

An  
Environmental Science Curriculum  
for Middle School

by

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The Nature Institute  
Educational Aids  
for Experiential Learning



# INTRODUCTION

In the fall and winter of the 2010-2011 school year I participated in the development of an environmental science curriculum for the middle school (grades 6 through 8) for the Detroit Waldorf School. The school's question was: Could a curriculum be developed that weaves together a phenomenological approach to science, environmental and social justice awareness, and service learning opportunities. The school felt that such a curriculum—which could be modified for other learning settings, such as urban summer camps—would be “an essential contribution that we could make to our community, especially to demonstrate to our young people how they can be instrumental in understanding and acting upon locally significant environmental issues. The central approach is to study topics around which the students can become passionate and can also fit into their understanding of the world at their age.”

Candyce Sweda, who has been involved in the school and other Detroit community activities for many years, approached Michael D'Aleo, Gary Banks (both Waldorf teachers and scientists with a passion for environmental topics) and me to develop this curriculum. This was an intensive and rewarding collaboration. Each one of us developed a specific area for each grade and then we worked as a group to create coherent courses: Michael focused on energy and transportation, Gary on substances and cycles (e.g. water, air, carbon), while I developed ideas for teaching about and experiencing plants, food, and agriculture.

The challenge was to craft a curriculum that would involve firsthand student experiences and not just transfer of information. Moreover, it was important that this curriculum be place-based so that the students could learn about the environment in and around Detroit and also be involved in community activities such as river monitoring and urban gardening. Detroit is a city that faces special challenges, having lost over one million residents since 1950 (when its population was nearly two million; now it has about 790,000 inhabitants). It is a vast urban landscape marked by many signs of decay and yet many grassroots and innovative initiatives are taking hold to change this landscape. The school, with this curriculum and the hope that it can bear fruits within the broader community, wants to contribute to the current of change. I felt it an honor to be part of this effort.

This project was supported by a grant from the Community Foundation for Southeast Michigan to the Detroit Waldorf School. The curriculum was presented at a meeting on January 22, 2011. The complete curriculum can be found at [www.detroitwaldorf.org/environmental-science-and-sustainability](http://www.detroitwaldorf.org/environmental-science-and-sustainability). This Educational Aid can be downloaded for free\* at [www.natureinstitute.org/txt/ch/envir\\_cur2011.pdf](http://www.natureinstitute.org/txt/ch/envir_cur2011.pdf).

Below you will find my outline for three one-week units for grades 6, 7, and 8. The overarching topic is plant and human interactions with a focus on food and agriculture. In the Detroit curriculum each of these units was planned as the third week of the grade 6, 7, and 8 blocks. The block concept stems from Waldorf education: main subjects are taught in blocks of three to four weeks, one and a half to two hours each day. So when below you read “Day 1,” etc. you should think of two-hour periods. The 8th grade week is conceived of as a service learning week and takes up the whole school day each day.

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\*The Nature Institute relies on contributions to support its work, so donations are always welcome.

Educators will find an array of activities that they could apply and modify for different courses and age groups. This sequence could also be taught as one unit in environmental science focusing on plants, food, and agriculture.

## PLANT AND HUMAN INTERACTIONS

### 6TH GRADE: Plant growth, ecology, and plants as food

*Emphasis:* The focus of this week is the central role of plants for life on earth, including their role as food, and our indebtedness to them for human life.

*Introduction:* After the first two weeks, we now turn our attention to living organisms, with a primary focus on plants. During this week the students first get to know the plant in its importance within the earth's ecology. The focus is not so much on the different types of plants and their make-up, which is often the topic in the 5th grade Waldorf botany block, but on plants in the context of the environment. By observing germination, for example, they see plants immediately take up relation to the environment—water, light, and gravity. They learn through their own observations that there is diversity in plant life and that this diversity shifts in relation to different environments. Then they learn how animal and human life is dependent on plants and get a sense of the “ecological organism” of the earth—the interconnected relations of the plants who build up living substances, the animals and human beings that live from plants (directly or indirectly) and, finally, the animals and microorganisms that make what has died into fertile soil for plant growth.

Then we move on to a consideration of plants as food for human beings. This exploration is based on what the students can discover for themselves when they consider more carefully the food they eat. What plants are in the food they eat? What parts of plants are they eating? Where does the plant food come from? Here they see how they are, through the food they eat, connected with vast portions of the earth and that they are not only indebted to the plants but to all the people who grow, process, transport, and sell the food.

#### Day 1 — The diversity of life

Why are plants important? The students' answers help the teacher get a feel for what the students know, believe, and maybe have misconceptions about. The task is then to actually observe plants—the first activity.

#### **Activity 1: Discovering biodiversity**

The teacher has pre-selected a couple of areas on or near the school grounds that the students can observe. (If it is possible for the teacher to have an entire morning, the class could take a field trip to Belle Isle and do the observing there, since it has a number of different habitats and plant communities.) The task is to take a square yard in two different microenvironments to observe, for example: a patch of lawn, plants at edge of the school garden, in a nearby park under the trees. What's important in selecting the areas is that they differ from each other.

Each student should observe the two microenvironments for about 10 minutes each. At first they should try to determine how many different types of plants and how many different types of animals there are in the first plot. They could record this in a notebook. They can also record whether the plant or animal is dominant, frequent or rare in the plot (names of the plants and animals is not important in this exercise—it's about discovering the variety!). Then they should spend five minutes just focusing on one small section of their plot (one sq. ft.) and wait and see whether anything happens or whether they discover things they hadn't seen in the initial survey. Next, they should go to the second plot and repeat the procedure. Here they can, in addition, record whether the composition of plants and animals was basically the same, somewhat different or very different from the first plot.

