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MS Interdisciplinary Studies

Problem Based task : The Big Challenge

Big Idea: The world's population is expected to increase by two billion over the next 20 years yet we are already struggling to feed everyone. Devise strategies to ensure equitable food distribution.

Focus: Changing patterns in agriculture & food systems

Years 11-12

Lesson	Duration	Lesson objective	Activity	Discussion / Brainstorming/ Teacher facilitation
1 Introduction What are the changes in food systems then and now	30mins	Students analyze both successes and problems associated with agriculture, food, and natural resources	The students brainstorm both successes and problems associated with agriculture, food, and natural resources today. Give each student a pad of post-it notes. Have them list problems and successes on the notes, one per note. Have them place their notes on a large flip chart sheet or chalkboard with the categories ECONOMICS, ENVIRONMENT, AND COMMUNITY written out. As each student adds a note, have them read it aloud to the class and explain which category they are placing it in.	Ask students to interview two people in their family or community. Interview one person who is 70 or older about the years around 1940. Also interview one person who is in their 40s, 50s, or 60s about the years around 1970. Ask each of these people to describe three things: What did farms look like at that time? What did main street look like and where did people get their food? and How was the quality of the environment? Ask students to answer these same three questions themselves about the local community now and record all three answers. Report findings to the rest of the class at the very beginning of Day 2
2 Where does our food come from?	60 mins	Students will begin to think about all the	Set the table" by placing a white paper plate and a piece of paper (as a placemat) at each student's seat.	Discuss what students found out from this exercise Possible discussion points:

		steps in the food system between the farm and their plates. Students will begin to realize the global nature of the food system.	Have the students draw what they had for lunch (or supper) on their plate. Then, on their placemat, have the students "map" where they think the food in their meal came from. To make things easier for the students you may have the "placemat" show a blank map of the US or the world Students should try to trace each part of their specific lunch as it moved through the food system from the farms where food was grown, through processing and distribution, to where the waste went.	We get our food from a global market – much of it comes from very far away. We don't usually know exactly where our food came from, or how it was grown or processed or transported. We rely heavily on government regulation, business responsibility, and the judicial system to ensure the safety of our food, because consumers usually don't have any knowledge of the specifics. The global food system relies a lot on energy from fossil fuels and produces a lot of waste.
3 How much of the field crops are used for human consumption?	60 mins	Students analyze the contribution of major field crops to their diet.	Advance preparation: Ask students to bring a week's itemized grocery receipt or shopping list Divide students into small working groups. Make sure each group has at least one grocery list to work with. Ask students what they think the major field crops of their state are. Explain that 3 crops (field corn, soybeans, and alfalfa) account for more than 79% of Wisconsin's cropland and more than 87% of Iowa's cropland. Ask students to: Identify which items in the week's groceries come from the 3 major field crops They can refer to the labels they brought in to get an idea of the role of these ingredients.	Little of the food we eat is directly supplied by our principal field crops. Field crops indirectly contribute to the food we eat as livestock feed used to produce dairy products, eggs, and meat, and as ingredients in processed foods. Corn sweeteners and starches, soy oil and stabilizers, and other additives derived from field crops are typically present in small quantities and add little nutritional value to a diet. For most people foods derived from field crops account for less than half of their diet—why is that when well over half of cropland is devoted to these crops? Ask if students can think of examples where principal field crops are also a major direct

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			Estimate the percentage of their diet supplied by the 3 major field crops, based on their findings from the grocery list. Assess the nutritional contribution of field crops to their diet. Have each group share its findings with the class and use class discussion to draw some broader conclusions.	component of the local diet. Do students' findings track with national statistics on use of field crops?
4 Food inequality	60 mins	Students will learn about unequal access to food in the world	Distribute the snacks to the students. Give two or three students a rich person's snack (for example fresh organic fruit and a fine pastry or chocolate). Give a third of the students a healthy middle class snack (for example crackers or bread, cheese, and carrot sticks) Give a third of the students an unhealthy middle class snack (for example donuts or cookies and soda) Give the rest of the students a poor snack (for example nothing or one piece of gum or half a cracker. You can use crumpled newspaper to stuff the bag) Begin the discussion with these questions: Which snack would the students prefer? Why? Ask them to rank the snacks in order of what they think their cost is. Which snack do they think would satiate them (fill them up)	Have the class discuss how this roughly represents food security?: about ten to twenty percent of the people can afford the finest foods (fresh, organic, carefully prepared), most people can easily afford enough food, but there are a lot of unhealthy options out there, and some people cannot afford enough food. Also, some poor people buy non-nutritious fattening foods because they are relatively cheap and very filling. Use the activity as a lead-in to present the information on hunger and obesity in the world in the background / lesson. Students brainstorm on what might be done to solve the problem of hunger in the world. Would producing more food solve the problem? Can private charity such as food pantries solve the problem? Do government food programs such as school lunches and food stamps solve the problem?

