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Curriculum Units by Fellows of the National Initiative
2023 Volume V: Nature-inspired Solutions to Disease Problems

Growing A Sustainable Future

Curriculum Unit 23.05.05, published September 2023
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Introduction

It should not require much justification to propose to educate students about the causes and potential solutions to some of the many environmental issues that threaten the future of our world. “In the twenty-first century, we face scarcity in critical resources, the degradation of ecosystem services, and the erosion of the planet’s capability to absorb our wastes”[1]

How we humans grow, process and transport food; clothe and house ourselves; heat and cool our homes and businesses; manage our water; and dispose of waste all contribute to the current crisis level of degradation of our planet.

“We are the first generation with widespread knowledge of how our activities influence the Earth System, and thus the first generation with the power and the responsibility to change our relationship with the planet. Responsible stewardship entails emulating nature in terms of resource use and waste transformation and recycling, and the transformation of agricultural, energy and transport systems”[2]

While there may not be consensus on what the optimal path forward to mitigate damage done, nor how to draw down excess carbon that is in circulation, there are no shortages of potential solutions and big ideas worth trying. Many of these potential solutions are inspired by natural systems and processes. There is hope that the health of our ecosystems, our species, and even our political systems may be supported and nurtured by innovative ideas gleaned from animals, plants, ecosystem interactions, and indigenous human cultural practices and teachings.

The U School offers ninth through twelfth graders a competency-based high school model that requires young people to demonstrate their learning through tangible performance tasks and attempts to be transparent with expectations of competency completion through a portfolio model. Teachers are empowered to determine the required portfolio expectations for each class, and to offer numerous opportunities for independent and self-directed learning. The U School Urban Agriculture, Food and Natural Resources (AFNR) Career and Technical Education (CTE) program is a unique one-year program for our high school seniors. This program combines traditional expectations of the CTE model within the specific context of urban Philadelphia. We are located in the heart of North Philadelphia, in a building designed for elementary school. The campus has a parking lot as our only open space. There are no fields, no grass, no trees. Our staff works together to try to engage and

empower young people with challenging and scaffolded learning experiences - in the classroom, school based ag and food “labs,” field trips, campus & neighborhood greening projects, internships and other real world learning opportunities towards deep and meaningful engagement in big issues and opportunities to explore green collar career pathways. This program does not yet have a set curriculum, but rather has a list of skills and tasks the students are meant to complete. It has been my goal, as the founding teacher for this program, to turn this list into a set of units which are relevant and engaging, and that can offer service and other real world learning opportunities for students inside and outside of the classroom. It is also my hope that students have the agency to co-create lessons and help to focus the priorities of our shared time together to meet their individual and collective needs as they complete high school and consider their places in the wider community.

My students and I designed and are building an ever-expanding urban farm on a portion of the paved parking lot. In the last three years we have built, filled and planted 20 large raised beds. This spring we de-paved another portion of this lot and planted deep rooted native plants for a new pollinator meadow and expanded our food growing spaces. AFNR staff and students started a food resource room in what was once the school’s main office, which provides local organic fresh food boxes, frozen prepared meals, sustainable pantry staples to students, staff and community members who might find themselves food insecure or living in a food desert. These initiatives offer students hands-on experiences with components of the food and agriculture system including: growing, harvesting, processing, inventory management, and preparation. These activities have now become part of *what we do* at school. That said, there are many opportunities that have yet to be realized for students to connect this work to personal health, environmental health and the larger food system.

Despite access to fresh locally grown ingredients from our food farm and food resource room, a significant number of our students get most of their daily calories from processed food. This is evidenced by the bags and wrappers that can be audited in every classroom, and a cursory analysis of food served in the cafeteria.

Many U School students come from the surrounding North Philadelphia neighborhood. According to the demographic information provided by the Philadelphia School District, our student population is 76%, Black/African American, 18% Hispanic/Latinx and 100% economically disadvantaged. [3] The U School, like all Philadelphia public schools, has a high concentration of students and their families living in historically disinvested neighborhoods, navigating food insecurity, and the other factors that contribute to the social determinants of health, or in this case the social determinants of illness. These six areas which shape a person’s health (Figure 1) include three areas - Education, Neighborhood and Built Environment, Social & Community which fit within the scope of the AFNR program, and so are topics to address in our curriculum planning.

Figure 1 A Constellation of Social and Environmental Factors Which Are Understood to Influence Health and Wellness

In this unit will begin to explore how food choices made in "nature" by people and by animals are influenced by seasonality, cycles of scarcity, and evolution. Students will read about how animals are trending towards obesity living in modern industrial societies, and how zookeepers manage overweight bears. As students begin to unearth the connection between the few global food brands that dominate the market and the government subsidies which have influenced their food choices and undermined their health outcomes, I hope this influences their relationship with food in a positive way, and perhaps sparks outrage and action. This is an equity issue, as "nearly 70% of youth in North Philadelphia, the majority of whom are black or Hispanic, are overweight or obese, which is nearly double the obesity and overweight rate for youth in the United States"[4]

My goal with this unit is to explicitly connect many of the discrete skills and tasks into a context that allows students to deepen an understanding of the interconnection between food production, environmental health and human health within the context of our school campus and North Philadelphia neighborhood. Our AFNR team plays a role in the agriculture system as producers, food distributors, and consumers. The choices about how we do this work has social, health and environmental impacts. By naming and contextualizing the connections between our approach as growers of chemical free, nutrient dense food, purchasers of local organic produce, builders of soil health and stewards of pollinators and trees, we can celebrate our participation in a resilient health supportive food system. This has potential impact on students' lives individually, as they make food choices for themselves; and on society as we grow consumers, policy makers, public health works and maybe even farmers of the future.

Michael Pollen, author of the influential 2006 *The Omnivore's Dilemma, A Natural History of Food in Four Meals*, spends 450 pages investigating how various food choices impact animal welfare and the environment. The dilemma to which the title refers is essentially- how can we choose what to eat if we don't understand how food is produced, and what impacts one's choice might have. He set out to educate a nation, and after

selling 2 million copies, he created a young readers edition subtitled *The Secrets Behind What You Eat*. His claim in the preface of this edition is that he "didn't write The *Omnivore's Dilemma* to convince you to eat one kind of food or another. [His] aim was to give you the information you need to make good choices. He continues…Our food choices are some of the most important choices we get to make in life. The way we eat has a bigger effect on our health and that of the planet than any other activity." [5]

This unit will provide our CTE students an opportunity to read the *Omnivore's DilemmaYoung Readers Edition*, to engage with the ideas and information it reveals, and to demonstrate competency in a wide range of specific skills and tasks that they must cover to complete their AFNR portfolio, while also trying to inspire students to embrace alternative methods of food production and processing and improve personal and community health outcomes.

One Health. People, Plants, Planet

Before I dig into the meat of this unit, I want to introduce a concept I learned about in our YNI seminar, Nature Based Solutions to Disease Problems with Dr. Paul Turner, that helped me frame these topics I knew to be connected in a simple and straightforward way. This idea is called One Health. As John Muir famously said, "When we try to pick out anything by itself, we find it hitched to everything else in the Universe."[6] Ecosystem connections underpin all agro-environmental science lessons, so I am aware that the health of people, plants, and our planet are intertwined and interdependent. What I was not aware of, is that there are cross sector initiatives collaborating on this idea at a policy and surveillance level world-wide. Whether through global food supply chains, human travel, or bird migration routes we are all in the pathway of infectious pathogens, and we all live downstream of farm or wild animals. The World Health Organization, The Food and Agriculture Organization of United Nations, and the World Organization for Animal Health have signed joint alliances. Universities and government agencies around the world have departments and staff focused on these intersecting issues. The One Health Institute of the University of California at Davis defines this idea simply as: 'One Health is an approach to ensure the well-being of people, animals and the environment through collaborative problem solving—locally, nationally, and globally'.[7]

The One Health idea can provide a frame for students to compare, contrast, and dig deeper into research and practices to evaluate how a specific food growing method, food policy, or practice impacts each part of the One Health triad. The One Health perspective asks us to consider more than economics, or taste, or personal health, but rather a more holistic view. We can grow food to positively or negatively impact the environment on and downstream of the farm. We can consume food that affects our health for good or for ill. When food scientists can transform corn grown on a thousand-acre farm using robotic tractors and workers in hazmat suits into Doritos dusted with a mixture of ingredients so tempting "you can't eat just one," while our students and their families are obese but undernourished, perhaps it is a One Health lens that can help us shift policies that subsidize and support these outcomes.

