

An Introduction to Cary Fowler and Crop Biodiversity

Standard(s): Human activity has consequences on living organisms and ecosystems.

7.4.3.2.3 Recognize that variation exists in every population and describe how a variation can help or hinder an organism's ability to survive.

7.4.4.1.2 Describe ways that human activities can change the populations and communities in an ecosystem.

9.4.3.3.4 Explain why genetic variation within a population is essential for evolution to occur.

Objective:

Students will be able to describe the basic elements of crop diversity and the value of archiving genetic strands of heirloom varieties of crops.

Type of Activity:

This is a preparatory reading of Dr. Cary Fowler, Ph.D., Director of the Global Crop Diversity Trust, with an introduction to his biography and basic concepts of seed saving and crop biodiversity.

Duration: 25-35 minutes

Timing in relation to Nobel Conference:

- pre-conference activity
- during conference activity
- post-conference activity

Recommended Prior Knowledge:

The students will need to be prepared to understand the underlying fundamental concepts of biodiversity and seed saving before attending the Nobel Conference 46 on “Making Food Good.”

Concepts, Connections, and Terms addressed in the activity:

- Biodiversity
- Seed saving
- What does it mean to be a species?
- What does it mean to be a variety?
- Future changing environmental conditions for growing food

Materials:

- Introductory reading and questions (pp 3-7)
- Website for Cary Fowler lecture on TED.com:
http://www.ted.com/talks/cary_fowler_one_seed_at_a_time_protecting_the_future_of_food.html
- Websites for the Global Crop Diversity Trust: <http://www.croptrust.org/main/>
- Website for Seed Saver Exchange: <http://www.seedsavers.org/>
- Website for Dr. David Tilman lecture, "Can We Feed the World and Save the Earth?" - Nobel Conference 46 Preview, May 14th, 2010, at Gustavus Adolphus College in preparation for the upcoming Nobel Conference 46 entitled "Making Food Good":
<http://www.youtube.com/watch?v=nGSXmrUcrss>

Description of Activity:

Fowler maintains the need to catalog varieties of seeds in preparation of changing global environmental conditions and an increasing need to feed more people on fewer resources. This activity is a combination of reading, watching an online video lecture and a series of questions for the students to address in light of Fowler's comments.

Procedure:

- Have the students read the following introductory articles and then answer the following set of questions.
- Watch the lead video on Cary Fowler at TED.com. Subsequent websites are listed to enrich and extend the activity.
- Lead an in-class discussion on the fundamental ideas presented by Fowler.

Assessment:

Responses of students on preview questions compared to post-view questions.

Extensions:

Additional websites are listed above on the Materials portion of this document, which can lead to extensions on this topic.

Background Information on Cary Fowler and Crop Biodiversity

Cary Fowler (born 1949, in Memphis, Tennessee) is the executive director of the Global Crop Diversity Trust, based in Rome, Italy. Previously, Fowler was Professor and Director of Research in the Department for International Environment & Development Studies at the Norwegian University of Life Sciences in Ås, Norway. Fowler holds a B.A. degree from Simon Fraser University in Canada, and a Ph.D. degree from Uppsala University in Sweden. He was given an honorary Doctorate of Law degree from Simon Fraser University. Fowler received the Right Livelihood Award with Pat Mooney in 1985 for his work in agriculture and the preservation of biodiversity. Following the massive media attention around the Svalbard Global Seed Vault, Fowler appeared on the CBS news show 60 Minutes and was profiled in The New Yorker Magazine.

From: http://en.wikipedia.org/wiki/Cary_Fowler, accessed June 15th, 2010.

“The Seeds of Evolution,” written by Cary Fowler in the February 16, 2009, edition of *The Guardian*

(<http://www.guardian.co.uk/commentisfree/2009/feb/16/charles-darwin-scienceofclimatechange>)

Climate change and other pressures on our food supply intensify daily. It's down to us to conserve the diversity of crops. The theory of evolution is a revolution in thinking that still reverberates around the world. Yet at its heart, it is so simple. As Thomas Henry Huxley famously lamented, "How extremely stupid not to have thought of that."

