needs vary with time. Water just right for plants needs, not too much or too little. Too little water then plants can wilt. Too much water causes algae on surface of soil.

Share which seeds are recommended for seeding in Greenhouse. Then transplanting into garden.

Share which seeds are recommended for direct seed. Never in Greenhouse

Share which seeds can be transplanted or direct seeded. Discuss why for each crop. ASK farmers for examples. DISCUSSION

KALE and Chard= early season helps to start seeds indoors. When soil temp is warmer it becomes easier to germinate outdoors.

Zucchini, Okra, Melons, Cucumber= early season helps to start seeds indoors. When soil temp is warmer it becomes easier to germinate outdoors.

Melons, Cucumbers, Squash= Do not like root disturbance. Hate to be transplanted. Use very large pot and do not allow to become rootbound.

Cilantro and dill= germinate, grow and flower quickly and then go to seed. More than 1 planting is necessary to ensure a longer harvest. Starting indoors or outdoors as space allows.

Why?

TIMING for CSA harvest or other ideal harvest time. Seed indoors or outdoors as required by season or space.

If limited GH space- TRY more for DS.

If you have lots of seeds, try DS. Try GH. Test different timing and strategies.

IF seed is very expensive, Keep it in GH where it can be more closely monitored!

If expecting weather or storms to impact planting in upcoming weeks, try planting GH.

If wanting to use rains to water in, Try DS.

IF your schedules allows better for DS? or GH?



Discuss CROP CALENDAR. Timing of cool season vs. Warm season. Some crops can tolerate frost. These can be grown in cool season. Starting seeds in the wrong season can cause crop failure. Practice reading Crop Calendar. Ask what crops farmers are familiar with to grow direct seed or in Greenhouse.

Compare CROP CALENDAR to planting dates for CSA... **SHARE** all farmer production plan

Discuss Farmer group 1 group 2 group 3 and graduate contracts.

Choosing trays or pots depends on crops. More roots need more space. Discuss crops specifically that farmers grow in greenhouse, and what size pots they grow in.

ACTIVITY: Part 1 DS

Make small groups- self assigned 3- per group, Give set of veggie cards to each group.

ASK farmers to go around and each name a crop that grows best Direct Seed.

Discuss why they are successful this way and not recommended for greenhouse.

Carrot, Turnip, Radish, Beet= taproots! These need to reach deep into soil as emerging seedlings to ensure proper root growth. From Seed straight into soil.

Spinach, Arugula, Lettuce, Greens= harvested in leaf stage, ok to seed dense for good production,

Covercrops= similar to lettuce, broadcast seeding, want to germinate thick and not allow weed competition

Beans and Peas= Roots are sensitive to disturbance, hate to be transplanted, don't do well in GH conditions

These cards are all gathered up and set aside. TO prepare for next part of activity.

PART 2 TRAYS

Each small group is provided with a selection of greenhouse trays.

Ask students to arrange the cards they have in their hands. They need to choose the crops they would plant and lay the cards in that tray.

What crop would you start in open flat? Add veggie flash cards here.

What plants in 6 packs?

What in larger 4" pots?

Teacher and support staff to talk through which plants are chosen in each tray. Remove and cards that are incorrect.

WAIT GH space is limited. ONLY 20 trays will fit on the table . **NO Building is allowed. WHY? For Greenhouse AIR flow is important. New fans help. Air circulation improves temperature regulation, and discourages pests. Easier to manage if pests are present.** Plants can be started and then hardened off so others



can be started in time. There is enough room to start transplants for your plot in 20 trays if properly timed. Staff is here to help. **ACTIVITY END**

Must record dates of seeding in Planting log. Helps to harvest on time, and learn year to year.

Thinning- removing extra plants, keeping 1 in each cell,

Space between each plant gives room to grow into a head. Thinking like head lettuce, pac choi.

In the field, crops that are direct seeded in the garden also need thinned. Each needs their own room to grow.

Potting up- means moving a small plant to a larger container.

Pot up when plants are root bound, too crowded, and/ or showing their true leaf.