Citizen scientists, students, public health practitioners, ecologists, geographers, biologists, physicians, veterinarians, agronomists, city planners, psychologists, anthropologists, politicians, and economists are just some of the disciplines that play a part of One Health efforts, which makes the ideas of one health a useful paradigm in a classroom, as there are various lenses with which to view the work we do. There is a potential role for everyone.

A One Health example that might resonate with policy makers deciding whether to fund a school garden, focused on sustainable growing practices, might be found in a study supported by the National Institutes of Health that demonstrated a direct connection between soil health and human health. Measurements from paired farms across the United States indicate that differences in soil health influenced crop nutrient density such that crops (wheat, assorted vegetables, beef) grown using regenerative farming practices were better for human health. These sustainably grown crops had increased vitamins, phytochemicals and beneficial fatty acid profiles. This "suggests that soil health is an underappreciated influence on nutrient density, particularly for phytochemicals not conventionally considered nutrients but nonetheless relevant to chronic disease prevention." [8] Students with obesity and diabetes might be better served by their school garden than their school cafeteria.

It might be useful for students to recognize that scientists and policymakers often overlook evidence that the One Health paradigm is already embedded in Indigenous values, worldviews, and laws." [9] Indigenous knowledge systems understand that to maintain human health over time, the health of future generations and the health of other species must be protected without compromise."[10]

As we work towards creating a more just and sustainable future, and work as educators to provide students with tools to reimagine the ways we will need to live and consume in the midst of the climate emergency, it will be useful to explore the food growing and eating traditions from myriad cultures, alongside traditional knowledge and modern innovations to walk a path informed by valuable lessons of the past into a shared future.

Organic regenerative farmers in many cultures, past and present, have touted the importance of soil health to create plant health which can lead to animal health and human health through webs of ecological interconnections. Agriculture practices have a wide range of impacts in the One Health paradigm and can be evaluated using this paradigm for policy decision making. One goal in this unit is to explore various agriculture practices; to compare the natural processes, rhythms and systems of provisioning and eating that have sustained and nourished humans over millennia with the modern farming and food systems that have been contributing significantly to both dietary disease and planetary demise. Using this One Health lens will make it harder to support practices that provide us tasty cheap food at the cost of high levels of carbon emissions, significant diet related health issues, animal suffering, and water pollution.

How Did We Start Farming with Fossils?

The following narrative is a simplified history of how humans came to rely on fossil fuel energy, and how this energy intensive farming has become unsustainable.

Plants transform solar energy into carbohydrates to feed themselves, the microorganisms with which they share space at the root level, and then go on to nourish everything that eats plants or that eats something that built its body mass on energy from a plant. When a tree breathes in carbon dioxide from the air through its leaves, some of the carbon goes into the tree and becomes part of the trees leaves, branches, bark or roots. When the tree is alive this carbon stays with the tree. When trees are burned, after clear cutting to make pasture, or to create agricultural fields, for example, - this carbon goes into the air –causing air pollution.

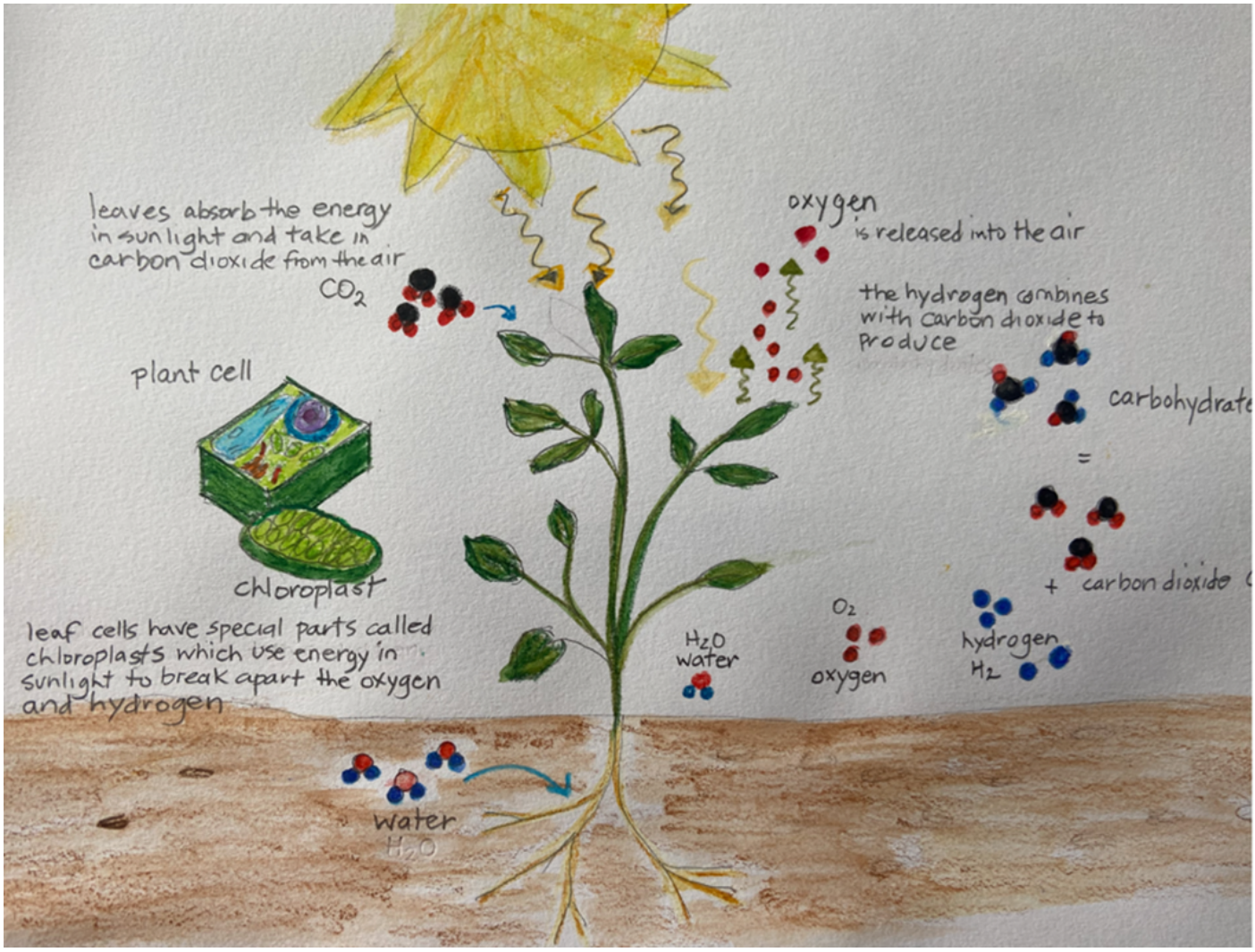


Figure 2 Diagram attempts to visualize the process of photosynthesis. Sunlight energy, combined with water and carbon dioxide is transformed into carbohydrates.

When plants and animals die and end up buried, the carbon in their bodies stays in the earth. Every year millions and millions of trees, plants, animals, fish, birds, insects and people die and decompose and become part of the earth's soil.

Some of these living things that died millions of years ago ended up buried far underground, or underwater, and were pressed down by the weight of the soil and rocks and turned into oil, coal and natural gas –which we call fossil fuels. This process took millions of years. These fuels are still full of the carbon that was breathed into plants and animals, way back when they were alive.

Early humans lived in groups, and each group figured out how to find food on the trees and bushes, the forests and fields and in the oceans and rivers in whatever part of the world they had settled.

Depending on where they lived, they may have hunted large animals, or gathered nuts and fruits and fish. Many groups moved about and gathered and hunted different foods depending on the season. Later humans learned to plant specific plants, and formed settlements which became villages and towns. Some raised animals like cows and goats who could turn forage that grew nearby into milk and meat. Others domesticated fowl that pecked at seeds and scraps and left behind eggs. Because humans are curious and smart and

always hungry, they figured out lots of different ways to grow and prepare lots of different kinds of food.