Back inside the students gather together their observations: Were the findings in the same areas by different students similar or different? How different from each other were the two different areas that were chosen? Perhaps the students make a table on the blackboard.

### ***Activity 2: Observing and drawing plant germination***

The week before, on Thursday or Friday, the students prepared a germination experiment: Seeds of two different species that we use as food—it is good to have a dicot (beans) and a monocot (a grain such as corn or rye)—were sown in a way that allows easy observation of the germination process. The students can do this in teams of two or else alone, depending on the materials available. One way is the following:

1. Wet two paper towels and then line the walls of a beaker (500 ml is a good size; wide-mouth Ball jars work too) with the towels. They should stick to the glass.
2. Fill the core of the beaker or jar with a crumpled sheet of newspaper. The newspaper will hold the wet towels in place.
3. Pour water into the bottom of the glass until it is about 1-3 cm. deep.
4. Now "plant" the seeds between the glass wall of the beaker and the wet paper towels, fairly high up in the beaker. Place at least two to three seeds of each variety along the beaker wall, alternating the species, and turned in different directions.
5. Place the beaker in a fairly warm place over the weekend.
6. Draw the setup so that you see the two different kinds of seeds next to each other.
7. In addition, the teacher and students also cover with a box one of the beakers with seeds (so that it is in darkness) and place another one in a refrigerator.

On the first day of this unit the students observe and record the changes that occurred over the weekend and, if there are marked changes, then a new drawing should be done.

[NOTE: This observing and drawing continues each day of the week. Depending on the rate of change, drawings will be done every day or every other day. In any case, there should be a recording of each day's observations.]

This activity gives students a firsthand experience with plant growth, aspects of the necessary context for growth (water, warmth, and then light), the polarization of the plant into the earth-water seeking pole (roots) and the light-air seeking pole (shoot & leaves). It also introduces an exercise in careful observation and comparative study—two important pillars of engaging in the world in a scientific way.

*Homework for next day:* As homework the students could write up a description of Activity 1—What they did, a summary of what they observed in the two areas, and a table derived from the observations of the whole group.

*Resources:*

#### ON PLANT GERMINATION

[www.juliantrubin.com/encyclopedia/botany/seeds\\_and\\_germination.html](http://www.juliantrubin.com/encyclopedia/botany/seeds_and_germination.html)

## Day 2 — Plants as food for all other life

*Review and deepening of concepts:* The students now have a firsthand experience of biodiversity—the variety of life forms even in small areas. They can begin to think of how much greater this variety is when we consider the different environments in and around Detroit. What are some of those environments that they know within a few hundred miles of Detroit? (E.g. farmland, rivers, lakes, swamps, northern woodlands, dunes.) To encompass an even larger area, the teacher could ask the students what kinds of different environments they have experienced on vacation trips. In addition, it would also be possible, if the students learned about some biomes in their geography courses, to list some of these different large-scale ecosystems in North America or South America. The important thing is that the students get a feel for how immense the variety of life on earth is. The term biodiversity can now be introduced.

*New topic:* We discuss some basic phenomena related to “food” in the most general sense. We know that animals feed on other animals and on plants. We can discover that there are many organisms (e.g. earthworms) that feed on dead plants and animals. All organisms are directly or indirectly dependent on plants for their food.

The teacher leads a conversation about food in different environments: What animals live in the city park and what do they feed on? What about in a river? Who else lives from the food in the school garden besides us? Can we observe them?

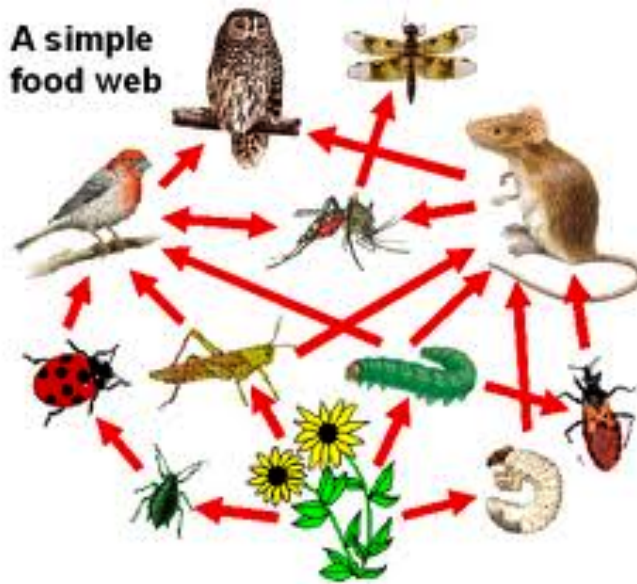
### **Activity 3: Finding out who feeds on whom**

The students go out into the school garden and in teams of two, make observations about any animals they see and what the animals might be feeding on. (Some close observation might be necessary; hand lenses are an option.) It is good if the students just sit quietly for a while and see if they can in fact observe animal life—butterflies, flies, or bees flying to the flowers, caterpillars, ants, or spiders crawling around on the vegetation. A second step can be to take some soil and compost and sieve through them to see what kinds of animals are living unnoticed there—worms, spring tails, etc. This is a fine way to discover how many animals are actually present in soil/compost. The question arises: What are these animals doing? This question can be discussed in the following days. Back inside, the students make a list of all the animals, write down who feeds on whom, and leave question marks where that is not clear.

*Possible direction for additional in-class student work:* Students write a brief description of the plot and observation activity, as well as make a table of findings. Also, continue observing and drawing the changes in plant germination (Activity 2).