HARDENING OFF helps transplants be ready for outdoors

. TEMPERATURE, WIND, AND SUN can be damaging, and shocking, to transplants

in the greenhouse, environment is controlled. Outdoors the young plants are exposed. Plants need to **adjust slowly**. Farmers need to be ready to protect their crops from temperature extremes.

Cool Season plants: transplants outdoors when nights above 25 degrees

Later... warm season plants, when nights stay above 50 degrees

Wind/ SUN can kill new transplants. Keep checking on them daily or 2 x day, **until established**.

STEPS for hardening off:

Day 1-3, protected area, 2-4 hours

Day 4, protected area, 6-8 hours (all day)

After 5 days, all day, overnight

- (check weather for overnight temperatures!)

After one week plants are ready to be planted outside, in the ground.

Discuss hardening off area made with haybales. And other options.

IV. Wrap-up/Self-assessment

Explain how to grow all plants needed for your garden

V. Additional Materials/Resources for Students



FIELD Walks are starting now. Earlier than last year. I want to work with you, and help in GH. For field walks, please have questions for me. Have a job or a goal. Something I can help you with. I don't like being the boss. I am here to help you.

Each farmer- When you come to GH for first starting seeds, let me know so I can meet you. Each farmer meets with me at least 1 field walk in February and at least 2 in March. Regular schedule in April through October.

Assessment Rubric

	Not at all (0)	Basic (1) (demonstrates some knowledge)	Proficient (2) (successfully demonstrates the complete knowledge)
Farmer can read Crop Calendar when given a vegetable can name the right month to start.			
Farmer can read Crop Calendar to name which vegetables they start in greenhouse.			
Farmer uses Planting Log correctly to record seed starting data.			
Farmer can choose the correct size tray for starting seeds in greenhouse.			
Farmer can identify when the correct time is to pot up or transplant by checking the roots.			
Farmer can explain how to prepare area and harden off transplants.			





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CULTIVATE The logo for Cultivate KC. The word "CULTIVATE" is in large, bold, green letters. To the right of "CULTIVATE" is a small green icon of a leaf with the letters "KC" inside it.



National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

Why use a greenhouse?



- Get crops started earlier in the season.
- Extend growing season for crops that require more time to grow.

Objectives:

1. Choose appropriate materials for planting in the greenhouse.
2. Know which crops to start as transplants in the greenhouse.
3. Explain warm and cold season.
4. Describe how to seed a tray.
5. Name (at least) 3 steps to maintain healthy plants in the greenhouse. (Thinning, Potting Up, Fertilizing, Pest/ Disease scouting, Hardening Off)



VOCABULARY

- Direct Seed-
- Transplants-
- Potting Up-
- Scouting-
- Greenhouse-
- Hardening off-