Over many years humans began living in much larger groups and formed cities where humans were farther away from where they grew their food. We started growing food on very large farms and trucking the food from the farm into the city. Farming shifted dramatically after World War II, when the US government had a huge surplus of bomb making ammonium nitrate, and "scientists at the Department of Agriculture had an…idea: Spread the ammonium nitrate on farmland as fertilizer. And so, our government launched the chemical fertilizer industry." [11]

Many farmers started using lots of chemicals to grow food faster and make more money. The biggest culprit of fossil fuel usage in industrial farming is not transporting food or fueling machinery; it is the production of chemicals for fertilizers. As much as 40% of energy used in the food system goes towards the production of artificial fertilizers and pesticides.[12] These fossil-fuel-based chemicals went onto the food, onto the people that worked on the farms, and into the air and water. Some of the animals that humans raised for food now live in huge factories where they are crowded together and are fed from bags of manufactured animal feed. They bring food for the cows on trucks from farms far away, using lots of energy and water to raise these animals. These cows burp and fart methane, and their manure is concentrated in a pit which fouls groundwater. Then the meat, vegetables, grains and fruit grown on these big farms must go on trucks and planes and boats to get to where the hungry people buy it. It took fossil fuel to grow the food, fossil fuel to process the food, to power these trucks and planes and boats that deliver it to the cities where the eaters live. The takeaway from this story is that "on the industrial farm it takes about ten calories of fossil fuel energy to produce one calorie of food energy…. This is the opposite of what happened before chemical fertilizers…. The factory farm produces more food much faster than the old solar-based farm. But the system only works as long as fossil fuel energy is cheap." [13]

While the economics may have been in favor of wasting energy to produce food, this process was, and is, not sustainable. Burning fossil fuels contributed to farming becoming a major contributor to climate change. The global food system is responsible for ~21–37% of annual emissions[14] - which is, of course, not One-Healthy.

This story has many other chapters of how industrial agriculture in its current form does NOT meet One Health criteria. Nitrogen pollution from fertilizer runoff causes significant damage to many major and minor waterways, animal manure improperly managed ends up on crops such as lettuce or cilantro causing food borne illnesses. Farm workers are at increased risk for a variety of cancers due to pesticide exposures. Beef fattened up with corn, as has become standard practice, has significantly more saturated fat, and significantly less omega-3 fatty acids - contributing to the heart disease epidemic. Antibiotics, have become a regular addition to animal feed to maintain the crowded unhealthy system where they are raised in fed-lots. As a veterinarian interviewed in Michael Pollen's *Omnivore's Dilemma* explains "Basically, almost all of the cattle in the feedlot are sick. And it's their corn-based diet that makes them ill."[15] Cows evolved to eat grass, and humans feed them grain. Then they are fed antibiotics prophylactically which turns out to cause them to gain weight faster. A win for farmers, but not a win for One Health. Antibiotic resistance is at such a high level that infections are harder to treat, and research into novel therapeutic approaches that can kill these antibiotic resistant bacteria are required to protect us from bacterial illnesses. Researchers are now beginning to investigate whether antibiotic use in children is connected to increases in obesity.[16] The more we dig into these issues the more interconnections we uncover.

The Modern Omnivore Has Choices

Corn Farming

The Omnivore's Dilemma spends several chapters looking at the history of the agriculture industry, focusing on the growth and prevalence of corn in our diet. Because of this I am spending a few paragraphs here explaining a bit about the omnipresence of this crop.

Our American food system is vast. American farmers produce enough food for each person living here to have over 4000 calories a day.[17] According to the most recent census by the U.S. Department of Agriculture the United States had over two million farms, which accounted for 40% of all US land.[18] Nothing dominates the American landscape like corn. This crop was originally known as maize and is "one of the most successful plants on earth."[19] It is eaten fresh on the cob, popped to snack on, distilled into whiskey, dried and ground into meal for cornbread or pancakes. High fructose corn syrup is in most sodas, cornstarch coats French fries and thickens salad dressings. "So dominant has this giant grass become that of the 45,000-odd items in American supermarkets, more than one quarter contain corn," states Pollan.[20] Many other products depend on corn as well, from paper goods and cardboard packaging, to all the meat, milk, eggs, poultry and other protein products that come from corn-fed animals. This, even though cows in nature eat grass, commercially raised cows are fed corn. "…[M]any are beginning to question corn as a *system*: how it dominates American agriculture compared with other farming systems; how in America it is used primarily for ethanol, animal feed and high-fructose corn syrup; how it consumes natural resources; and how it receives preferential treatment from our government".[21]

Global food production has become one of the largest contributors to environmental degradation, contributing to air and water pollution and soil loss. The demand for cheap food has created agriculture policies that prioritize large quantities of inexpensive calories. "Two of the cheapest sources of calories are corn and soy, which the federal government has long subsidized, and which make up a large percentage of our caloric intake today (often in the form of high fructose corn syrup or soybean oil)."[22] Modern corn farming and consumption – as food for humans and animals, and as fuel, clearly have a range of negative One Health impacts.

Carbon Farming

According to the USDA Carbon farming is the use of specific on-farm practices designed to take carbon out of the air and store it in soils and plant material.[23] Carbon farming is way of describing a variety of farm management practices that explicitly manage and sequester, rather than squander the energy embedded in the plants, animals, and crop residues.

There are a number farming practices that fall into this category of sustainable or regenerative agriculture. Because agriculture includes such a wide range of tasks -growing and processing food and fiber from plants and animals– in as wide a range of locales as there are places on earth – these practices are often bio-regional and crop specific. There is no firm definition of what sustainable, regenerative or carbon farming is, which allows for rich discussions as we engage and evaluate case studies of these practices in classrooms. The top four of these practices include: low or no till -which means farmers do not "turn over" their fields between plantings with a plough, but rather keep soil covered with living or decomposing plant material and plant the

next crop through this layer. This practice reduces soil erosion and keeps carbon in the soil rather than dispersed into the atmosphere. No till also prevents weed seeds that were lower down in the soil from germinating, retains water, and doesn't damage the optimal functioning of the microorganisms that coexist in communities underground. The next practice is planting cover crops, also called green manure, which are crops grown not to eat or sell, but to suppress weeds without chemicals, build soil fertility with nitrogen fixation, and add organic matter (carbon!). Cover crops also keep soil microbes fed and multiplying in between agronomic crops. Next is crop rotation – where a particular field or growing area will include a crop in a new plant family following harvest of the previous crop in a planned sequence to maximize nutrient exchange and minimize pest damage. Lastly for now is the practice of composting - in which crop residue, food scraps, animal manure and bedding, is facilitated to decompose and be returned to the soil as a valuable fertilizer. All the practices listed above are being demonstrated in our school food growing spaces – and can be easily demonstrated with only a few raised beds in a school garden setting.

More carbon in the soil means less greenhouse gas emissions. Regenerative farms – and sustainably managed school gardens, have the co-benefits of increased soil water holding capacity, pollinator and wildlife habitat biodiversity, and cleaner air. In cities, gardens help decrease the urban heat island effect as plants transpire and cool air and may provide shade if (edible crop bearing) trees are included in the planting plan.

There are many other carbon farming/regenerative techniques that are appropriate for specific farms, land management and growing spaces. Animals can be raised to eat what they evolved to digest - in environments closer to how they lived in nature than a packed warehouse. This might include silvopasture - integrating animals who forage on semi-forested lands; or rotational grazing that moves animals around a large piece of land to fatten themselves while trimming the grass, not fully denuding it thereby cycling the solar energy in the grass into protein. These practices maintain a spiral of fertility in which soil microbes and sunlight feed and nurture plants, which nurture animals and humans while sustaining and even restoring ecosystems.