			the most? Which snacks are most nutritious? Let the class know what each of the snacks cost. Have the class discuss how this roughly represents food security in the US: about ten to twenty percent of the people can afford the finest foods (fresh, organic, carefully prepared), most people can easily afford enough food, but there are a lot of unhealthy options out there, and some people cannot afford enough food. Also, some poor people buy non-nutritious fattening foods because they are relatively cheap and very filling. Use the activity as a lead-in to present the information on hunger and obesity in the World in the background / lesson.	Are there other approaches students can suggest?
5 Will GMOs Feed the World or Are They Frankenfoods?	60 mins	Find out how much information students have absorbed from news stories and advertisements . Students will get an overview of the range of claims made about	**Advance preparation** : Have a place such as a flip chart or board to record the information. Have a page or column for each category Divide students in groups of. Ask students to brainstorm and list what they have heard about The benefits of GE crops The problems with GE crops Who is in favor of GE crops, and why Who is opposed to GE crops, and why And finally, if they can remember, where have they heard or read these things?	

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MS Interdisciplinary Studies

		GMOs by different groups.	Have the each group create its own table a Claims and Counterclaims table, using the claims related by students and	
6 Biotechnology an agricultural dilemma	60 mins	Students will research the types of genetically modified crop plants Students will examine the impacts of genetically modified plants on the environment	Distribute or ask students to download and read Dr. Altieri's article at http://www.actionbioscience.org/biotech/altieri.html Follow the reading with students brainstorming questions about the article in groups and sharing with the class	Describe three consequences of the spread of transgenes from genetically modified crops (GMCs) to related wild plants. What kinds of problems do genetically modified crops with transgenes pose for farmers who do not grow the altered crops? What are some pest management methods other than bioengineering that farmers can use? Give three examples of the rationale that biotechnology companies use to support the use of genetically modified crops. Why is crop diversity important?
7 Perspectives on Biotechnology	60 mins	Students will analyze the benefits and risks of genetically modified crop plants	Students are divided into four groups to research and create articles on GM foods <u>1. Biotech Agency</u> You and your partners have launched an advertising agency that specializes in biotechnology clients. Create a full-page newspaper ad that touts the benefits of genetically modified crops (GMCs). Use examples of GMCs in development that	Students explain and state their positions regarding their respective articles

			can help humankind, e.g., rice with built-in Vitamin A that can help prevent blindness in 100 million children suffering from Vitamin A deficiency. 2. Animal Protection Activist Your team belongs to an organization that wants to ban GMCs because of the potential harm they can have on animals. Research the evidence that has shown that: the declining monarch butterfly population may be linked to Bt crops being used in the United States or a native farm bird of Britain, the Skylark, was indirectly affected by the introduction of GM sugar beets designed to resist herbicides Then, get up in front of the class and state your position using your researched examples. 3. Fighting Superweeds Your team lives in an agricultural area and you are concerned by the possibility of superweeds taking over farmland. First, find out: What are superweeds and what are two ways that they can be developed? What are some strategies scientists are using to prevent the production of superweeds? Then, speculate how would you control	

			superweeds if they invaded most of the farm fields in your area. Write up a plan of action. <u>4. Agricultural Fair</u> Your team is assigned to educate the public attending the local agricultural fair. Your task is to: create a flyer or poster explaining the similarities and differences between conventionally-bred and genetically-modified crops use illustrations or other graphic explanations to make the message clearer for a non-scientific audience	
8 Fate of Biotechnology in a developing country	60mins x2	Students apply scientific information to resolve a societal issue	Students role-play taking part in a public meeting to determine the fate of agricultural biotechnology in India. Following roles are allocated in class • Biotechnology company 1, AgRice Ltd., representative (1 student) • Biotechnology company 2, NewSoy Ltd., representative (1 student) • Botanists (2 students) • Rural farmers in India (4 students) • United Nations World Health Organization (WHO) representatives (2 students) • Government of India (8 students) • Citizens of India (remaining students in	