Direct Seed-

Planting seeds
directly into the soil
*press firmly into soil surface

NOT all seeds should start
in greenhouse



Best for carrots, and other roots, beans, peas, and greens

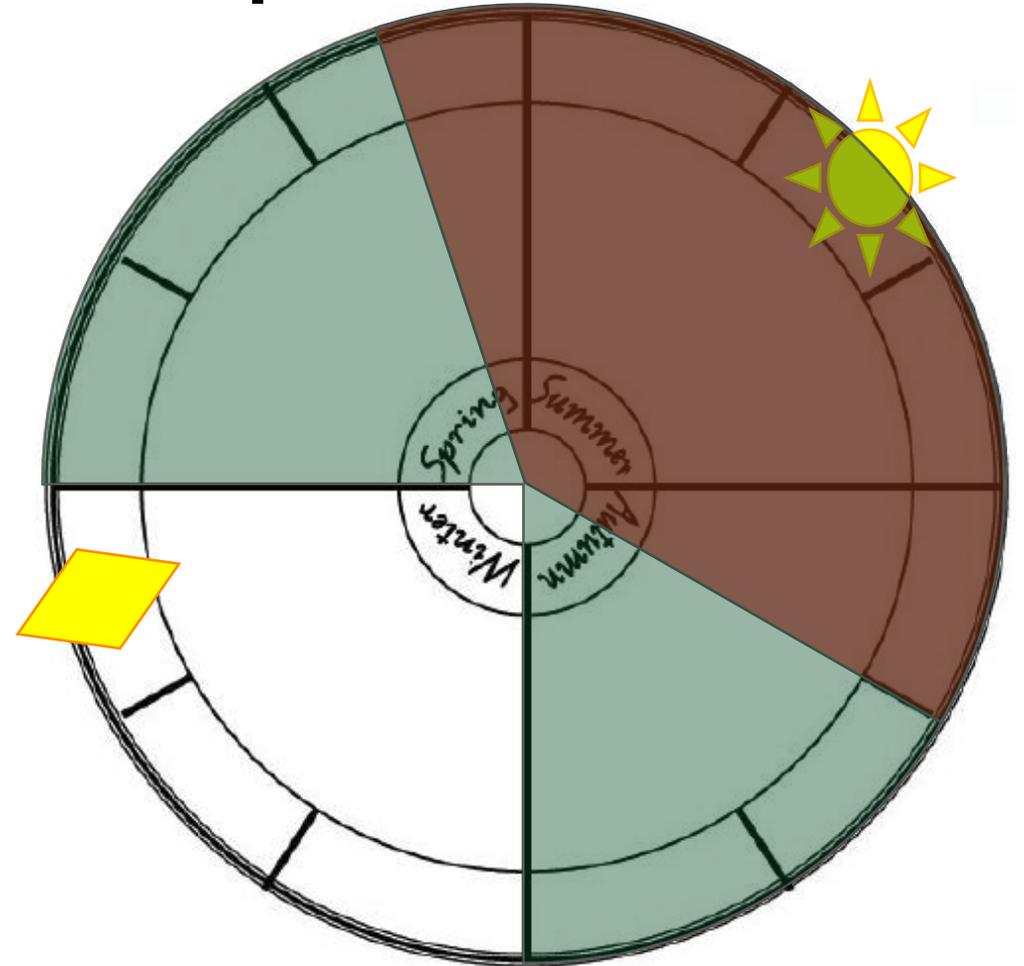
4 seasons- changes in temperature

Kansas City's GROWING SEASON-
March through November

- Field Walks during growing season
- What month is it very hot?
- What month is it now?
- When is warm Season?

Winter- too cold to grow outdoors
without season extension

MORE on weather in class 2/24 called Climate Resilience





Cool Season Crops



grow best when 30- 60° f

March	April	May	June	July	Aug	Sept	Oct
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- Spinach
- Lettuce
- Chard
- Onions
- Beets
- Potatoes



- Radishes
- Cabbage
- Kale
- Collards
- Peas
- Pac choi
- Carrots



Warm Season Crops



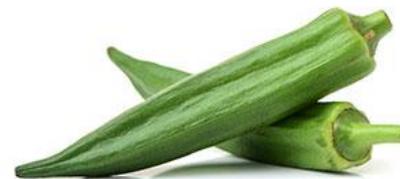
grow best when 50- 85° f

February	March	April	May	June	July	Aug	Sept	Oct
X	X	X				X	X	X

- Beans
- Squash
- Cucumbers
- Sweet Potatoes



- Okra
- Eggplant
- Peppers
- Tomatoes



Activity PART 1

Direct Seed in your Garden Plot

- Which seeds will be planted directly into garden soil?
- Next only looking at seeds for GH (use Crop Calendar)





Greenhouse -

- a building to grow plants that need protection from cold weather

Why do plants like the greenhouse?



HEAT



AIR
SPACE



LIGHT



WATER



WHAT DO I NEED?

LABELS

CROP and VARIETY
name and
DATE



SEEDING LOG



SEEDING LOG						
 Seed Date	 Crop & Variety	 Quantity	 Date Outdoors	 Bed #	 Days to Maturity	 Notes
1/20/23	Sweet Alyssum White + Pink x2	1801 x2				germ 3 days!
	Brussel sprouts Long Island Improved x2	1801 x2				germ 3 days!
	BO PAK Pac choi	1801				germ 3 days!
	Kale Winterbor	1801				germ 3 days!
	White Russian	1810				
	Lettuce Flashy Trout Back	1801				
	Parsley	1801				
	Broccoli Waltham 29 x2	1801 x2				germ 3 days!
	Thyme German Winter	1801				
	Sage Extra Petite	1801				
	Cardoon Porto Spinules	1801				
	Cabbage Minuet x2	1801 x2				
	Mint	1801				
1/20/23	Lemon Grass	1801				germ 1/30/23

WHAT DO I NEED?

