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Carbon Farming: Lesson Plan Recommended for Grades 8 - 12

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CARBON FARMING & AGROECOLOGY IN CALIFORNIA FARMLANDS

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CARBON FARMING
& AGROECOLOGY IN CALIFORNIA FARMLANDS

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KEYWORDS

- carbon farming
- agroecology
- adaptation
- soil carbon sequestration
- carbon cap and trade market

The mounting scientific evidence of climate change and predictions for the future (sea level rise, increasing droughts, flooding from extreme weather events, and global temperature rise) carries with it a need for human action. Both adaptation and mitigation are necessary action pathways upon which society must embark. Adaptation, or dealing with the inevitable changes already happening, is distinct from mitigation, which minimizes the predicted consequences through activities that reduce the concentration of greenhouse gases in the atmosphere. This lesson focuses on mitigation activities possible through the lens of agriculture, specifically agriculture practiced in an agroecological fashion. Many terms are used interchangeably when it comes to mitigating climate change on farmland, including climate smart agriculture, agroecology, and carbon farming.

Agroecology is the practice of agriculture in a way that mimics natural processes and takes an ecosystem approach to growing food. It is based on ecological principles such as:

- Minimizing waste via closed-loop systems
- Recycling nutrients and resources
- Maximizing biodiversity on farms

Agroecological lands are resilient, diversified farming systems that can produce large amounts of nutritionally-dense, environmentally friendly vegetables and animal products while minimizing off-farm inputs such as fertilizer, pesticides, and water imports. Common practices include:

- cover cropping
- integrated pest management
- combining hedgerows and perennial plants with annual crop production
- crop rotation
- intercropping
- composting

By composting on-site through animal manure recycled onto cropland, and building soil fertility that increases water-holding capacity, a range of co-benefits accrue. One of the benefits includes storing or sequestering carbon into well-managed soils. Soil carbon sequestration, also referred to as "carbon farming," is becoming a focus area for many California farmers, in part because of the Carbon Market that would allow farmers to sell carbon credits and receive additional income for providing carbon storage benefits to the state. In order to sell carbon credits, it is necessary to quantify the amount of carbon accumulation in soils, compared to a baseline that farmers must establish before they begin a carbon-

storing process (such as compost application, perennial planting, or no-till). Quantification is possible through soil testing and is becoming more widely available through tools like the USDA-COMET website (link below)- a voluntary carbon reporting platform for farmers and ranchers. Several farms in Northern California are actively sequestering and measuring carbon storage on their lands, including TomKat Ranch in Pescadero, and many farms in Marin that are participating in the Marin Carbon Project (in partnership with UC Berkeley researchers). Carbon farming, and associated soil fertility benefits, is becoming increasingly common and recognized as a "best practice" by farmers from Lopez Island, WA, to Kansas, who are eager to prevent another Dust Bowl through appropriate soil carbon management.

RESOURCES

Marin Carbon Project- Good example of a collaboration between researchers and rangeland managers to measure carbon benefits of compost application to rangeland, and reduction in greenhouse gases from manure piles when they are managed for on-site compost application.
>> http://www.marincarbonproject.org/

TomKat Ranch- Educational and demonstration farm project in Pescadero, CA, that takes a life cycle approach to raising cattle for beef production while restoring biodiversity and soil fertility on managed lands.
>> http://www.tomkatranch.org/

USDA-COMET Farm- A great resource that offers whole farm and ranch carbon and greenhouse gas accounting, developed in partnership between the USDA and Colorado State University.
>> http://cometfarm.nrel.colostate.edu/

Soil Solutions: a solution to climate change right beneath our feet- website providing evidence and videos on the process of soil carbon sequestration. Includes great video to show students, 4- min documentary narrated by Michael Pollan.
>> https://soilsolution.org/

Soil C 4 per Mille initiative- An initiative launched at COP21 in Paris to increase carbon in all world's soils by 4 parts per mille, or 0.4%.
>> http://4p1000.org/understand

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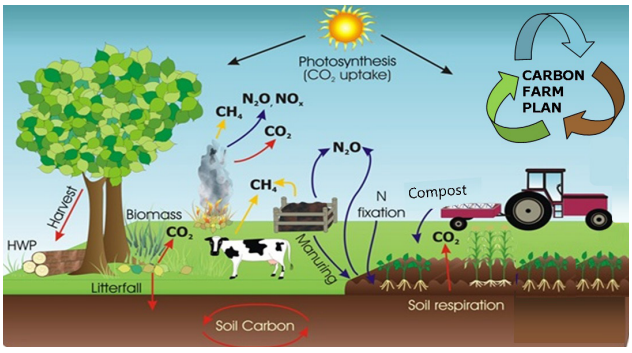
Think about the last meal you ate. Where did the food come from? It can be hard to tell, unless you grew the food for your last meal yourself, or purchased the food from a farmer's market or directly from a local farm. What is the environmental impact of our current food system, and how can we minimize impact through certain farming practices? Many farmers in California and elsewhere are considering this question and starting to farm differently. The practices go way beyond organic, into the realm of "agroecology."

