Module 4: Plant Growth, Management & Pest Control

Think, Pair, Share Activity A: Mini Circular Loop

Red Notes

Lesson A
Grouping: 2-3 persons
Time: 25-30 minutes

Materials:
Scratch paper, Markers or colored pencils, and class notes (optional)

Objective:
Students will design a circular loop that represents how a plant manages its energy—moving from photosynthesis and growth to defense—when facing stress like pests or pathogens. They'll show the relationship between sugar movement, hormonal signaling, and energy trade-offs.

Instructions:
1. Form a group of 2–3 students.
2. Review the diagram in the lesson slides on sugar flow and hormone signaling
3. Choose one plant stressor (e.g., pest, drought, pathogen)
4. Together, build a Mini Circular Loop to show the steps a plant takes from making sugar to defend itself
5. Be ready to share your loop with the class in a quick 2-minute presentation

Your Task:
Use the graphic organizer below to design your plant circular loop. Fill in each section clearly, then apply your loop to a real-life crop example showing how the system works when your plan is applied.

Key Terms Refresher:
- Photosynthesis: How plants use sunlight to make sugars (energy) in their leaves.
- Hormone: A chemical signal that tells the plant how to respond to changes (e.g., stress).
- Abscisic Acid (ABA): A hormone that helps the plant react to drought.
- Defense Structure: A Physical or chemical feature that protects a plant (e.g., toxins, waxy cuticle).
- Trade-Off: What the plant gives up (like growth or reproduction) to defend itself.

Step 1: Pick a sugar-related step to model	**Step 2: Choose a plant stressor**	**Step 3: Choose a hormone triggered by the stress**
☐ Sugar production (Photosynthesis) ☒ Sugar Allocation ☐ Hormone signal ☐ Defense Construction ☐ Something else: _____	☒ Pest (e.g, caterpillar) ☐ Pathogen (e.g, virus/fungus) ☐ Drought or wounding ☐ Other: _____	☒ Jasmonic Acid (JA) - chewing pests ☐ Salicylic Acid (SA) - infection ☐ Abscisic Acid (ABA) - drought ☐ Other: _____

Step 4: Use evidence from the lesson slides to support your loop (or find an on-line rebutable resource).
What changes in sugar flow or metabolism did you learn about? Use arrows and key words to show cause-and-effect relationships.

Photosynthesis in source leaves → sugars (sucrose) made and available for transport.

Chewing damage occurs → JA rises in damaged tissue and triggers defense programs.

JA induces VOC release (distress scents).

VOCs attract natural enemies (e.g., parasitic wasps) and also warn nearby plants.

Sugar allocation shifts: more carbon goes to leaves/stems to build defense compounds/structures (e.g., tougher tissue), less to growth/reproduction → classic growth-defense trade-off.

Outcome: herbivore pressure drops (biocontrol help), but there's a temporary yield/growth cost.

(Optional) Step 5: Apply your loop to a real-life crop example..
Pick one from your notes or this list:

- Examples: tomato, lettuce, strawberries

Crop: Tomato (greenhouse or field).
Stress: Tomato hornworm (chewing).
Trade-offs a grower considers: allow/encourage biocontrol (banker plants, habitat) and accept a short-term growth/fruiting slowdown while defenses are built; escalate to IPM tools only if monitoring shows economic thresholds are met (cultural/mechanical/biological first; chemical last).

What stress could this crop face?

Chewing herbivory by tomato hornworm → rapid defoliation, photosynthesis loss; triggers jasmonic acid (JA) defenses and VOC release that can attract parasitic wasps.

What trade-offs would a grower need to think about?

Accept a short-term slowdown in growth/fruiting as sugars shift to defense vs pushing for immediate pest knock-down.

Invest in scouting + hand removal/biocontrol (banker plants, habitat, Bt) vs faster but broader-spectrum sprays that can harm beneficials.

Balance cost/time of monitoring and releases against economic thresholds and potential crop loss.

Consider resistance, residues, and pre-harvest intervals if spraying, especially in protected culture (greenhouse) where re-entry and climate affect biocontrol performance.

Reflection:

1. What part of the plant system did you focus on and why?

   I focused on sugar allocation and defense construction because it shows how plants have to make tough choices—either spend sugars on growth (like making new leaves and fruit) or redirect them to build defenses when under attack. It's a clear example of the growth-defense trade-off.

2. How does this circular loop help you understand plant strategy under stress?

   It shows that plants don't just "react" randomly. They use hormones like jasmonic acid to coordinate responses, redirect sugar flow, and even call for help with VOCs. The loop makes it clear that every stress response has a cost, but it's also a survival strategy to reduce long-term damage.

3. How does this activity connect to what farmers or gardeners might do in real life?

   Farmers and gardeners face the same kind of trade-offs as plants. They have to decide whether to let natural defenses and biocontrol do their job—even if it slows crop growth a little—or step in with chemical controls for faster results. Understanding the plant's internal "decision-making" helps them use IPM strategies more effectively, balancing plant health, pest control, and yield.

Skills You'll Use

- System thinking
- Cause-and-effect reasoning
- Visual explanation

Example:

Sugar made in leaves goes to the roots during growth. When an insect bites, JA hormone is triggered. Sugar gets redirected to build stem defenses and toxins. Root growth slows. This helps stop the pest but lowers fruit yield temporarily.