SEEDS



SOIL MIX



Special mix
used to grow
plants in
containers

TRAYS OR POTS

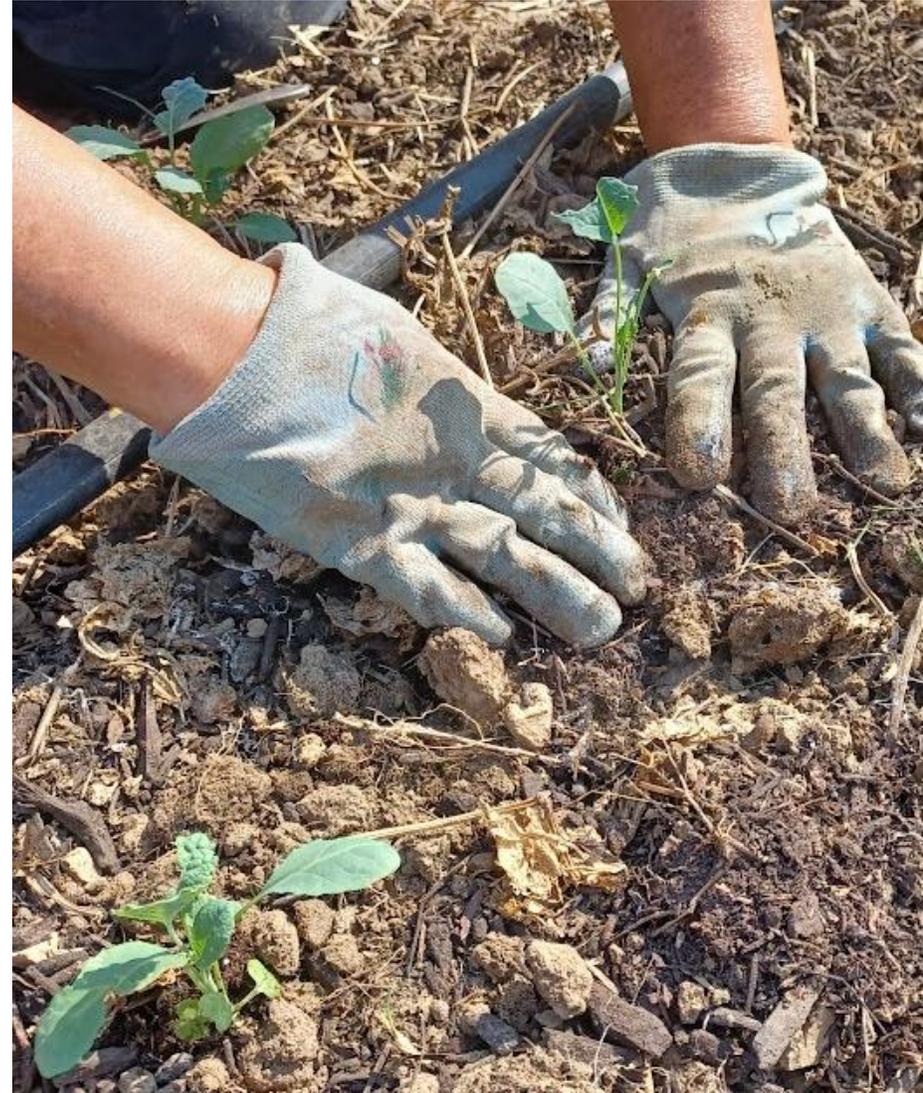


containers for
growing plants

WATER



a transplant – a young plant started in greenhouse
transplanting – planting young plants outside



Remember to use
your booklet

- NEXT class is all
about recordkeeping



What is the best for greenhouse growing?