Agronomists, biologists, environmentalists, farmers and others have been advocating for alternatives to what became the industrial food system for generations. For many thousands of years, farmers on the Indian sub-continent practiced Vedic agriculture which was built around religious customs and land management practices that centered on building and maintaining fertile soil using compost and integrating animals into a cropping system to transform biomass such as crop residue, into manure to fertilize. With these practices Indian farmers were able to build soil fertility year after year. Sir Albert Howard, an agronomist from England who became a pioneer in organic farming practices, was sent to India in 1905 to teach Western farming techniques. Over his 26 years in India, his views radically changed. "I found," Howard wrote, "I could do no better than watch the operations of the peasants…and regard them and the pests…as my best instructors."[24] He went on to publish, *An Agricultural Testament in 1940*, much read by modern organic farmers, where he explains that the lessons he learned from nature were also key to how to farm successfully. He writes at length describing the lessons from how a forest cycles nutrients to manage water and build soil fertility and suggest mimicking these practices with mulching, cover cropping, composting, and leaving roots to degrade to feed soil micro-organisms.[25]

In 1943, Lady Eve Balfour, who founded and ran the UK Soil Society for over 20 years, published *The Living Soil*, a book explaining her experiments and detailing the links between healthy soil, organic farming, and human health. She wrote: "We cannot safely separate human health from the health of farm produce whether animal or vegetable. All have their origin in a fertile soil."[26]

In the Americas, well before "first contact" between the Europeans and Indigenous populations it appears that

the people native to various bioregions in what we now call the USA had been sustainably cultivating and managing land, protecting ecosystems and biodiversity. The narrative that the European settlers arrived to an empty wilderness is a myth. “These continents were already populated. The indigenous people hadn’t always been there, nor had they originated there, as some of their traditions state, but they had occupied these American lands for at least 20,000 years.”[27] It is now well understood that long before the arrival of Europeans, Indigenous populations protected local ecosystems and preserved biodiversity through land management and farming practices.[28] They planted corn, beans, and squash together, which they referred to as the Three Sisters. “Early European settlers mimicked this innovation. Indeed, scholars estimate that close to one-third of modern American agricultural products and practices may have originated with Native American farming innovators.”[29]

Just(ice) Farming

In discussing food production, farming, farming practices and food systems we cannot escape the reality of the injustices that underpin, and have undermined, societies world-wide fully committing to One-Health as policy. Black and brown communities, indigenous communities, and poor-white communities have been, and continue to be, impacted most by the lack of affordable nutritious food in urban food deserts, the negative environmental impacts of agriculture chemical production, and the health disparities that result.[30] Teaching this material to students for whom the consequences of unjust policies are evident and palpable, requires consideration and sensitivity. That said, it is also an opportunity to mobilize student voices, to find community partners to work alongside, and to advocate while we educate.

Leah Penniman founded Soul Fire farm in 2006 with her husband, to end what she terms food apartheid. She is the author of several books, including *Farming While Black* and *Black Earth Wisdom*. Soul Fire Farm has grown to become the center of a movement, and education space hosting over 5000 people each year to connect and reconnect with the land. This work empowers and inspires and supports farmers within an “Afro-Indigenous centered community farm committed to uprooting racism and seeding sovereignty in the food system. Their farming workshops and writings all focus on Afro-indigenous agroforestry, silvopasture, wildcrafting, polyculture, and spiritual farming practices to *regenerate* 80 acres of mountainside land, producing fruits, plant medicine, pasture-raised livestock, honey, mushrooms, vegetables, and preserves for community provisioning, with the majority of the harvest provided to people living under food apartheid or impacted by state violence.[31]

“Black and Indigenous farmers have been practicing regenerative agriculture without any specific title or performative acknowledgement for generations,” said Angela Dawson, the Minnesota-based founder of the 40 Acre Cooperative, a national agricultural cooperative owned and operated by Black farmers, “This is the way I learned to farm from my grandparents.” [32]

Urban Farming: Modern Practices, Cultural Connections

I will use our school food farm to demonstrate many of these regenerative practices, introduce students to local practitioners, a plan to spend time at two other urban farms each week. We will spend class time learning through case studies about cross cultural and historical perspectives, and the contributions of all

sorts of farmers from all sorts of backgrounds who are committed to regenerative sustainable food systems. Students will have hands-on opportunities to plan, plant, tend and harvest from a various food growing spaces and will learn first-hand how to manage soil fertility with compost, how to rotate crops, and how to incorporate cover crops in a planting plan.

One particular garden technique, called Three Sister's Garden, has a central role in our garden space. We live and learn together in Philadelphia. This place is also named Lenapehoking or, "Land of the Lenape." This region stretched from what is now Delaware through New York. This Three Sisters Growing method does not seem to have originated with the Lenape tribe, but has become part of the Lenape tradition, and now is part of our U School Food Farm tradition. It turns out these plants have a central role in a the One-Health lessons they can engender.

Figure 3 An illustration of a symbiotic three sisters garden planting. Corn, beans and squash.

Figure 3 illustrates how a three sisters garden can be created. Corn is planted in mounds. The corn seeds can be planted with a fish or fish parts for fertilizer. Once the corn is several inches tall beans are planted at the base of each corn plant so the bean vine can trellis itself on the cornstalk. Squash plants are planted between the mounds, and the sprawling plants shade and cool the soil, and block the sun from encouraging weed growth. When grown in fields, the prickly squash leaves would keep racoons or deer from walking up to eat the ripening corn. As urban growers, we have different concerns. Our school garden is often vandalized by what we believe are elementary age students who play unsupervised in our school yard on weeknights and weekends. Perhaps the prickly squash leaves will keep them from walking in our garden beds, and protect our pumpkins so they can be harvested by the students who tend the garden on the weekdays.

There are other lessons we can learn from Three Sisters plantings. Bean plants have a relationship at the root level with rhizobia bacteria which take nitrogen from the air and bring it into the soil. Corn plants require considerable nitrogen to flourish, and this partnership underground helped feed the three sisters. Corn, beans and squash complement each other nutritionally, and all three can be dried to store to provide sustenance through a long winter. Being able to demonstrate and explain companion planting, symbiosis in garden planning, ecological soil practices, healthful traditional cultural dietary practices make the Three Sisters a

terrific exemplar of a One Health approach with food and agriculture at the center. It is also a terrific project that can expand to include readings and discussions about culture, history, cooking (and co-existing in community with garden destroying rascals).

These ideas are not new. Like nutrients they cycle and recycle and will hopefully help transform current day farming practices which seeks not only sustenance and health, but justice and respect for all the residents of our shared blue planet. Sustainable food systems will require moving towards practices that impact the whole world. If that's the case perhaps the most important consideration isn't which specific practices to include or discard, but rather who benefits and is included in the whole. This demonstrates that it is not only practices, but value systems and ethics, needed for us to move closer to One Health.

Fat Food Nation.

Humans living in cities, humans living in rural areas, animals in zoos and even animals living in rural areas are fatter than ever. "The proportion of US human adults who are now either overweight or obese is close to a jaw-dropping 70 percent"[33] "Domestic animals around the world are fatter than ever before, and steadily gaining more weight."[34] Bears in the zoo don't burn calories wandering the woods in search of berries, they are even fed during months when in nature they would be hibernating. A young person with only a few dollars to spend can fill up a small plastic sack at the corner store with a full day's worth of calories from highly processed food and beverages. "… animals can get fat the same way humans do: in environments with unfettered access to abundant food."[35]

How both animals and humans learn to make food choices has a cultural component. Infants of many species are initially fed by a parent, and so learn what to eat by a combination of observation and practice. Until relatively recently in human societies the options of what to eat were based on what grew or lived in your bioregion. "The Green Revolution of the 1960s converted whole nations from a relatively healthful, native derived crop diet … and encouraged farmers to abandon local plants that were hardy, disease resistant and well-suited to their climate and are instead growing plants imported from other regions, plants dependent on chemical and petroleum companies for their yield.[36]

Coupled with the industrialization of agriculture production, modern humans are also tempted with products made with ingredients that are unrecognizable and irresistible. "The evolutionary biologist Peter Gluckman calls contemporary obesity an example of "mismatch," the widening gulf between our genetic inheritance and our environment.[37] Humans inherited eating behaviors to keep us alive through famines and droughts. Peasant cultures ate large hearty meals after a full day of manual labor. Animals in the wild might stalk prey for hours with no catch. Desk work and zoo-life require fewer calories than we now eat, and these mismatched habits are making us fat.