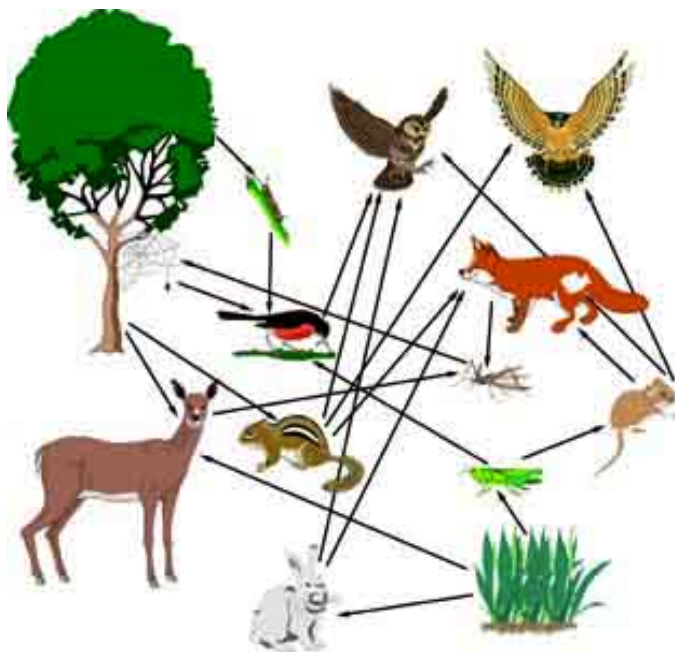
## Day 3 — The plant and its “food”

*Review and deepening of concepts:* The work yesterday leads to the formation of the concept of “food webs.” One can construct, based on yesterday’s experiences and discussion, one or two food web diagrams on the blackboard to provide a visual overview of the ecological relations. Since the students might have heard of “food chains,” one could go into the difference between a chain and web—the chains are always incomplete parts of the webs. Examples of food webs:



This simple web is for a garden/yard area and includes lots of insects. When an arrow has an arrow pointing from it to another one, it means that it is food for that organism.

I would include the names of the animals and plants in such a food web.



This web is for a forested area.

For more examples of food webs from different kinds of environments, just google “images for food webs” and you will find many different food web diagrams to choose from or to adapt to what makes most sense for the class and environments they know.

Possible question to ponder: What might happen if there are suddenly too many squirrels resident in a park? What might be the consequences (not just one!)?

Possible answers: They eat most of the nuts/fruits from the trees and no tree seedlings can develop; coyotes and hawks are drawn

to the park because there are so many squirrels to feed on; the nests of birds in the trees are increasingly robbed of their eggs (squirrels like eggs) and there are fewer nesting birds over the course of time. With an exercise like this the students beginning thinking in connections—how in

the biological/ecological world any given change can have multiple effects. If you change one aspect, everything changes!

This is ecological thinking. The teacher could provide some examples of what occurs when such an imbalance arises through the introduction of foreign species into a country/habitat. For example: rabbits in Australia ([www.en.wikipedia.org/wiki/Rabbits\\_in\\_Australia](http://www.en.wikipedia.org/wiki/Rabbits_in_Australia); also, go to [www.aridrecovery.org.au/fact](http://www.aridrecovery.org.au/fact) and open the fact sheet on rabbits).

*New topic:* What does the plant “feed” on—i.e. what allows it to create all this food for other life? Without going into any details of photosynthesis (more in 7th and 8th grades) we paint a picture of how the plant—usually as a stationary organism that does not need to move around to find and take in its food—lives from the finer elements of its environment.

As the basis for discussion, we refer to what we have been observing (plant germination). We have not observed that the plants are eating animals to grow. We can look at the germinating seeds and compare the ones that the students have been drawing, the ones kept in darkness, and the ones kept in the refrigerator; we find that the plants need warmth, light, air, and water to grow. If we were to keep them in the jars, how long might they continue to grow? Certainly they would not grow into fully developed plants. Plants need soil. Do they “feed on” soil?

Here’s a nice experiment that Jan Baptista van Helmont (1577-1644) carried out and describes as follows:

*I took an earthen pot and in it placed 200 pounds of earth which had been dried out in an oven. This I moistened with rain water, and in it planted a shoot of willow which weighed five pounds. When five years had passed the tree which grew from it weighed 169 pounds and about three ounces. The earthen pot was wetted whenever it was necessary with rain or distilled water only. It was very large, and was sunk in the ground, and had a tin plated iron lid with many holes punched in it, which covered the edge of the pot to keep air-borne dust from mixing with the earth. I did not keep track of the weight of the leaves which fell in each of the four autumns. Finally, I dried out the earth in the pot once more, and found the same 200 pounds, less about 2 ounces."*

In Howe, H.M. (1965). A root of van Helmont's tree. *ISIS*, 56,408-419.

(If the teacher has a scale s/he could let the students in the classroom find a few things that weigh 2 ounces—which is not very much! It never hurts to make abstract measurement units more concrete! Two ounces of water is  $\frac{1}{4}$  cup!). Evidently the plant is not getting much food from the soil. The plant is making its own substance out of the air, water, and tiny portions of soil, a process that is made possible through light and warmth. (This is enough for 6th grade; more comes in the 7th grade block.)

*Possible direction for additional in-class student work:* Students make a page with one or two food webs and explain briefly what the diagrams represent. Also, continue observing and drawing the changes in plant germination (Activity 2).

*Homework for next day (as basis for new topic):* Students do an inventory of all the plants that are in the food they have at home—both fresh and packaged. They write down, if it is a packaged product, what it is (cereal, crackers, etc.) and what plant or plant-derived foods it contains. If they



are unsure, they can ask their parents, look up the ingredient on the internet, or write it down anyway with a question mark to be looked at tomorrow.