36-Cell Jumbo Plug Insert



Medium Weight Mesh



72-Cell Plug Flat



Lightweight Deep Tray (with Holes)



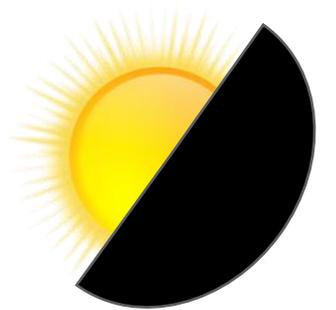
Germination-



- Baby plant growing from a seed

Germination Rate: 95% seed success vs failure

“bad” or “low germination rate” less than 50%



Germination Chamber- warm, dark, and humid space helps seeds to open and grow

- use **domes** (to maintain temperature in the soil mix, and to maintain the water and keep soil moist.)

Domes

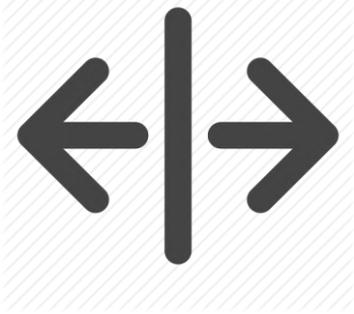
- Use Domes for germination only. Remove when green plants appear.
- Check daily for germination, move to full sunlight as they grow up enough.
- Great for extra protection during cold weather