In an article published in the New York Times Magazine in 2013, titled *The Extraordinary Science of Addictive Junk Food*, the author reports on over four years of research on the food industry's impact on diet related disease. He concludes that there "isa conscious effort — taking place in labs and marketing meetings and grocery-store aisles — to get people hooked on foods that are convenient and inexpensive." [38]

A study, conducted by researchers at the National Institutes of Health…the first randomized, controlled trial …

show[ed] that eating a diet made up of ultra-processed foods drives people to overeat and gain weight.[39] Overall, the proportion of calories in youths' diets that came from ultra-processed foods rose between 1999 to 2018, from about 61% to 67%. The proportion from whole, unprocessed foods dropped from almost 29% to 23.5% during the same time period.[40]

Food companies hired food scientists to engineer products – snacks, sodas, and packaged meals, which maximized cravings. By the mid 1900s food scientists and processors discovered combinations of sugar, salt and other ingredients that "could be formulated to produce a state of satiety, pleasure, and hedonia in those who consumed them. American market researcher and psychophysicist, Howard Moskowitz, termed this the "bliss point" or the point where the levels of saltiness, sweetness, and richness were perceived by the consumer as just right."[41]

Combined with another finding, that there is a tendency for distinct full flavors to overwhelm the brain which limits the desire to overconsume which is dubbed "sensory-specific satiety."[42] This sensory-specific satiety "became a guiding principle for the processed-food industry. The biggest hits — be they Coca-Cola or Doritos — owe their success to complex formulas that pique the taste buds enough to be alluring but don't have a distinct, overriding single flavor that tells the brain to stop eating."[43]

These influences are not inescapable, though they do pose an extraordinary challenge when coupled with the marketing, availability and affordability of these foods. That processed food calories are both inexpensive and desired, while fresh food is expensive and often unfamiliar, makes the challenge of encouraging students towards healthful dietary choices fraught.

Within the One-Health approach, we can examine and critique the results of food formulated by food processors, and the marketing and sales strategies that have made these foods ubiquitous. Perhaps the fight against the systemic forces that are tempting us into ill-health can be challenged by deepening our knowledge and experience with alternative dietary options.

Heritage Diets & Cultural Foodways

This final stop in our One-Health journey through the food system will be looking at how the dining traditions, food preservation techniques, cultural festivals and special occasion feasts from many cultures world-wide can support human health, while maintaining and sustaining healthy animal populations, and ecosystem wellness. Students will compare the food pyramids of African, Asian, Latin American and Vegetarian diets for their One Health benefits. Students will explore the consequences of the multitude of options that people who raise farm animals, and zookeepers who care for wild animals, have when choosing how to feed the animals in their care. This final section will allow students to integrate all the aspects of One-Health into a meal plan which features foods they have helped grow in healthy soil, purchased from regenerative farms, prepared from recipes with cultural relevance.

Teaching Strategies

As I described earlier, I teach an intensive one-year Urban Agriculture, Food and Natural Resources Career and Technical Education program. For the first three years of this program, I was the sole teacher, and was responsible for teaching the same 20 students five hours a day in various spaces on our school campus.These spaces include my classroom, which is divided into an urban agriculture lab and food lab with a reading lounge in the center. Each space is flexible and can be used for direct instruction sessions at tables facing front, collaborative team projects with desks pushed together, work at stations set up with cooking equipment or microscopes, hand lenses or looms depending on the unit. We also have a large growing space that consists of 20 large, raised beds and two new 75'x15' garden spaces that were formed after depraving a section of our parking lot. These teaching gardens serve to demonstrate a range of sustainable urban agriculture and agronomic practices and offer students places to not only see food growing, but to be part of all aspects of this work.Lastly my students are also responsible for running a food resource room, where food from our gardens, foods we might preserve or prepare in some simple ways in our food lab, and foods we bring in from outside farms and donations are shared. This room is effectively free food farm market or community pantry, and offers students real world learning experiences purchasing wholesale foods and setting up a retail food environment. They create signage in English and Spanish and are starting to offer culturally relevant recipes and cooking demonstrations, so that students or their families who take fresh food boxes home, have support to use this food. I am repeating some of what I said in the introduction to explain that my teaching strategies are as wide and varied as are the spaces I am responsible for, and teach within, and vary significantly based on the prior experiences and interests of the students in a given section of the program.

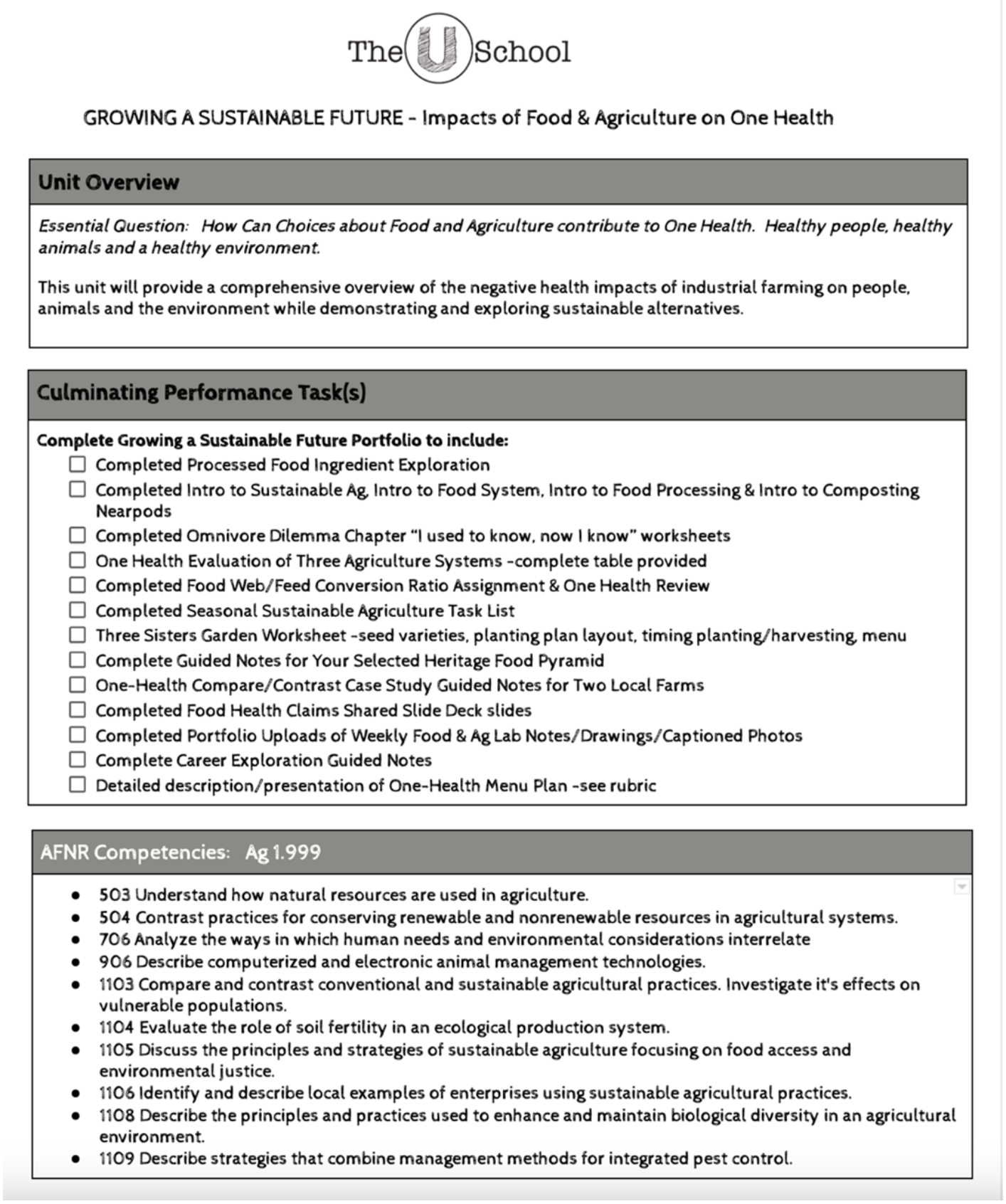
Students must complete required performance tasks by presenting evidence that demonstrates understanding and/or engagement with each competency. Sometimes this evidence is teacher directed, and other times students can create their own assignment and assessment to demonstrate their learning. Each student has some agency as to which of the competencies they are going to invest extra effort into demonstrating, and which they are going to demonstrate in a more straightforward way. For example, a student might be invited to fulfill the CTE 1.999 requirement to: *Identify and describe local examples of enterprises using sustainable agricultural practices* by creating a photo essay of the three urban farms in our school neighborhood and which of the sustainable agriculture practices from our classroom lessons they see in use. Alternatively, a student might opt to do internet research about local cheese makers and evaluate their sustainability practices using a rubric. A third student might complete a graphic organizer answering a series of specific questions about three sites we visited on a field trip.