## Day 4 — Plants as food for human beings (Part 1)

*Review and deepening of concepts:* Out of the work of the first three days we now have a sense of the diversity of life, the interconnectedness of all life forms, and the different roles different kinds of organisms play in the life on earth. We bring this together in an overview and possibly introduce some ecological terminology:

- Plants as producers: plants make living substance out of water, air, and minerals through light and warmth. They are the primary food for all other life forms.
- Animals as consumers: as herbivores they feed directly on plants; as carnivores they feed, mainly, on herbivores (therefore carnivores are also dependent on plants!).
- Animals, fungi, and bacteria as decomposers: these organisms live from dead organic matter and their excretions help form soil and the minerals that plants need (in minute amounts) to grow. Many of the animals in soil and compost are decomposing dead plant and animal matter (e.g. earthworms).

[NOTE: This topic is brought back in the 7th and 8th grade blocks so that the understanding of this overarching “ecological organism” will become more saturated.]

*New topic:* To begin the consideration of plants as food, take up the previous days’ homework assignment: What plants are part of the food we eat? Gather and list them on the blackboard. Discuss the cases where it is not clear where the ingredients come from (for example—that lecithin, which is in many processed foods, comes from soybeans.) It might be good to help the students become more aware of the kinds of food they are eating by letting them order the plant foods into groups: fresh plants or plant parts; canned or frozen, but still whole plant parts; highly processed plant parts (sugar, corn syrup, etc.).

### **Activity 4: What different parts of the plants do we eat?**

The teacher has brought in a variety of fruits, nuts, and vegetables and students explore what part of the plant they come from (roots, leaves, stems, buds, etc). Are there parts of the plants that aren’t present? If so, which? Do we ever eat flowers? The students make a table listing the parts of the plant and examples of food that comes from them. Some examples:

- Root vegetables: carrot (very top part of the carrot is actually still stem), parsnip, horse radish
- Stem vegetables: asparagus (also has buds on it); the following consist of the swollen base of the stem: kohlrabi, radish, rutabaga
- Tubers (tubers are underground stems—rhizomes—they are not roots!): potatoes, sweet potatoes, yams, Jerusalem artichokes
- Leaf stalk vegetables: celery (it’s not a stem but the thickened stalk of a leaf!)
- Leaf vegetables: spinach, swiss chard, kale, lettuce
- Bud vegetables: Brussels sprouts (side stem buds)
- Bulbs (bulbs are made up of many leaves tightly packed and are basically swollen buds): onions, garlic; leeks can be considered elongated bulbs
- Flower vegetables: flower buds: artichokes, broccoli, cauliflower; flowers: nasturtium,

violets

- Fruit vegetables (this means that the vegetables consist of the botanical fruit): squashes, pumpkins, zucchini, beans, tomatoes, avocado
- Seed vegetables: peas, chickpeas, lentils
- Nuts (nuts are seeds) and seeds: walnut, sunflower seeds, cashews, peanuts
- Sweet fruits: cherries, apples, oranges, bananas, etc.

*Additional in-class student work:* Continue observing and drawing the changes in plant germination (Activity 2).

*Homework for next day:* Where do the plants we eat come from? The teacher has made different lists with the names of a number of plants we eat or make plant-derived products. Each student gets such a list and is asked to find out where they were grown, either by asking in the supermarket/store for fresh fruit/nuts/vegetables or by finding out the source (books, internet, informed adults). They should also take two foods from especially far away and look up how far (approximately) they have traveled. (There is a simple distance calculator at: [www.geobytes.com/CityDistanceTool](http://www.geobytes.com/CityDistanceTool))

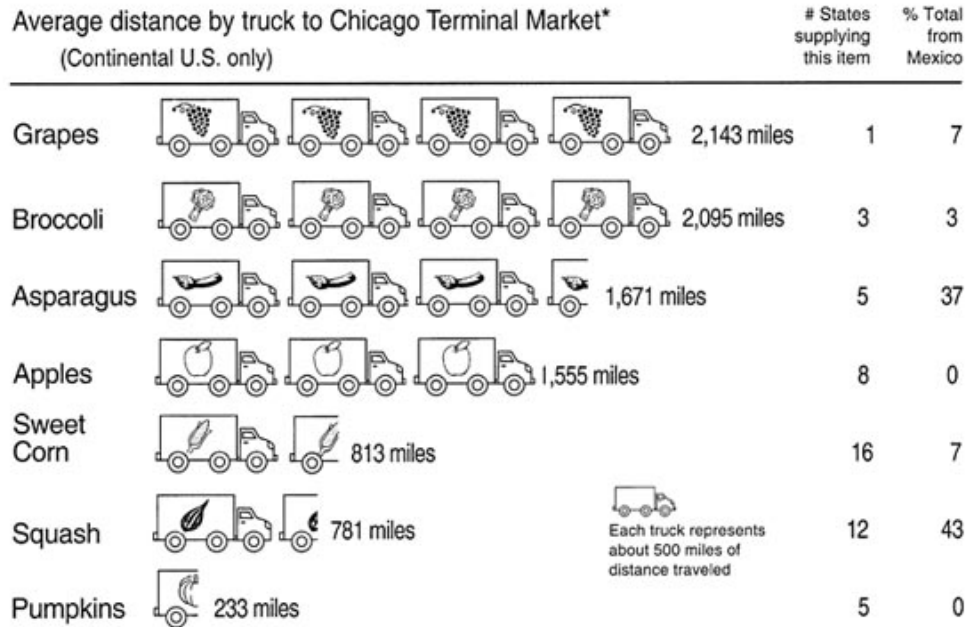
## Day 5 — Plants as food for human beings (Part 2)

*Review and deepening of concepts:* The teacher asks for the results of the students' investigations about where food comes from. Together a list can be made, and grouped according to where the food comes from (e.g. local, regional, California/west coast, southeast, Midwest, South America, Europe, Asia, etc.). The result will probably be that their food comes from various parts of the U.S. and a variety of foreign countries; probably not much will be local. Through this exercise the students can begin to realize that the food they eat connects them with a large part of the planet and shows our dependency on plants and people in other parts of the country and planet for our food.

