Apprenticeship On-Farm Learning Activity Guide

The following guide is a list of potential activities that apprentices and mentors can explore to enhance on-farm learning. Please note that not all activities may be applicable to your farm and that we encourage you to adapt them as you see fit. There is no expectation to complete or do any of the following activities although we encourage you to look over them with your apprentice and see which ones could potentially benefit your farm operation and or support your apprentice with their learning.

Guiding questions for conversation between mentors and apprentices:

- How is the mentoring partnership working?
- What is working well?
- What, if anything, could be improved in the collaboration?
- What are you both gaining from your experience?
- How does the apprentice feel about the support the mentor is providing?
- What does the mentor feel about the support the apprentice is providing?
- What additional support might the apprentice be seeking?
- What additional support might the mentor desire?
- What external constraints or difficulties are affecting the partnership?
- What changes might be helpful to make for the remainder of the apprenticeship?

Below are examples of activities to deepen this experiential learning. It would be best to make applicable activities together based on the interests of the apprentice, and the skillset of the mentor!

Activity Guide:

1) Identifying Farm Challenges and Solutions
2) On-Farm Soil Assessment
3) Crop Planning
4) Farmers Market Sales
5) Farm Business 101
6) Pest Management Plan

7) Irrigation Design
8) Harvest Plan and Food Safety
9) Plant Pathogens
10) Compost Tea
11) Farm Certifications
12) Cover Cropping
13) Food/Farm Advocacy and Community Organizing

Activity 1: *Identifying Farm Challenges and Solutions*

The apprentice conducts an interview with their farm mentor in which the farmer identifies 3 different challenges they have had to overcome on their farm over the years.

1) How did they identify the challenge?
2) What factors played into this challenge?
3) How did the farmer identify a solution?
4) Were there any outside agencies or organizations that offered support (ex. extension service, a university, USDA etc.)

Activity 2: *On-Farm Soil Assessment*

The apprentice does a preliminary soil observation assessment by identifying certain weeds that are soil indicators, tasting soil, etc. Then the apprentice learns how to take soil samples and conducts soil tests (AC can support covering these costs). The apprentice then takes soil results and their findings to Cole (soil ecologist from UC Berkeley) to discuss more. The apprentice identifies the following soil characteristics and components and brings them back to discuss with the farm mentor.

- Minerals (45%), Air and Water (25% each), and Organic Matter (usually 2 - 5%)
- Soil Texture: Sand, silt, & clay, the soil triangle, and associated properties:
  — Sandy soils - low water and nutrient holding capacity, droughty
  — Clay soils - high water and nutrient holding capacity, but low permeability, poor tilth
- Soil Nutrient Profile: major and minor nutrients, trace elements
  Macronutrients
  — NPK (three numbers on every bag of fertilizer, e.g., fish meal = 10- 6-2)
  — Nitrogen = healthy foliage growth, essential for photosynthesis
  — Phosphorous = energy storage, root growth, disease resistance
  — Potassium = enzyme activity, transpiration and translocation, N uptake, protein synthesis

Micronutrients

— Sulfur, Calcium, Magnesium, Boron

— Others: copper, iron, chloride, manganese, molybdenum, zinc x pH

Additional Resources to Support Activity:

Read:

- Composting's Colonial Roots and Microbial Offshoots by Michelle Niemann This
- Land Was Made: Considering the soil that bears witness to America by Ama Codjoe
- Sun Hemp Soil Building Superhero Forage Potential
- Soil Health and Agricultural Systems by Kibblewhite, Ritz, and Swift
- Agroecology the Ecology of Sustainable Food Systems by Stephen Gliessman
- Farming While Black, Chapter Four: Restoring Degraded Land by Leah Penniman
- Ecologically Based Nutrient Management by Laurie E. Drinkwater, Meagan Schipanski, Sieglinde Snapp, and Louise E. Jackson
- How to Build Up and Maintain the Virgin Fertility of Our Soils by George Washington Carver
- Soil Testing Interpretation Guide Oregon State University Extension Service

Listen:

- Phosphorus – "Guano Mania" by 99% Invisible (23 min)
- Nitrogen – "How do you solve a problem like Fritz Haber?" by Radiolab (22 min)
- Episode 2: Fungi – the Kingdom of Mushrooms, Spores, and Networks (33min)
- Episode 3: The Soil Food Web – A Jungle in Tiny Dimensions (33min)

Watch:

- A Climate Change Solution that is Right Under Our Feet by Asmeret Asefaw Berhe (19 min)

Activity 3: *Crop Planning*

The apprentice designs a crop rotation plan for the next season. The design aims to address how sequentially planting different crops in the same plot can improve soil health, optimize soil nutrients, and counteract the pressure of pests and weeds. The mentor can then review the apprentices' crop rotation plan and offer feedback from their expertise.