Darwin discerned that differences were heritable. Small, incremental improvements could be passed from generation to generation and changes could be accumulated, leaving the starting point far behind. Perhaps Huxley would have been even more self-critical considering that this was nowhere more evident than in the species on which we most depend – our crops. Little wonder then, that the first chapter of Darwin's monumental On the Origin of Species was entitled Variation under domestication.

Unlike wild species, crops are domesticated. Their fitness, their evolution, is in our hands and, as Sir Otto Frankel put it, "we have acquired evolutionary responsibility". Darwin understood that populations that made appropriate and successful adaptations survived and that those that didn't perished, and that agricultural crops were not exempt. He noted, for example, that certain crop varieties "withstand certain climates better than others" and in *Origin*, outlined a screening and breeding experiment, suggesting that someone sow kidney beans:

So early that a very large proportion are destroyed by frost, and then collect seed from the few survivors, with care to prevent accidental crosses, and then again get seed from these seedlings, with the same precautions.

Plant breeders are essentially doing this today on a large scale and with many crops. Drawing on the huge diversity of seed samples stored in gene banks, breeders expose plants to different conditions (heat, drought, a new disease) to find the adaptive traits for producing the new varieties that farmers will grow in the future. But if this genetic diversity is not conserved, if we lose the ability to make and accumulate those small changes so central to evolution, we will have removed one of Darwin's essential pillars of evolution – variation – and will have rendered selection impotent.

Climate change, and other pressures on our food supply intensify daily. Agriculture needs to respond with crop varieties adapted and ready to meet these challenges. There is no scientific obstacle to conserving the diversity of our crops, but the world's gene banks remain chronically underfunded. What better way to commemorate Darwin's life and work than guaranteeing that agriculture's evolutionary process can continue?

Barack Obama, in his inaugural address, said "What is required of us now is a new era of responsibility ... This is the price and promise of citizenship." For the world's food supply, good global citizenship requires us to embrace our "evolutionary responsibility." It remains to be seen whether we are prepared to pay its price.

“From Poison to Antidote: How a Crop Can Save the Day”, written by Cary Fowler in the February 17, 2010, edition of the *Huffington Post*

Bumping along in a Land Rover an hour's drive outside Addis Ababa, Ethiopia, Regassa Feyissa, former director of Ethiopia's national genebank, waved his arm towards the fields. "Everything you'll see today that's green is lathyrus". It was literally true.

What? Never heard of lathyrus?

In the words of Mahmoud Solh, Director-General of the International Center for Agricultural Research in Dry Areas (ICARDA), lathyrus is a "crop for all seasons." It is a traditional food of more than 100 million people in drought-prone areas of South Asia and Africa.

Lathyrus is also known as "grass pea." A beautiful little plant with white, pink or blue flowers, one of its numerous species is even sold in the U.S. and elsewhere as an ornamental -- the sweet pea. But you won't find it amidst the vegetables in a supermarket.

Lathyrus is as tough as it is beautiful. It survives drought better than just about anything. When every other food crop shrivels up and dies, lathyrus persists producing peas in a pod that resembles the sugar snap pea. It also survives floods. It takes heat, tolerates cold and thrives in incredibly poor soil. It wards off pests and diseases and even controls some weeds. With twice the protein by weight of wheat, lathyrus is nutritious. It's tasty too, eaten fresh (I tried some with Regassa in the field), roasted, made into a sauce, or ground into flour for baking.

The crop doubles as forage for animals and, because it is a legume, serves to enrich the soil with nitrogen. It doesn't need fertilizer.