*New topic:* There is no new topic for this last day, but rather the topic of where food comes from is carried a step further, and the unit is rounded off by completing the seed germination activity.

### **Activity 5: How far food travels**

The students share some of the large food travel distances they found when doing their homework. For example, apples from New Zealand, travel about 9,000 miles to get to Detroit! This table shows some distances that food within North America travels to Chicago.



(Source:  
Center for

Leopold

### Sustainable Agriculture

The teacher could provide a world map to each student. The students then fill in the places where their plant food is coming from and include for some of the examples the approximate miles between the point of origin and Detroit. This will give the students an impression of what kind of a transportation network is necessary to move all this food (this will be covered in more detail in the 7th and 8th grade Transportation units).

#### **Activity 2 (completion): Observing and drawing plant germination**

Finish the observation and sketches of plant germination. What has changed over the week? The students can make a short write-up to accompany their sketches describing how the plants have changed during the week and a half since they were “planted.” They make note of how the seeds in the dark and in the refrigerator did not thrive: the plant needs not only moisture, but also light and warmth to grow well. If we were to leave the plants like this a few more weeks and only water them, they would die—they need the minute amounts of minerals in the soil to grow and need the earth to give them support so that they can grow larger.

Ideally the seeds could either be eaten as sprouts or planted in the garden so that they do not just get thrown away. Alternatively, the students could each plant a few of their seedlings in pots and take them home for further observation.

*Review of the Plant and Human Interactions week:* In the first days of this unit the students have become familiar with plants and animals in an ecological sense. They experience the diversity of life and how plants and animals are related to each other in food webs. They learn that plants have a special place in the ecology of the earth since they do not need to eat food that is derived from life, but build up living substance through light, air, water, and minerals from the soil. All other life depends in the end on plants. In the second part of the unit the students learn more about plants as food for human beings—the variety of plants and plant parts we eat and the great distances plants

travel to get to our tables. By the end of the unit the students should have a sense of how important plants are for all life on earth and how essential they are to us as a source of food. By considering where the plants are grown that they eat, the students are taking a first step to understand the global nature of food production and its ramifications, which will be considered in greater detail in the 7th and 8th grade Environmental Studies blocks.

## **7TH GRADE: Food and the Evolution of Agriculture**

*Emphasis:* In this week the topic is the evolution of agriculture and food within the context of the Detroit region (southeast Michigan).

*Introduction:* Through presentations and activities the students become familiar with: how human beings have interacted with nature in the area over the past centuries; how the whole landscape has been altered; the changing methods of farming; the shifts in food production and what kinds of food people eat. We begin with the hunter/gatherer habits of the indigenous peoples and consider as well their agricultural practices. In the 19th century the European settlers arrive and within less than a hundred years everything has changed. The indigenous people have been killed or forced west. Farmers come with pre-existing habits: forests are felled, fields cleared, and when the land's fertility is exhausted, new fields developed until the previous ones have rejuvenated. Southeastern Michigan, which was previously forested, now becomes an agricultural landscape with many farms. The development of cities (Detroit!) occurs—urban populations in contrast to rural populations; food is hardly grown in cities; transportation of food to the cities from the rural areas increases especially when railways are developed (1860s). Gradually, as cities get bigger and transportation networks (trains) grow, food comes from farther and farther away. Mechanization in agriculture increases in the latter part of the 19th and 20th century—fewer people with machines produce more food. After WWII chemical fertilizers become available and farmers tend more and more to specialize on certain crops and their yields grow as do the landscapes covered with monocultures of, in the Midwest, wheat, corn, or soybeans. Industrial agriculture, as we know it today, develops. Concomitantly, people eat fewer whole foods and more and more refined food.

Clearly, there is a sense of loss and tragedy involved in these developments and the students will experience that. They also learn how their own lives today are bound up with the development of agriculture, transportation, and energy sources. It will be important in this unit to balance the learning through teacher presentation with firsthand experiences. So the unit begins with the students getting to know the trees of a forested area and collecting wild edible plants to eat. Then the students experience two different modes of agriculture by planting a three-sisters garden and a row-crop garden. They compare wild plants with related domesticated plants. After learning about industrial agriculture, they return to the basics of food production by grinding their own corn and making a meal from it.

### **Day 1 — The forest and gathering food**

To begin this week it would be great if the students could go back to the same forested area that they visited on the first day of the 6th grade block (see Transportation & Energy, 6th grade, Day 1.) It is important that the teacher finds an area that is somewhat similar to the forest that was here before European settlement. The teacher can give a brief introduction, painting a picture of the forest that spread throughout the eastern half of the U.S. prior to the influx of Europeans on the

continent. This was not, however, a forest without human beings—the native peoples moved through these forests, started fires that burned the underbrush, and also produced clearings for their settlements and agriculture (tomorrow’s theme).