			class) Each student carries out the following task- 1.Review the information on the Role Card for your role. Students with similar Role Cards should consult with each other before the debate is to begin. 2. Research background information on the Internet to strengthen your presentation before the meeting. 3. Begin the meeting with the biotechnology representatives, in the order listed above, with each biotech rep having 5 minutes to present the company's views to the Government and Citizens of India. Students representing the Government will time each speaker, cutting the speaker off after 5 minutes of presentation. 4. Farmers, Organizations, and Botanists can now pose questions to the biotechnology representatives. The Indian Government will hold the questions and responses to about 3 minutes per question & answer (let this dialogue run no longer than 30 minutes). 5. The Indian Government then asks citizens to indicate whether they are for or against	

			growing each Bt crop (someone can keep a tally of a head count where those in favor stand up). 6. The Indian Government representatives will consult, vote, and announce the vote to the Indian citizens, providing a short, clear rationale for each vote. 7. Indian citizens submit written comments of support or opposition to the government's decisions.	

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Role Cards

Rural farmer in India

Your job is to evaluate the merits of each of the genetically modified crop plants being investigated for

growth in India. The crops are:

• rice that is genetically altered to produce vitamin A

• a soybean that produces amylase inhibitor to kill only pest insects

You will listen to the testimony of three biotechnology company representatives speaking about their crops. Think about some questions to ask the representatives about the agricultural benefits and risks of their crops. You will have time after their presentations to ask questions.

United Nations World Health Organization (WHO)

Your job is to evaluate the merits of each of the genetically modified crop plants being investigated for growth in India. The crops are:

• rice that is genetically altered to produce vitamin A

• a soybean that produces amylase inhibitor to kill only pest insects

You will listen to the testimony of three biotechnology company representatives speaking about their crops. Think about some questions to ask the representatives about the health benefits and risks of their crops. You
will have time after their presentations to ask questions.

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Botanist

Your job is to evaluate the merits of each of the genetically modified crop plants being investigated for

growth in India. The crops are:

• rice that is genetically altered to produce vitamin A

• a soybean that produces amylase inhibitor to kill only pest insects

You will listen to the testimony of three biotechnology company representatives speaking about their crops. Think about some questions to ask the representatives about the environmental benefits and risks of their crops. You will have time after their presentations to ask questions

Biotechnology company 1 – AgRice Ltd.

Your job is to convince the Indian Government that your company's genetically modified rice plant is invaluable to India's future. Some points to consider:

• The rice is genetically altered to produce vitamin A in its grain for human consumption.

• A bacterial gene for vitamin A production was inserted using a plasmid.

• Vitamin A deficiency, often the cause of childhood blindness, is common in developing nations.

• It is inexpensive to grow in the field. You will be asked questions after your presentation is over.

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Biotechnology company 2 - NewSoy Ltd.

Your job is to convince the Indian Government that your company's genetically modified soybean plant is invaluable to India's future. Some points to consider:

• The soybean is genetically altered for human consumption to produce amylase inhibitor in its seeds.

• A plant gene for amylase inhibitor production was inserted using a plasmid.

• This particular amylase inhibitor stops beetles and other pest insects from eating stored soybeans.

• At least 60% of the stored soybeans can be ruined by insects.

• It is inexpensive to grow in the field. You will be asked questions after your presentation is over.

Government of India

Your job is to evaluate the merits of each of the genetically modified crop plants being investigated for growth in India. The crops are:

• rice that is genetically altered to produce vitamin A

• a soybean that produces amylase inhibitor to kill only pest insects

You will listen to the arguments of representatives from the biotechnology industry and concerns of farmers, the World Health Organization, the World Wildlife Federation, and botanists. You will also take a poll of your citizens by head count. You cannot ask questions. At the end of the meeting, you will make 3 decisions by voting on the acceptance or rejection of each crop.

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Citizens of India

Your job is to evaluate the merits of each of the genetically modified crop plants being investigated for growth in India. The crops are:

• rice that is genetically altered to produce vitamin A

• a soybean that produces amylase inhibitor to kill only pest insects

You will listen to the arguments of representatives from the biotechnology industry and concerns of farmers, the World Health Organization, the World Wildlife Federation, and botanists. You cannot ask questions. At the end of the presentations, you will decide where you stand on the growing of each crop, listen to the Indian Government's decisions, and submit written comments in support of or opposition to

Resources used for the lesson plan

Adapted from

http://www.cias.wisc.edu/

http://actionbioscience.org/biotech/lessons/altierilessons.pdf