This unit portfolio covers a wide range of competencies, some of which will take many weeks to complete. Students working to plan, plant and care for a three sisters garden will be able to demonstrate understanding of portions of this process without completing a full harvest cycle, but many skills and tasks in food and agriculture are truly learned by doing over a time scale of months. Authentic performance-based assessments for skills related to growing, preparing and preserving food can take time, practice and repetition, and many of the teaching strategies and assessments are therefore individualized and not formulaic.

Some other aspects of the competency model at the U School are worth noting. It is the expectation that: Students will be working at different places on a competency's learning progression; instructional decisions are based on student needs in real time; learning assets – i.e. teacher support – are available "just in time" so students can self-pace; units are designed to be student-facing; assessment "*as* learning" – i.e. revision cycles

are part of the learning process. There are multiple opportunities to explore, engage and practice competencies.

For each unit I provide a student facing unit guide that clearly lays out the opportunities and resources available and the requirements for portfolio completion. This multipage document will have links to each of the guided notes, assignments and resources. This one-stop document serves as curated resources, templates for completion, and always includes vocabulary lists, and career connections options. Some of the tasks build on each other – and must be completed in sequence, but others can be done (or may have been done over the summer) and can be signed off on whenever they get done. See Figure 4 for an example of one page of this document.



The U School

GROWING A SUSTAINABLE FUTURE – Impacts of Food & Agriculture on One Health

Unit Overview

Essential Question: How Can Choices about Food and Agriculture contribute to One Health. Healthy people, healthy animals and a healthy environment.

This unit will provide a comprehensive overview of the negative health impacts of industrial farming on people, animals and the environment while demonstrating and exploring sustainable alternatives.

Culminating Performance Task(s)

Complete Growing a Sustainable Future Portfolio to include:

- ☐ Completed Processed Food Ingredient Exploration
- ☐ Completed Intro to Sustainable Ag, Intro to Food System, Intro to Food Processing & Intro to Composting Nearpods
- ☐ Completed Omnivore Dilemma Chapter "I used to know, now I know" worksheets
- ☐ One Health Evaluation of Three Agriculture Systems -complete table provided
- ☐ Completed Food Web/Feed Conversion Ratio Assignment & One Health Review
- ☐ Completed Seasonal Sustainable Agriculture Task List
- ☐ Three Sisters Garden Worksheet -seed varieties, planting plan layout, timing planting/harvesting, menu
- ☐ Complete Guided Notes for Your Selected Heritage Food Pyramid
- ☐ One-Health Compare/Contrast Case Study Guided Notes for Two Local Farms
- ☐ Completed Food Health Claims Shared Slide Deck slides
- ☐ Completed Portfolio Uploads of Weekly Food & Ag Lab Notes/Drawings/Captioned Photos
- ☐ Complete Career Exploration Guided Notes
- ☐ Detailed description/presentation of One-Health Menu Plan -see rubric

AFNR Competencies: Ag 1.999

- 503 Understand how natural resources are used in agriculture.
- 504 Contrast practices for conserving renewable and nonrenewable resources in agricultural systems.
- 706 Analyze the ways in which human needs and environmental considerations interrelate
- 906 Describe computerized and electronic animal management technologies.
- 1103 Compare and contrast conventional and sustainable agricultural practices. Investigate it's effects on vulnerable populations.
- 1104 Evaluate the role of soil fertility in an ecological production system.
- 1105 Discuss the principles and strategies of sustainable agriculture focusing on food access and environmental justice.
- 1106 Identify and describe local examples of enterprises using sustainable agricultural practices.
- 1108 Describe the principles and practices used to enhance and maintain biological diversity in an agricultural environment.
- 1109 Describe strategies that combine management methods for integrated pest control.

Figure 4 The first page of the student facing guide for Growing a Sustainable Future Unit

It is important to me that students have some concept of metacognition, and are considering how one goes about questioning, exploring, investigating, acting, reflecting and otherwise engaging with ideas and day to

day issues. For the case study and evaluation projects within this unit such as -on various farming techniques, animal feeding strategies, meal planning and sustainability of food choices the report back (assignment) will be a variation of Harvard's School of Education's Project Zero Thinking Routines.[44] The first, *I used to think... Now I think,* encourages self-reflection on prior knowledge, and attention to what is being/has been learned.

Another Project Zero thinking routine we use is: *Claim, Support, Reason, Question.* This thinking routine is similar to: claim, evidence, reasoning – with the small shift that there is an expectation of still having questions once you have spent time investigating a topic. Students start by drawing on some issue, experience, prior knowledge, or reading to make a claim about (or give an explanation for, or offer an interpretation of) the topic. Then they identify support (things they can see, feel, know, read) for this claim. Then they should ask a question or series of questions related to their claim, their reasoning, or the supports. After reviewing with classmates or teacher they can attempt to answer these questions. They are also expected/encouraged list questions they still have after completing this routine.

I also use a variety of garden themed teaching strategies within our program. One of these is:

Right Plant/Right Place.

If you know the conditions (shade, water etc.) you can find the right plant to thrive in these conditions. Each student has prior knowledge and experiences which they will apply to their work creating evidence to demonstrate a competency or even mastery of a skill. I use this metaphor to bridge to the idea of "Right Strategy/Right Outcome." Someone who is using recipes to share One-Health food stories might need a notebook, or computer, an outline, or a to do list. Someone making a video about farming practices in North Philadelphia urban farms might need to create a storyboard. Each project requires the appropriate tools and organization, and each student has a slightly different portfolio.

Unit Activities

This unit will provide a comprehensive opportunity for AFNR CTE students to complete numerous required competencies to add to their portfolio.

This unit will start in the fall with students listing and categorizing all the ingredients in snack bags culled from school trash bans, and end before Thanksgiving with a pot-luck meal made with seasonal locally grown ingredients from the range of culinary and cultural traditions in our classroom community.

Students will be introduced to One-Health through an overview Nearpod presentation, then reading sections of the *Omnivore's Dilemma Young Reader's Edition*, and watching the film *Food Inc*. They will be asked to complete "I used to know, Now I know" reflections on each assigned chapter, with guided note prompts for key concepts. There will also be a set of guided notes worksheets on which they will be asked to tally the pros and cons in the categories of human health, environmental health and animal health for each of three different farming systems: Industrial Agriculture, Industrial Organic, and Regenerative/Sustainable Agriculture,

using information gleaned from readings, farm visits and independent research.

There will be several other Nearpod direct instruction/assessment presentations of content; farm and food system basics; composting basics; three sisters gardens - which we will do together in class and will then be available on the learning management platform for student paced independent learning for those who miss class lessons.

Students will complete an assignment that looks at the economics, climate impact and health implications of how various farm animals gain weight by calculating what is called the Feed Conversion Ratio for fish, chicken, dairy & meat cows using different feeding strategies. Farmers cannot afford to raise animals if they spend more money feeding them then they can earn back by selling their eggs, milk or flesh. This traditional agriculture lesson will be expanded to include One-Health concerns. Students will be provided case-study data and sources for them to trace and consider the impact of the various feeding regimens, to complete a table that evaluates those choices for three animals. If farmed fish are fed Round Up Ready Genetically Modified (GMO) soybeans which can farmed by spraying the fields with Round Up (an herbicide), and then trucked to waterways which polluted by fish waste and pesticide residue, the feed conversion ratio economics might work out, but there are One-Health implications that could be calculated, or at least acknowledged.

Students will complete a Climate Diet Challenge, an on-line tool that the New York Times created,[45] which allows students to see how food choices impact the environment and be asked to find the combination of daily meals which has lowest environmental impact and highest, and explain why. This will be done in the form of Claim, Evidence, Reasoning, Questions.