### ***Activity 1: Becoming familiar with the forest***

We want to let the students become familiar with the forest. This can be done in a variety of ways:

1. The teacher can help the students pay attention to the overall composition/structure of the forest. Are all the trees the same size/height? Are there layers (shorter and higher trees)? Are there bushes? Are any wildflowers (herbaceous plants) growing out of the forest floor?
2. The students can then collect leaves from the different types of trees they can find in the area; if the students don’t know the names, that’s okay. They can keep the leaves pressed in a notebook, and take them back to school, but it would be good for them to learn, in the course of the week, some key forest species: e.g. white oak, hickory, sugar maple, red maple, beech, birch(es), white pine. (The activity of getting to know trees can continue during the week if there are native trees in or around the school grounds that the students could go to, look at, and collect leaves from.)
3. Collect edible plants. Here the teacher will need to know some edible wild plants or bring someone along who does. *Warning: some edible plants resemble plants that are not edible, so make sure that the teacher/guide has adequate knowledge of the plants that are harvested.* The knowledgeable guide could also dig up a plant or two that has edible roots or tubers. The students can come back to school and prepare a salad for lunch!

*Homework for next day:* As homework the students can begin a page listing native trees they have observed. Names can be added to the list as new species are discovered and named. Also the student can make a separate list of the plants they collected and ate in their “wild plant salad.”

## **Day 2 — Native agriculture**

*Review and deepening of concepts:* How different life would be if we still lived in a forest that was only interrupted by occasional clearings! How would we exist if we only hunted and gathered plant food? We would lead a nomadic life but would still—due to our climate—need some food storage. Most importantly, there couldn’t be too many of us or we would end up eating all the available plants and animals and thereby destroying the basis of our life. Indigenous nomadic peoples have relatively small communities and there are not many people within a large area.

*New topic:* The Native American tribes in the area that is now called southeast Michigan also practiced agriculture. Three important crops to them were the three sisters: beans, corn, and squash (which includes pumpkins!). How did they view these crops? The teacher can present the myths/legends that informed the way the Native people felt and thought about these crops. S/he can also present how they were planted and tended.

### ***Activity 2: Planting a three-sisters garden***

The students plant a three-sisters garden: corn in the middle of a mound, surrounded by a circle of beans, which are surrounded by a circle of pumpkin/squash seeds (see resources). Ideally, the teacher can have some native varieties of beans, corn (on cobs if possible!) and squash (see

resources). The students can select seeds to sow. The students prepare the soil using implements of the kind that the Native peoples might have used, such as simple digging sticks and shells (see resources). They sow the seeds and during the remaining part of the school year tend the garden. (See also note under Activity 3 below.)

*Homework for next day:* Students can make a drawing of the layout of the three-sisters garden and label where they planted each species.

*Resources:*

#### BOOKS

*Iroquois Corn: Its History, Cultivation and Use* by Jane Mt. Pleasant

*Native American Gardening: Stories, Projects, and Recipes for Families* by Michael J. Caduto and Joseph Bruchac

*Iroquois Corn in a Culture-Based Curriculum* by Carol Cornelius

#### NATIVE AMERICAN FARMING TOOLS

[www.museum.state.il.us/OHIA/htmls/technology/hand\\_tools/tech\\_hand\\_na.html](http://www.museum.state.il.us/OHIA/htmls/technology/hand_tools/tech_hand_na.html)

#### NATIVE SEEDS

Nativeseeds.org has a large variety of native seeds in its catalog ([www.nativeseeds.org/pdf/seedlistingcatalog.pdf](http://www.nativeseeds.org/pdf/seedlistingcatalog.pdf))

The southern exposure seed exchange ([www.southernexposure.com](http://www.southernexposure.com)) sells a variety of corn called Black Mexican sweet corn, which actually comes from New York, and is probably the most similar to varieties used by Native Americans in the Detroit area. This would be a great variety to plant in the gardens

### Day 3: Agriculture of the European settlers

*Review and deepening of concepts:* Yesterday we got to know three crops that were important to the Native people and we heard why they cherished them. How can we view, today, the advantages of growing these three crops together? They provide nutritional variety (it might be interesting to briefly present the disease pellagra, which arises when people eat essentially a corn-only diet). These crops can be stored, and corn can be made into flour. Together the three plants help each other grow (e.g. corn as stalk for beans vining upward; large leaves of squashes near the ground provide shade, leading to fewer weeds and the soil not drying out as easily). The beans increase the fertility of the soil. (The topic of nitrogen fixation via bacteria in the root nodules of beans and other legumes will be covered in the 8th grade block, so it needn't be gone into here.)

*Homework for next day:* The students can, as homework, write a brief description of the three-sisters garden to accompany their drawing. They should state the reasons why these crops were planted together in the way they were. They can include the tools they used to do the planting. Perhaps they can also write out a portion of a myth or legend about the three sisters.

*New topic:* When large numbers of eastern US and Canadian settlers migrated to southeastern

Michigan after the opening of the Erie Canal in 1825 (by 1833 most Native Americans had been forced out and to the west of the Mississippi), the landscape and agricultural practices changed dramatically. The population increased radically between 1820 (8,900 inhabitants) and 1840 (212,000 inhabitants; see [www.census.gov/dmd/www/resapport/states/michigan.pdf](http://www.census.gov/dmd/www/resapport/states/michigan.pdf)). Many European immigrants who were farmers made up this growing population. Forests were cleared and crops such as wheat and many different vegetables were grown. At the same time Detroit became a commercial center—mediating between east and west—and agriculture in Michigan, and increasingly in the Midwestern states, expanded and fed the people in the urban centers (see Transportation in first week of this block).

### **Activity 3: Planting a row-crop garden**

Now plant a row-crop garden using modern implements. The students should plant the same three species as were planted in the three-sisters garden, but now they plant in rows, each species by itself. They can use the native seeds, but it would be possible—and perhaps preferable—to use the modern varieties of corn, beans, and squash that a farmer/gardener would plant today. These can be purchased at any garden supply store. If the teacher decides that the students should plant modern varieties in the row-crop garden, then the students can compare the modern seed varieties to the native ones: Are there size and shape differences? The activity of planting a row-crop garden, even on a small scale, can give the students a sense of modern agriculture.