Agroecology is based on the concept of agriculture mirroring ecological processes. The same basic principles that apply to healthy ecosystems are extended to farming: high biodiversity, recycling nutrients, and minimizing waste through closed-loop processes. Agroecosystems typically include plants and animals, so the manure from cows, chickens, sheep, pigs or goats can be mixed in with crop residues to create healthy compost piles that are then applied as a high quality soil amendment to crop rows. Applying compost as fertilizer that is generated on-site both reduces transportation costs and carbon emissions, and eliminates the need for the energy intensive practice of manufacturing fertilizers in large factories. Compost increases the amount of soil organic matter, nutrient bioavailability, and water-holding capacity of the soil. And, it increases the amount of carbon that is converted from CO_2 in the atmosphere (an abundant greenhouse gas linked to climate change) into soil carbon, which is a huge benefit from a climate mitigation perspective. Farming traditionally has been a source of carbon emissions, from tilling the soil and applying manufactured fertilizers, but agroecology shows how agriculture can be a carbon sink.

Farmers are working with researchers and scientists to quantify the amount of carbon they are storing in their soil, a practice known as "carbon farming" or soil carbon sequestration. If they can accurately estimate the total amount of carbon they're storing over time, compared to an initial baseline, they are not only reducing the concentration of greenhouse gases in the atmosphere, but they could make money selling "carbon credits" in states that have a Carbon Cap and Trade system. California has this kind of carbon marketplace, where farmers can sell carbon credits to industries or companies that are emitting carbon pollution. The idea is that once carbon has a price associated with it, companies will emit less of it in order to avoid costs and maximize profit. So, farmers and ranchers might have more interaction with economists, fossil fuel companies, and climate scientists than they might have thought when they first started raising livestock or crops on their farmlands.



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A few examples of farms in California that are already incorporating agroecology and carbon farming into their operations include TomKat Ranch in Pescadero, ranches in Marin participating in the Marin Carbon Project, and the UC Santa Cruz Center for Agroecology and Sustainable Food Systems (CASFS). These farms are all collaborating with academic researchers to enhance the impact of climate friendly farming practices. TomKat Ranch is an educational foundation established by a wealthy benefactor who believes strongly in grassland restoration, biodiversity, and sustainable beef production. The ranch is restoring degraded and overgrazed pastures, bird habitat, and watersheds on the property as well as growing vegetables hydroponically, raising grass-fed cattle sustainably, and hosting educational visits from local schools. The Marin Carbon Project is a collaboration between UC Berkeley researchers and ranchers in Marin who are applying compost to rangelands and measuring the soil carbon benefits, decreased greenhouse gas emissions from manure piles, and other metrics to quantify the climate benefits of compost application. The UC Santa Cruz CASFS is a farm on campus that teaches students about agroecology through demonstration and experience — students work on the farm and raise vegetables that are then sold to students and food venues at the university. There are many co-benefits to all of these operations — delicious food products and long-term benefits of mitigating climate change.

Everything you eat is an opportunity to make a positive environmental impact! Vote with your fork, and start to reduce the carbon foodprint (or rather, footprint) of your food consumption. This can be a delicious and nutritious experience, with widespread physical and mental health benefits. Visit or research your local farmers market or whole foods store to learn more about the farms nearest to where you live, and see if they too are incorporating carbon farming or climate friendly practices on their farm. Supporting small organic farmers by shopping at a farmers market or joining a CSA (Community Supported Agriculture) are great ways to make sure these kinds of farming practices continue to exist and scale up in the future. This is possible in both urban and rural areas; in more urban centers, look for opportunities to get involved in community or rooftop gardens to build green space (for carbon sequestration) in your city!

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DISCUSSION QUESTIONS

1. After watching the soil solutions video (https://soilsolution.org/watch-the-film/), what was the most surprising fact you learned about soil? Why do we want carbon in the soil but not in the atmosphere?

2. What is the connection between healthy soil and healthy food?

3. Does your school have a garden? If so, how can you build the soil fertility in your garden? If not, what would it take to get one started?

DISCUSSION QUESTIONS continued

4. Imagine you are a farmer. What are the competing priorities might make it difficult for you to implement climate smart practices on your farm? How can these challenges be overcome? (Hint: think about- cost of labor, labor intensive component of certain practices, pests, weather, yields, economies of scale, etc).

Bonus: What is the Farm Bill? What changes might you propose to make the farm bill more supportive of climate friendly agriculture practices?