Throughout the fall students will have weekly food and agriculture labs – hands on opportunities to work in the food garden, our small food preparation and processing “lab” and in our school food resource room. Students are expected to document their lab activities using a choice of provided guided lab notes, captioned photos/sketches, or pen/paper lab notebook.

Students will need to complete several hands-on food labs on traditional food preservation: fermentation, dehydration, freezing - and will view videos to explore food science, processing technology, and food marketing strategies.

Food labs will include weekly exploration of seasonal vegetables from our garden and CSA boxes from a local farm cooperative. Students will be tasked with photographing (or sketching) at least one unfamiliar or favorite item in CSA box each week for their portfolio. Students will be tasked to use resources from Oldways, a non-profit with the goal of “helping people rediscover and embrace the healthy sustainable joys of the “old ways” of shared cultural traditions to suggest recipes that interest them to try with these vegetables. Students will help prepare at least one dish that they can justify is “One-Healthy” using the Oldways Heritage Food Pyramids,[46] information from one of our classroom resources, or independent research.

Hands-on agriculture labs will include: harvesting three sisters crops planted this summer; planting and tending to cover crops, a key aspect of sustainable, regenerative farming; integrated pest management (a set of practices that considers all the alternatives to chemical pesticides) workshop; succession planting and crop rotation, two other key regenerative farming techniques. Students will spend time observing the garden ecosystem and gaining firsthand understanding of energy transfer, symbiosis, decomposition.

The unit will culminate in a One-Health meal before Thanksgiving break, which will include a printed menu and visual guide in which each student details the One-Health attributes of one of the dishes or ingredients we are

serving and provides a quote/short reading to accompany their dish.

I will serve up a vegetable and bean medley from my home garden, from which I can recount the stories of where each seed came from, some culinary traditions from my family, and I will read several quotes from Wendall Berry, whose statement “eating is an agricultural act” from his essay *The Pleasures of Eating*, inspired me 40 years ago when I was working as a professional cook/chef to learn about food systems and farming. Berry continues later in this essay to say; “Eating with the fullest pleasure — pleasure, that is, that does not depend on ignorance — is perhaps the profoundest enactment of our connection with the world. In this pleasure we experience and celebrate our dependence and our gratitude, for we are living from mystery, from creatures we did not make and powers we cannot comprehend.”[47] I hope readers of this unit will find pleasure in eating, pleasure in teaching, and pleasure in learning more about how our food choices matter.

Endnotes

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[1] Will Steffen et al., “The Anthropocene: From Global Change to Planetary Stewardship,” *AMBIO* 40, no. 7 (October 12, 2011): 739–61, https://doi.org/10.1007/s13280-011-0185-x.

[2] Will Steffen et al., “The Anthropocene: From Global Change to Planetary Stewardship,” *AMBIO* 40, no. 7 (October 12, 2011): 739–61, https://doi.org/10.1007/s13280-011-0185-x.

[3] “Philadsd.org,” Philadsd.org, 2023, https://philadsd.org.

[4] CDC, “Childhood Obesity Facts,” Centers for Disease Control and Prevention, May 17, 2022, https://www.cdc.gov/obesity/data/childhood.html.

[5] M. Pollan, *Omnivores Dilemma*, *Young Readers Edition*, 4

[6] “John Muir Misquote: When One Tugs at a Single Thing in Nature, He Finds It Attached to the Rest of the World - but the Correct Quote Is Actually - When We Try to Pick out Anything by Itself, We Find It Hitched to Everything Else in the Universe. - John Muir Exhibit,” vault.sierraclub.org, n.d., https://vault.sierraclub.org/john_muir_exhibit/writings/misquotes.aspx.

[7] “What Is One Health?,” School of Veterinary Medicine, January 16, 2019, https://ohi.vetmed.ucdavis.edu/about/one-health.

[8] David R. Montgomery et al., “Soil Health and Nutrient Density: Preliminary Comparison of Regenerative and Conventional Farming,” *PeerJ* 10, no. https://www.frontiersin.org/articles/10.3389/fsufs.2021.699147/full (January 27, 2022): e12848, https://doi.org/10.7717/peerj.12848.

[9] Joe Copper Jack et al., “Traditional Knowledge Underlies One Health,” *Science* 369, no. 6511 (September 25, 2020): 1576–76, https://doi.org/10.1126/science.abe2401.

[10] Symma Finn, Mose Herne, and Dorothy Castille, “The Value of Traditional Ecological Knowledge for the Environmental Health Sciences and Biomedical Research,” *Environmental Health Perspectives* 125, no. 8

(August 16, 2017): 085006, https://doi.org/10.1289/ehp858.

[11] M. Pollan, *The Ominvore's Dilemma, Young Readers Edition*, 41

[12] John Lynch et al., "Agriculture's Contribution to Climate Change and Role in Mitigation Is Distinct from Predominantly Fossil CO2-Emitting Sectors," *Frontiers in Sustainable Food Systems* 4, no. 2571 (February 3, 2021), https://doi.org/10.3389/fsufs.2020.518039.

[13] M. Pollan, *Omnivore's Dilemma*, Young Readers Edition, 44

[14] John Lynch et al., "Agriculture's Contribution to Climate Change and Role in Mitigation Is Distinct from Predominantly Fossil CO2-Emitting Sectors," *Frontiers in Sustainable Food Systems* 4, no. 2571 (February 3, 2021), https://doi.org/10.3389/fsufs.2020.518039.

[15] M. Pollan, *The Omnivore's Dilemma, Young Readers Edition*, 74

[16] Amy Maxmen magazine Nature, "Antibiotics Linked to Weight Gain," Scientific American, August 2012, https://www.scientificamerican.com/article/antibiotics-linked-weight-gain-mice/#:~:text=Bacteria%20living%20naturally%20within%20the.

[17] "U.S. Food System Factsheet," Center for Sustainable Systems, September 2022, https://css.umich.edu/publications/factsheets/food/us-food-system-factsheet.

[18] "Farms and Farmland Farms and Farmland Continue to Decline as Average Farm Size Increases Highlights," August 2019, https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Farms_Farmland.pdf.

[19] "Corn It's Everything," www.iowacorn.org, 2023, https://www.iowacorn.org/education/corn-its-everything#:~:text=In%20fact%2C%20a%20typical%20grocery.

[20] M. Pollan, The Omnivore's Dilemma, Young Readers Edition, 19

[21] Jonathan Foley, "It's Time to Rethink America's Corn System," Scientific American, March 5, 2013, https://www.scientificamerican.com/article/time-to-rethink-corn/.

[22] Carolyn Denton, "How Are Food and the Environment Related? | Taking Charge of Your Health & Wellbeing," Taking Charge of Your Health & Wellbeing, 2016, https://www.takingcharge.csh.umn.edu/explore-healing-practices/food-medicine/how-are-food-and-environment-related.

[23] "Soil Health, Soil Amendments, and Carbon Farming | USDA Climate Hubs," www.climatehubs.usda.gov, accessed July 10, 2023, https://www.climatehubs.usda.gov/hubs/california/topic/soil-health-soil-amendments-and-carbon-farming#:~:text=WHAT%20IS%20CARBON%20FARMING%3F.

[24] Patricia Klindienst, *The Earth Knows My Name : Food, Culture, and Sustainability in the Gardens of Ethnic Americans* (Boston Beacon Press, 2008), 175.

[25] Albert Howard -Toc and Albert Howard, "An Agricultural Testament - an Agricultural Testament," 2009,

https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=d868272e2223bdfea93c3628a8bcc981e8f3f049.

[26] Lauren Drabenstott, “The Leaders Who Founded the Organic Movement,” Rodale Institute, March 15, 2021, https://rodaleinstitute.org/blog/leaders-organic-movement/#:~:text=In%201943%2C%20Eve%20published%20The.

[27] Adam Rutherford, “A New History of the First Peoples in the Americas,” The Atlantic (The Atlantic, October 3, 2017), https://www.theatlantic.com/science/archive/2017/10/a-brief-history-of-everyone-who-ever-lived/537942/.

[28] Tracy Heim, “The Indigenous Origins of Regenerative Agriculture,” National Farmers Union, October 12, 2020, https://nfu.org/2020/10/12/the-indigenous-origins-of-regenerative-agriculture/.