Components/ questions to answer within the crop plan:

- What factor does the soil play in this crop plan?
- How many years are the rotations?
- How does marketing and sales affect the crop plan?
- List of plant families
- Map of crop plan for next season

- What are the nutrient needs of your different crop families, and what amendments might you want to consider?
- How many successions does the farmer need depending on their market channels?

Plant Families

— Alliaceae (onion)
— Amaranthaceae (Quinoa, Beet, Spinach)
— Apiaceae (parsley, dill, carrot)
— Asteraceae (sunflower, artichoke, dandelion)
— Brassicaceae (mustard, cabbage, radish)
— Cucurbitaceae (cucumber, melon, squash)
— Fabaceae (bean, pea, lentil, clover)
— Lamiaceae (mint, basil, lavender)
— Poaceae (corn, wheat, rice, barley)
— Rosaceae (rose, apple, blackberry, plum)
— Solanaceae (tomato, pepper, potato)

Additional Resources to Support Activity:

- Farmers Almanac Crop Rotation Guide

Some points of assessment to check apprentices' understanding might be:

- Why is it important to have a solid understanding of the characteristics of specific crops and the relationships between specific crops in order to design an effective crop rotation system?
- What is the importance of legumes in a rotational cycle of planting?
- Besides general soil/plant health, what are some specific benefits of rotating crops?

Activity 4: *Farmers Market Sales*

Apprentice observes farmers' market sales and supports with setup and breakdown. The apprentice doesn't need to be directly involved with sales but can observe the farmer at the market. The apprentice can potentially schedule a meeting with the farmers market organizing entity to learn more about requirements for selling at the market and how to get into local markets.

Activity 5: *Farm Business 101*

Apprentice designs their own farm business plan based on their interests. The mentor then offers their feedback and expertise in farm business management and planning.

Potential components to include in the business plan:

- Executive Summary
- Management Plan
- Land Management Plan
- Risk Assessment
- Products
- Capital Investments
- Markets
- Marketing Plan
- Budget

Additional Resources to Support Activity:

- Farm Business Online Course TUFTS
- Payroll Programs: Intuit, Payroll Program, Sage, Gusto
- The Organic Farmer's Business Handbook by Richard Wiswall
- Farmers Beet Podcast
- Business Structure Fact Sheet
- Business Plan Fact Sheet

Some points of assessment to check apprentices' understanding might be:

- Discuss components of a solid business plan
- Discuss the next action steps for the apprentice to take with their business plan
- Have the apprentice identify where they think there are gaps in their business plan
- Mentor shares about their own learning over the years of running a business, what mistakes have they learned from, what are their future goals that they have for their business, etc.

Activity 6: *Pest Management Plan*

The apprentice learns how to create an integrated pest management plan. Have them go into the field and identify and list of different pests (as well as beneficial insects) on the farm. Then have the apprentice research these pests and learn more about their biology and the ecology associated with them. What are the different insects' prey and habitat? The apprentice can then schedule a meeting with an extension service entomologist to learn more. From there the apprentice can draft an ecological, whole-farm systems approach using PAMS model (see details below). Finally, the apprentice brings back their IPM plan and findings and shares it with their mentor.