[NOTE to Activities 2 & 3: Planting the two gardens may take more time than the portions of two main lessons indicated above. It could be that the schedule will look more like: The latter parts of Days 2 & 3 for planting three-sisters garden and all of Day 4 for planting the row-crop garden. In this case, Days 4-6 below would become Days 5-7.]

*Additional in-class student work:* The students can make a sketch of the row-crop garden layout, like they did of the three-sisters garden, and add a brief description.

It would be important that the students follow the development of their two gardens and tend them until the school year is over. If some students would want to volunteer to tend the gardens on a weekly basis during the summer that would be great; they could keep a record of when the plants began flowering and setting fruit, when they began to harvest and what was harvested. In any case, the students should, in the first week of school visit the gardens and note their development: Are there differences in the growth of the plants in the two gardens? What about weed growth?

*Resources:*

#### DETROIT LAND USE HISTORY

[www.epa.gov/med/grosseile\\_site/indicators/landuse.html](http://www.epa.gov/med/grosseile_site/indicators/landuse.html)

[www.publicsectorconsultants.com/wp-content/uploads/2017/04/issue-42.pdf](http://www.publicsectorconsultants.com/wp-content/uploads/2017/04/issue-42.pdf)

[www.publicsectorconsultants.com/wp-content/uploads/2017/04/30-Land\\_Use\\_Sustainability.pdf](http://www.publicsectorconsultants.com/wp-content/uploads/2017/04/30-Land_Use_Sustainability.pdf)

#### HISTORY OF AGRICULTURE IN MICHIGAN

[www.geo.msu.edu/geogmich/ag\\_history.htm](http://www.geo.msu.edu/geogmich/ag_history.htm)

## Day 4: Crop cultivation and domestication/breeding

*Review and deepening of concepts:* The students compare the two different types of gardens they planted and review the experiences they had in planting them.

*New topic:* Domesticated plants have been bred by human beings. People who breed plants (before the 20th century, mainly farmers; thereafter, increasingly scientists) observe the plants and have a sense of what characteristics they would like to see enhanced. They choose plants that have some of these features and cultivate them. They may cross-pollinate with plants that have different characteristics and then see what their offspring show. They select again, and so the interaction between human, plant, and the environment continues and new varieties arise. As a result, the plants can usually no longer survive in the wild—they need cultivation by human beings. For example, corn's kernels will tend to rot in the husks if we don't open them up and spread the kernels.

To cultivate plants, farmers need to work with and consciously alter the environment. They no longer simply gather what is there. They clear land to create a light-filled environment for plants they want to grow, since most of the cultivated plants in temperate climates need ample sunlight. Air is always present. If it is a dry climate they may irrigate the plants or if it is too wet, they will drain the area (what was done with much swampy land near lakes and rivers). Then the farmers tend to the land and soil. Although, as we saw from van Helmont's experiment in 6th grade, little of the substance of the plant comes directly from the soil, the soil is crucial to the healthy development of plants. Soil arises when the dead parts of plants, animals, and microorganisms are broken down, all of which happens through living organisms! This brings us back to the importance of the cycle of producers, consumers, and decomposers. Without these different kinds of organisms there would be no soil. Soil is a result of life and makes more life possible! The danger in farming is that farmers use up what we call the fertility of the soil and that soil gets washed away (erosion).

### **Activity 4: Comparing wild and domesticated plants**

The students compare different domesticated plants with their wild relatives: For example, they compare the grass, teosinte, which is considered by most scientists to be the wild ancestor of corn, with corn, or compare a wild mustard (which will be growing as a weed in Detroit and probably flowering in mid to late May) with the different food plants of the genus Brassica (cabbage, cauliflower, kale, broccoli, etc.). The students will see that the whole plant or certain plant parts are much bigger in cultivated plants. There is more to eat! But these plants also demand more water and fertile soil to grow so large.

*Homework for next day:* As homework the students could write a brief comparison contrasting the wild plants and the cultivated plants.

*Resources:*

SEEDS

[www.nativeseeds.org/pdf/seedlistingcatalog.pdf](http://www.nativeseeds.org/pdf/seedlistingcatalog.pdf) (includes teosinte seeds and lots of varieties of cultivated corn/maize and beans)



## Day 5 — A taste of industrial agriculture

*Review and deepening of concepts and transition into new topic:* Most plant breeding was done by farmers on small farms until the 20th century. Then, especially in the U.S. and in Europe, university scientists and companies began breeding crops; the companies then sell the seeds. At the same time, especially in the U.S., with the help of tractors and other farm machinery, farms got larger and larger. Fewer farmers could grow more food for more people and animals. In modern agriculture plants have been bred to have ever greater yields, partially through increasing the size of the plant (in vegetables), the number of seeds or fruits, or—especially in grains including corn—the ability of the plants to grow very close to one another. This all works only if you give the plants substantial amounts of water and liquid fertilizer, so that modern varieties are ones that utilize fertilizers best. A prime example is corn (also called maize). It is “soil hungry” and depletes the soil when planted continually on the same field year after year.

### ***New topic and Activity 5: Comparing different types of corn***

Corn was the main dietary staple of the Mayan and Aztec peoples of what is now Mexico, and continued to be a staple after Mexico’s settlement by the Spanish. They grew hundreds of varieties of corn (maize) and, of course, grew it in conjunction with other crops such as beans and squashes. The teacher should bring in some examples of “Indian” corn. Today in the U.S. most of us know from direct experience only sweet corn. But most of the corn grown in the U.S. is not sweet corn, but a variety known as Dent (because, when it ripens, it has a dent in the top—the teacher should definitely have some in the classroom!). Let the students taste the Dent—it’s nothing to get excited about because it is so mealy! What is it used for? It is largely fed to animals and processed into high fructose corn syrup that is a ubiquitous sweetener. Have some commercial corn syrup and, if possible, high fructose corn syrup, to taste; compare with maple syrup—the local, less refined sweetener!