[29] “Garden State History Garden at Updike Farmstead - Historical Society of Princeton,” princetonhistory.org, accessed July 18, 2023, https://princetonhistory.org/garden-tour/02.html#:~:text=They%20planted%20corn%2C%20beans%2C%20and.

[30] “SOUL FIRE FARM,” SOUL FIRE FARM, 2023, https://soulfirefarm.org.

[31] Anna Brones, “Food Apartheid: The Root of the Problem with America’s Groceries,” the Guardian (The Guardian, August 2, 2018), https://www.theguardian.com/society/2018/may/15/food-apartheid-food-deserts-racism-inequality-america-karen-washington-interview.

[32] B.N. Horowitz, K. Bowers, *Zoobiquity*, 170

[33] B.N. Horowitz, K. Bowers, *Zoobiquity*, 170

[34] B.N. Horowitz, K. Bowers, *Zoobiquity*, 174

[35] Janine M. Benyus, *Biomimicry : Innovation Inspired by Nature*, 160.

[36] Michael Moss, “The Extraordinary Science of Addictive Junk Food,” *The New York Times*, February 20, 2013, https://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html.

[37] Michael Moss, “The Extraordinary Science of Addictive Junk Food,” *The New York Times*, February 20, 2013, https://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html

[38] “NPR Choice Page,” Npr.org, 2019, https://www.npr.org/sections/thesalt/2019/05/16/723693839/its-not-just-salt-sugar-fat-study-finds-ultra-processed-foods-drive-weight-gain.

[39] CDC, “Childhood Obesity Facts,” Centers for Disease Control and Prevention, May 17, 2022, https://www.cdc.gov/obesity/data/childhood.html.

[40] DEREK LOWE, “Is Everything Getting Fatter?,” www.science.org, August 21, 2015,

https://www.science.org/content/blog-post/everything-getting-fatter.

[41] New York Times Magazine
https://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html

[42] New York Times Magazine
https://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html

[43] New York Times Magazine
https://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html

[44] "Homepage | Project Zero," pz.harvard.edu, n.d., https://pz.harvard.edu/.

[45] Nadja Popovich, Cari Vander Yacht, and Eden Weingart, "Quiz: How Does Your Diet Contribute to Climate Change? (Published 2019)," *The New York Times*, April 30, 2019, sec. Climate, https://www.nytimes.com/interactive/2019/04/30/climate/your-diet-quiz-global-warming.html.

[46] "Traditional Diets | Oldways," Oldways, 2019, https://oldwayspt.org/traditional-diets.

[47] Wendell Berry, "Wendell Berry: The Pleasures of Eating," ecoliteracy.org, June 29, 2009, https://www.ecoliteracy.org/article/wendell-berry-pleasures-eating.

Bibliography

Benyus, Janine M. *Biomimicry : Innovation Inspired by Nature*. Pymble, NSW: HarperCollins e-books, 2009. An extensive, if dated, deep dive into inpsirations for what can be learned from animals, indigenous culture and the wide natural world for health and design solutions.

Berry, Wendell. "Wendell Berry: The Pleasures of Eating." ecoliteracy.org, June 29, 2009. https://www.ecoliteracy.org/article/wendell-berry-pleasures-eating. Inspiring essay on the fundamental connections between our food choices, agriculture and the environment.

Brones, Anna. "Food Apartheid: The Root of the Problem with America's Groceries." the Guardian. The Guardian, August 2, 2018. https://www.theguardian.com/society/2018/may/15/food-apartheid-food-deserts-racism-inequality-america-karen-washington-interview. A short interview with Karen Washington, a leading advocate for Black and Brown farmers.

Drabenstott, Lauren. "The Leaders Who Founded the Organic Movement." Rodale Institute, March 15, 2021. https://rodaleinstitute.org/blog/leaders-organic-movement/#:~:text=In%201943%2C%20Eve%20published%20The. An overview of key figures who have been researching and advocating for sustainable and organic food production over the decades.

Foley, Jonathan. "It's Time to Rethink America's Corn System." Scientific American, March 5, 2013. https://www.scientificamerican.com/article/time-to-rethink-corn/. A long form essay detailing the historical,

social, political and environmental impacts of corn production in the USA.

Sir Albert Howard. *An Agricultural Testament*. Oxford University Press, 1943. This early treatise on what we now call organic agriculture details the importance of soil health, compost and ecosystem diversity.

Klindienst, Patricia. *The Earth Knows My Name : Food, Culture, and Sustainability in the Gardens of Ethnic Americans*. Boston Beacon Press, 2008. A series of interviews with a range of immigrants whose stories inspire and promote culturally diverse values around sustainability.

Moss, Michael. "The Extraordinary Science of Addictive Junk Food." *The New York Times*, February 20, 2013. https://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html. Fascinating long form essay detailing just how much, and for how long, the food industry has known how much ultra-processed foods have been implicated in obesity and disease.

Natterson-Horowitz, Barbara, and Kathryn Bowers. *Zoobiquity : The Astonishing Connection between Human and Animal Health*. New York: Vintage Books, A Division of Random House, Inc, 2013. An overview with examples extolling the value of collaboration between scientists studying and working with humans and animals to inform and improve the health of both.

Ohlson, Kristin. *The Soil Will Save Us*. Rodale Books, 2014. A comprehensive look at how soil management and farming practices may have an outsized role in climate crisis solutions.

Oldways. "Traditional Diets | Oldways," 2019. https://oldwayspt.org/traditional-diets. A website that promotes health through education and information promoting heritage foodways.

Pollan, Michael. *The Omnivore's Dilemma: The Secrets behind What You Eat*. New York: Penguin Publishing Group, 2009. This groundbreaking best-selling book exposed many readers to the largely hidden environmental and health impacts of our industrial food system, and unearthed alternatives with an engaging investigative storytelling approach.

Pollan, Michael. *The Omnivore's Dilemm : The Secrets behind What You Eat, Young Reader's Edition*. New York: Penguin Publishing Group, 2009. A shorter, accessible version this book. Suitable for middle through high school readers.

Rutherford, Adam. "A New History of the First Peoples in the Americas." The Atlantic. The Atlantic, October 3, 2017.
https://www.theatlantic.com/science/archive/2017/10/a-brief-history-of-everyone-who-ever-lived/537942/. A long form essay which uses genetic research to revisit and rewrite the story of the people who first populated, farmed and settled the Americas.

Appendix on Implementing District Standards

The following are the Agriculture CIP 1.999 Standards that will be covered within this unit.

There are numerous Next Gen & Common Core Standards in Environmental Science, Biology & Earth Science

that could be covered by unit content.

503	Understand how natural resources are used in agriculture.
504	Contrast practices for conserving renewable and nonrenewable resources in agricultural systems.
505	Understand how new energy sources are developed from agricultural products (eg: gas co-generation and ethanol).

607	Identify elements of a soil management plan for a natural resource management area.
706	Analyze the ways in which human needs and environmental considerations interrelate.

903	Explain the importance of, uses of, and arguments against cloning.
904	Describe methods and advantages of pollinators.

1004	Contrast practices for conserving renewable and nonrenewable resources in agricultural systems.
1005	Understand how new energy sources are developed from agricultural products (eg: gas co-generation and ethanol).

1103	Compare and contrast conventional and sustainable agricultural practices. Investigate it's effects on vulnerable populations.
1104	Evaluate the role of soil fertility in an ecological production system.
1105	Discuss the principles and strategies of sustainable agriculture focusing on food access and environmental justice.
1106	Identify and describe local examples of enterprises using sustainable agricultural practices.

1108	Describe the principles and practices used to enhance and maintain biological diversity in an agricultural environment.
1109	Describe strategies that combine management methods for integrated pest control.
1110	Discuss key principles and practices related to sustainable vegetable production.

1602	Identify emerging technologies and their impacts on food products and processing.

1701	Discuss justifications given for genetically modifying food and animal crops (e.g.: pest resistance, improved yields or nutrition, increased ease of processing and/or transport).
1702	Describe the microorganisms and processes used in biotechnology.
1703	Explain human& environmental safety concerns and impacts related to new technologies used in foods and agricultural production.

1704	Understand the environmental impacts of recent innovations and agriculture policies on the environment (such as "The Green Revolution".