Four-step approach (PAMS), starting with the first, using the last only when you must:

- Prevention — Prevent introduction to the farm, hot spots, spread between fields
- Avoidance — Avoid pest susceptible crops or practices that increase losses

- Monitoring — Monitor and identify pests, manage sites of high pest risk and use decision-support tools
- Suppression — A) physical, B) cultural or biological, C) chemical methods of suppressing pests

PAMS

1. Prevent introduction into the farm/field:
    — Certified seeds or hot water seed treatment
    — Build a habitat for beneficials and predators
    — Healthy transplants
    — Make sure compost is hot enough to kill weeds and diseases
    — Clean equipment after use
    — Don't have exposed potato cull piles
2. Avoid susceptible crops or practices:
    — Resistant or tolerant varieties
    — Nutrient deficiencies or excess
    — Deficient or excessive irrigation
    — Compaction or poor soil health
    —Poor crop rotation
3. Monitor and ID pests & use decision-support tools:
    — Walk your fields
    — Check hot spots (field edges, last year's problem areas, etc.)
    — Look under leaves and in leaf axils
    — Use a hand lens
    — Keep field notes
    — Talk to experienced farmers

4. Suppression (least toxic and less impacting first):
    • Physical barriers
        — Floating row cover / Insect netting
        — Surround (kaolin clay)
    • Cultural & biological
        — bT (Bacillus thuringiensis)
        — Nematodes
        —Trap Crops in-field plantings that draw pests away from your primary crop (examples: blue hubbard squash, mizuna, bok choy). Plant trap crop 2 – 4 weeks before main crop. Perimeter vs. Strip trap crop. Light green crops (e.g., arugula, radish greens) attract flea beetles, dark green, waxy crops (e.g., collards) attract aphids
    • Chemical
        — Soap or pepper sprays

Additional Resources to Support Activity:

- Farming with Soil Life- A Handbook for Supporting Soil Invertebrates and Soil Health on Farms Xerces Society
- Recommended Plants: California Central Coast Region for Pollinators and Beneficial Insects Xerces Society
- Agricultural Pest Guide UCANR
- USDA IMP Resources

Activity 7: *Irrigation Design*

The apprentice practices designing their own irrigation system for a fictional or existing farm plot. The apprentice then brings this plan back to their mentor to get their feedback and insight.

- Based on your crops, soil profile, and infrastructure in place apprentice creates an irrigation design that includes the following:
    - Demonstrates how the design is redundant and flexible
    - Lists out needed parts, quantity needed for design, and suppliers to purchase them from. Examples of materials: water meter, filter, water pressure reducer, x of feet of drip tape, etc.
    - The plan takes into consideration different crop's water needs
    - Makes argument for the best type of emitter (for example overheard, 6-inch emitters, etc.)
    - Lists out the advantages and disadvantages of design choices (examples buried PVC, thickness of drip tape, etc.)
    - Comes up with a budget for build-out
    - Looks at soil type and identifies irrigation needs based on soil type
        - Coarse – sand – drains quickly, increases the frequency of irrigation
        - Medium – loam – drains moderately
        - Fine – clay – drains slowly, decreasing the frequency of irrigation
    - Identify GPM (gallons per minute)
        - measurement of flow (volume of water from a given source in one minute)
    - Identify PSI (pounds per square inch)
        - measurement of water pressure (the force that water exerts on a given area)
    - Identify velocity
        - Rate at which water moves through a pipe system. As velocity increases, pressure decreases. Velocity should be 5ft/sec or less.
    - Identify Evaporation
        - Loss of water from soil to atmosphere
    - Come up with watering schedule

Additional Resources to Support Activity:

- Rain Bird Irrigation Design Manual
- TURF Irrigation Manual

Some points of assessment to check apprentices' understanding might be:

- What are the symptoms and effects of water stress in plants?
- What are some different irrigation models and what are their advantages and disadvantages?
- What factors might change your irrigation plan or system?

Activity 8: *Harvest Plan and Food Safety*

As the apprentice and farmer approach the harvest season they make time to discuss some of the following topics in regard to harvest. Based on these conversations the apprentice comes up with a harvesting plan for their own farm business plan or existing farm.