The Dark Side

Lathyrus is a food for the poorest of the poor. It is a life-saver. In a severe drought, it can be the only food available. Since the poor cannot buy their way out of starvation, they eat what they have -- lathyrus. Therein lies the problem. Lathyrus offers a "Hobson's Choice," a choice that is no choice at all.

Grown for thousands of years, its dark side has been known at least for 2,400 years. Hippocrates even noted it. Lathyrus contains a powerful neurotoxin that becomes doubly concentrated in drought conditions. Eaten in quantity and over time, the toxin causes paralysis in the legs -- lathyrism. The paralysis is permanent and irreversible. Some of the poison can be leached out if the peas are soaked or boiled in water, but water is in short supply in a drought. And water used for leaching cannot be drunk afterward.

In regions where lathyrus grows, the poor can face the most difficult of choices -- starve or become paralyzed.

The poor know what will happen. But what can they do?

Victims of lathyrism, "crawlers", are numerous among the poor in Ethiopia, India, Bangladesh and Nepal where the affliction remains a present threat. One study in Ethiopia revealed an incidence of 7.5 cases per 1,000 in the population of one area. An epidemic in the 1970s left 1% of the population permanently paralyzed in the Gondar region.

Epidemics have been frequent throughout history touching developing and developed countries alike, including Afghanistan, Algeria, China, France, Germany, Italy, Russia, Syria, and post-war Spain. An earlier epidemic during Spain's war of independence from Napoleon inspired a drawing of its victims by Goya: "Thanks to the Grasspea Flour." An outbreak in a German concentration camp in the Ukraine during World War II affected 60% of its inmates.

Understandably, many countries over the years have made lathyrus cultivation illegal. But this approach has never worked. The poor continue to grow it for obvious reasons.

Their fate could be worsening. Climate change is predicted to affect marginal agricultural areas and poor people in Africa and Asia the most, increasing incidents of both droughts and floods. Occasions when the world's poorest people, the lathyrus eaters, will be confronted with one of the world's most awful choices, will multiply. Inevitably, the crop will compound the problem unless it becomes part of the solution.

Plant breeders at ICARDA, at Australia's Centre for Legumes in Mediterranean Agriculture (CLIMA), and in India's national agricultural research program are tapping major lathyrus collections at ICARDA and elsewhere to produce new varieties that retain the considerable positive attributes of the crop while eliminating the dangerous neurotoxin. Already the scientists are tasting success. With perseverance and sufficient diversity with which to work, they will

transform lathyrus into a potent ally of the poor in hard times and a more valuable crop in good times.

After 2,000 years as poison, lathyrus is poised to become antidote.

Questions:

1. What is crop diversity as described by Cary Fowler in each of the two articles?
2. Why would crop biodiversity be important in the development of new varieties of crops?
3. Why is it important to sometimes develop new varieties of crops on a global basis?
4. What are the 1st and 2nd most important and commonly planted crop(s) on a worldwide basis? (hint: they are both an important source of starch for a large majority of the human population)
5. How many different varieties of bean exist in the world?
6. Provide reasons as to why an obscure or “old” variety of a current modern crop is valuable to save?
7. Use any or all of these internet resources and then fill out the table below:

Global Crop Diversity Trust: www.croptrust.org/

Seed Saver Exchange: www.seedsavers.org/

Burpee Seeds and Plants: www.burpee.com/

The Victory Seed Company: www.victoryseeds.com/

The Territorial Seed Company: www.territorialseed.com/

- List a modern, popular variety of each vegetable, along with three heirloom varieties.
- Provide a unique phenotypic characteristic from each variety.

<u>Tomatoes</u>	<u>Unique phenotypic characterisitc</u>
<u>Corn</u>	<u>Unique phenotypic characterisitc</u>
<u>Peas</u>	<u>Unique phenotypic characterisitc</u>
<u>Cucumbers</u>	<u>Unique phenotypic characterisitc</u>

8. State a hypothesis as to why a certain characteristic was selected in one of the heirloom plant varieties.