2" Clear Acrylic Dome



Large 7" Clear Propagation Dome



SPACING

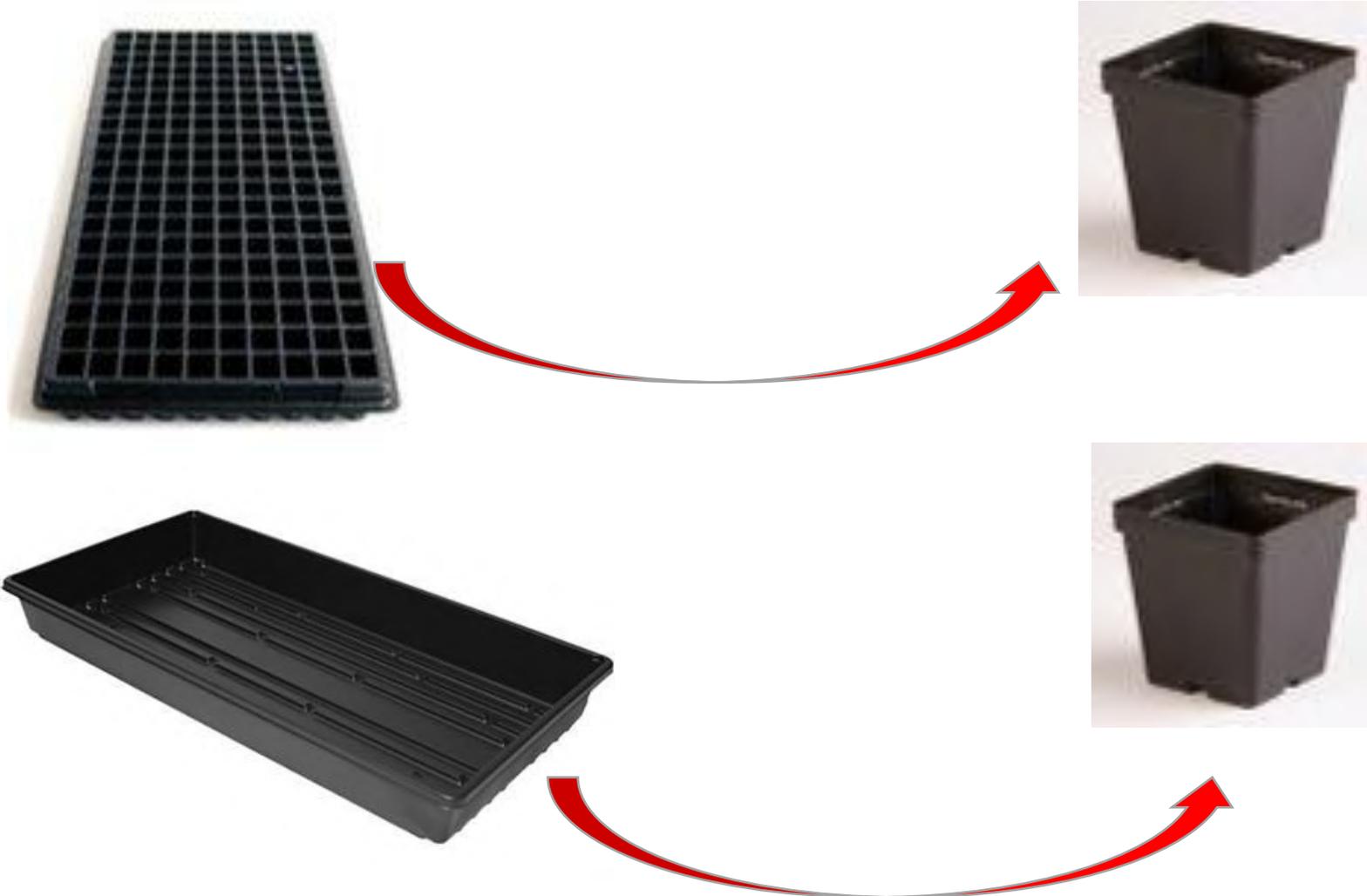


- **Thinning** – removing some plants that are growing too close together

Give space to each plant



Potting up - re-planting transplants into larger containers or pots



What size are the roots?



POTTING UP – WHICH PLANTS?

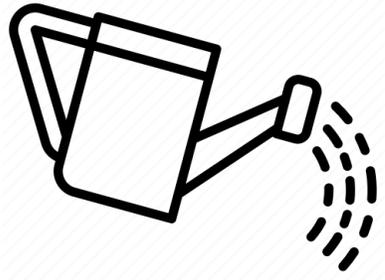


Water

Check every day!

- Always start with moistened potting mix.
- Water-In seeds and transplants after planting.
- Water new seeded trays gently.
- After germination, allow soil to get dry between waterings.





WATER

TOO LITTLE



TOO MUCH



Scouting-

- Keep watch for pest and diseases as they arrive
 - Looking every time, before you water your plants
 - Checking on the stem
 - Check under the leaves
 - Check the soil surface
-
- Ask for another farmer to look if you see something is unusual
 - Ask Haley

Tips for Healthy Plants

- Check daily for strong green plants, NO diseases
- NO pest problems, Give each plant space.
- Don't become rootbound. Allow to grow steady both tops and roots. Pot up as necessary.
- Provide a half dose of fertilizer if plants become yellow.
- First IN, First OUT
- Plants only stay in Greenhouse if NECESSARY. Don't leave them in greenhouse too long.

Activity PART 2

Which trays should we use for each crop?



Activity PART 3- **HOMework** DURING 1-1 Field Walk PLANNING your greenhouse table



- Last year, only 20 trays can fit
- NEW table **27 trays!**
- First in, first out
- WHAT seeds will you start first?
- What seeds will you start each WEEK following?

Hardening off-



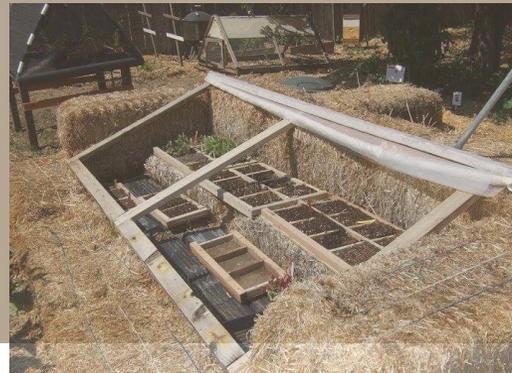
in greenhouse

OUTSIDE
Protected
from wind
from direct
sunlight

transplant in
garden bed

How Haley Hardens Off Transplants

Day 1	Day 2	Day 3	Day 4	Day 5
Only 1 hour	2-4 hours	3-5 hours	6-8 hours	All day, overnight, Ready to plant after 1 week
Protect from wind	Protect from wind	Allow some light wind exposure	Allow some light wind exposure	Remove some protections
Protect from direct sun	Protect from direct sun	Full sun	Full sun	Watch for extremes in weather
Protect from harsh temps	Protect from harsh temps			Add back protections if necessary



Tell me one new idea you learned today?



THANK YOU