- Harvest tools
- Food Safety Common Sense vs. a GAP (Good Agricultural Practices) audit
    - Understanding pathogens
    - Statistics
    - Legal perspective/liability
    - Traceability
- Key production considerations:
    - Water & irrigation
    - Soil amendments - manure
    - Equipment cleaning
- Key harvest considerations:
    - Food contact surfaces
    - Soil contact
    - Tools
    - Water used during harvest
    - Transportation
    - Containers
    - Cooling
    - In fielding packing vs. wash and pack-out area
- Key processing considerations:
    - Wash water
    - Personal health & hygiene
    - Effective sanitation practices for facility, equipment, utensils
- Key storage considerations:
    - Temperature/proper cooling
    - Moisture/respiration
    - Packaging

Activity 9: *Plant Pathogens*

The apprentice identifies different plant pathogens in the field and creates a guide. Within the guide, they will identify what type of disease agent the pathogen is (see list below). Based on their findings they can come up with a treatment/mitigation plan that can be shared and discussed with their mentor. The mentor will offer input and feedback on the plan based on their own findings over the years.

Disease Agents:

- Bacteria: These single-cell organisms absorb the nutrition from their host plant and thrive by killing the plant and living off of their decomposing organic matter. This is often described as a saprophytic relationship. Bacterial pathogens cause blights, rots, and wilts.
- Fungi: Fungal pathogens are spread by many different environmental conditions such as wind water, seeds, human and other non-human vectors. (A vector is a host capable of transferring a particular pathogen.) Fungi that are capable of regenerating spores during the growing season and re-infecting plants are known as polycyclic. Fungi that must wait for next season are monocyclic.
- Viruses: Viruses are pieces of genetic material (RNA/DNA) that disturb the plants by mimicking naturally occurring genetic abnormalities. There are more than 700 plant viruses known. Viruses can be spread by tractors or equipment, tainted seed, or by a traveling vector.
- Nematodes: Nematodes are both a pathogen and a vector. Nematodes are microscopic worms and are one of the most abundant phyla with over 20,000 different species. A nematode either infects a plant by injecting a needle-like mouth into the plant or it actually enters the plant with its entire body. The nematode's saliva is the infecting agent and disturbs the metabolic process of the plant and causes disease and death.
- Abiotic: This refers to deficiencies in the soil or surrounding environment that cause a debilitating illness that is harmful or fatal to the plant.
- Oomycetes: These organisms act much like a fungi, however, they have a very different evolutionary history. They have mobile spores and can be primarily spread by both wind and water. Vectors can also spread them.

Additional Resources to Support Activity:

- Plant disease management guide
- OMRI Products List

Activity 10: *Compost Tea*

Have the apprentice experiment with making different types of liquid fertilizers and compost teas based on the needs of plants and soil on the farm. You can potentially create a test plot where the apprentice can test different fertilizers/teas.

Additional Resources to Support Activity:

- Soil Foodweb Compost Tea Brewing Manual

Activity 11: *Farm Certifications*

Is your farm CCOF certified, GAP food safety certified, or have other types of certifications? Sharing more with your apprentice about how you received these certifications is a valuable learning lesson. If you have an upcoming audit or inspection invite your apprentice to observe this inspection and show them the type of documentation you must gather for this type of inspection.

Additional Resources to Support Activity:

- USDA GAP
- CCOF

Activity 12: *Cover Cropping*

Identify an area of the farm you would like to cover crop and explain to your apprentice what you would like to get out of cover cropping this section of the farm, for example:

- Provide nitrogen
- Increase soil organic matter
- Prevent soil erosion
- Improve soil structure
- Improve drainage

From there have the apprentice research different types of cover crop seed based on your farm's needs and have them come up with a cover crop plan. Have the apprentice identify the quantity of seed needed for the acreage you're seeking to cover crop and the type of crop based on your farm's needs.

Types of crop:

- Cover crop: Mainly used to prevent soil erosion by covering soil with living plants
- Green manure: Crop grown mainly to be turned under for soil improvement
- Catch crop: Used to “catch” nutrients left after harvest of a cash crop and prevent leaching out of the field

Additional Resources to Support Activity:

- Seeds for Bees

13. *Food/Farm Advocacy and Community Organizing*

Are you involved with any advocacy work around the food movement or partake in any agriculture-related community organizing? If so consider inviting your apprentice to sit in on some of these meetings or events. This is a great opportunity to strengthen the movement!

Knowledge to Gain/Skills to Build. *(What must I acquire/improve ?)*	**Projected Outcome** *(How will I know I did it?)*	**Action Steps** *(How will I actually gain/build/develop these?)*	**Resources Needed** *(Besides the help of my mentor, I will need what?)*	**Target Completion Date** *(When will I be there? Estimated number of hours)*