*Resources:*

#### BOOKS

*Omnivore’s Dilemma* by Michael Pollan; this book gives a vivid and concrete picture of the development of industrial agriculture through the lens of corn.

*1491* by Charles Mann; Chapter 6 in this book gives a nice picture of the culture of maize (corn) cultivation by Native Americans.

## Day 6 — Conclusion

*Review and deepening of concepts:* From the past days’ consideration we can see a trend in modern farming to large farms that focus on one or two crops, the breeding of high-yielding crops that, however, also demand much water and fertilizer. Modern agriculture uses great amounts of resources (what all goes into the production of the machines, the use of the machines, and the fertilizers!). In addition, because one grows only plants of one type in large fields, and the modern breeds do not have great disease resistance, there are large pest problems. So big conventional farms spray lots of poisons (called pesticides) to kill insect pests and also to kill weeds. This all has consequences: For example, the runoff of pesticides and fertilizers pollutes rivers and the lower layers of water in the Gulf of Mexico are dying. Such are the environmental costs of our food, while the store prices remain low. (Here the government helps out with subsidies.)

*Review of the Food and the Evolution of Agriculture week:* The teacher and students review the evolution of food and agriculture they have discussed during the week:

- Gathering of wild plants
- Native American agriculture – the example of the three-sisters. This is an example of traditional ecological farming where different plants are planted together and support the growth of each other (called polyculture in contrast to monoculture)
- Row-crop agriculture. The beginning monocultures—planting one crop by itself in rows. When used on a larger scale the implements become more complex (e.g. plow) and more energy is used (for centuries horses and oxen, which the farmer needs to tend and feed)
- Industrial agriculture. Highly mechanized and the use of much energy for irrigation, fertilizer, pesticides, and tractors. The crops have been bred to be high yielding but the energy input is huge and the environmental effects are also greater (e.g. pollution of ground water and streams). Also the distances food travels become immense, which is an additional environmental burden

The pressing question arises: Are there alternatives to this way of producing food? That will be a major focus of the week in 8th grade, when the students explore urban gardening/farming in Detroit.

Based on an outline like the one above, which could be on the blackboard as a result of the class discussion, the students can make a final write-up of this central theme of the week.

### ***Activity 6: Preparing and eating the corn***

To end the block with a positive activity is important after all of this weighty material. Returning to the roots of food production and agriculture the students can carry out the following activity. The students take corn cobs (a native yellow corn works best) remove the kernels and grind them. Ideally the teacher would find a large flat piece of granite or other hard rock and use it as the surface on which to grind the corn with a roundish/oval hard rock. This would mimic the traditional method of grinding (see photo: [www.tradebit.com/filedetail.php/2637838v1358202-traditional-grinding-stone-for-the-production-of](http://www.tradebit.com/filedetail.php/2637838v1358202-traditional-grinding-stone-for-the-production-of)). Large stone mortars and pestles could also be used. The students can then cook a porridge and sweeten it with maple syrup. Also, the students could roast pumpkin seeds. (It is significantly more involved to prepare the corn and grind it to a flour for tortillas, so this is not recommended unless the teacher has lots of time to start the preparation on one day and finish on the next day. To prepare and grind corn for tortillas see: [www.gourmetsleuth.com/Articles/Homemade-640/make-masa-nixtamal.aspx](http://www.gourmetsleuth.com/Articles/Homemade-640/make-masa-nixtamal.aspx))

## **8TH GRADE: Urban Agriculture**

Students are divided among several urban gardens in Detroit during the week. The goal is for the students to experience firsthand gardening/farming in an urban setting. They will be involved in the day-to-day work of the garden and at the same time learn how urban agriculture could have, especially if more widely implemented, significant social, economic, educational, and ecological impact. In addition to the hands-on work during the week, they investigate the following questions for presentation to their class/group:

1. Who eats food from this garden? Where does it go and how does it get there? How many pounds of food are grown and how many people does it feed?

2. What crops are grown and why? What is the length of the growing season? Where do the seeds/starts come from?
3. Describe the cycle of crops grown in the garden: when planted, when harvested, etc. Is there some form of crop rotation?
4. What kind of technologies are used and not used in the garden:
  - Fertility/compost piles
  - Season extenders/cold frames, hoops, etc.
  - Watering
  - Pest control
  - Human beings: organization of labor, cooperation among gardeners
  - Tools/labor-saving devices
  - Raised beds
  - Etc.
5. What raw materials are used? Recycled?
6. What is the value of having urban agriculture? How is it different from rural areas?
  - What economy is produced from the garden activity?
  - Is it sustainable?
  - How does it connect to natural systems?
  - How does it connect to community building?
  - How would the energy and transportation costs change if more people in Detroit ate locally grown food?

On the last day of the week the students meet together and share their experiences and also their answers to the above questions. One suggestion would be that the students make a presentation to the parent body, a neighborhood group, or to other students about the significance of urban agriculture.

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This document: [www.natureinstitute.org/txt/ch/envir\\_cur2011.pdf](http://www.natureinstitute.org/txt/ch/envir_cur2011.pdf)

Whole curriculum: [www.detroitwaldorf.org/environmental-science-and-sustainability](http://www.detroitwaldorf.org/environmental-science-and-sustainability)