

Review of a 4-H Youth Curriculum: Field of Genes, Making Sense of Biotechnology in Agriculture

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"As we deepen our imprint on the natural world,
we increase our responsibility for it."
Mahlon Hoagland. *The Way Life Works*,
(New York: Random House, 1995).

Teaching young children about the importance of the environment and taking care of the world is critical for the next generation. Addressing scientific topics allows children to stretch their thinking and learn to test hypotheses while discovering problem-solving and critical thinking strategies. These aspects of development are essential for youth. The 4-H youth program offers many opportunities to do just that. In North Carolina, [4-H](#) provides many resources for learning, but more importantly, encourages learning through hands-on experiences, club work, and camping.

[Field of Genes](#) is an online 4-H curriculum that is touted to boost students' enthusiasm and interest in the burgeoning field of biotechnology. This is a scientific area that can clearly support youth critical thinking. Please be aware that this reviewer is not well versed in the area of biotechnology, but does have knowledge of children's development. With that in mind, I ask the reader's forgiveness when the meaning of the scientific concepts is not well represented in this review.

The curriculum defines biotechnology as *simply using the biological processes to make things for humans. Bread, for example, is made using biotechnology. The biological activity of the yeast helps dough rise, creating a low-tech product with the help of active microorganisms. Since humans have been making bread for thousands of years, we could say that biotechnology is an old process. But today when discussing high-tech applications involving transferring genetic material between organisms, this process uses the tools of genetic engineering or recombinant DNA technology.*

This is complex science! Designing a curriculum for children 5 to 18 years old was no easy task. According to the leader's guide, the curriculum helps children ages 5 to 8 focus on understanding the living and nonliving parts of their world, and helps adults assist children in developing the knowledge base on which they will build values, skills, and actions. Children ages 9 and up continue to explore and understand genetics, biotechnology, and genetic engineering. Members of this age group examine social and scientific issues related to new technologies, as well as their personal values and those of others. Older youth also define, describe, and plan environmental stewardship activities related to biotechnology and the environment.

When looking closer into the activities for young children, it seems that the concepts and suggested activities are far and above the level of cognition for 5-to-8-year-old children. Many of the concepts are very abstract and complex for young, concrete thinkers. Some of the activities will be fun for children, such as the "Bubblin' Bread" in Chapter Four. However, clear understanding that sugar fed the dough to make the yeast rise would be sketchy at best.

Children are very inquisitive. A skilled leader can build on this explorative inquisitiveness using open-ended questions and an inquiry-based learning approach. In addition to understanding children's abilities and potential, the adult leader working with this project will need an extensive background with scientific concepts to address questions as they arise and assist children in searching for the answers. Many of the activities can be interesting if the leader has a clear understanding of the content, the right tools (microscope, collections), and the patient ability to guide inquiries into answers using concrete experiences. Some of the hands-on activities could be appropriate for children younger than 9 if they are subdivided into parts that are shorter than the suggested 45 minutes. Forty-five minutes is a long time for young children to stay with one activity unless there is one-on-one time with an adult to demonstrate, guide, use inquiry learning, and spark questions.

One section lists razor blades, tweezers, and eye droppers for an activity with 5 year olds. Razor blades, I assume would not be accessible. Tweezers and eye droppers are interesting to young children, but the children may need some practice to get their small hands to cooperate for the correct measurements. Simple practice making slides would be a precursor to actually understanding the cells within the onion skin to which the lesson refers.

The total curriculum seems better suited for the older child. And for much of the information, 9 years old is not old enough. One of the questions suggested for 9-to-12-year-olds to be posed by a leader is "What things are important to sustain in your life? " Sustain? This word alone would most certainly need to be defined and then explored. Leaders will need to be well versed in the scientific foundations, as well as child development expectations, when using this source.

Field of Genes is a wonderful compilation of information and seemingly best suited for children in middle school and high school. It would be a real find for a science teacher and offers many interesting lessons to explore. There is a final section that lists some very useful links to additional resources and information.

To make this curriculum material better suited to young children, I suggest that leaders consider a few concepts to be addressed and then determine a way to introduce those concepts in an intriguing way to spur their interest. When children generate questions, it is best to note the questions (even on large easel paper as they reel them off). The adult listens, then reflectively considers what interests the children. From this, many learning activities and even total curricula are often built. In child development, we call this process webbing. Here is an example using one of the activities from the current guide.

Chapter Four has a recipe for bread sticks. The recipe states: *Sprinkle yeast and sugar over warm water in a large bowl. Let stand until it starts to bubble.* This activity will surprise young children, and they will begin to ask questions. Note their questions, and ask them more. Here is one example of a possible dialogue.

Child: What is happening?

Leader: Wow? What do you think that is?

Child: Is it going to blow up?

Leader: We followed the directions. Let's check the recipe.

Child: Is it going to taste bad now?

Leader: We will have to wait and see.

Child: Why did it do that?

Leader: Do you think we added something that caused it to bubble?

Child: Yes -- one of these caused it to bubble. Which one?

Child: If we find out which one, let's leave it out next time!

Child: It might cause other things to bubble. Maybe we could add it to something else.

Child: Can we make bubbles from this? What else can we do with the bubble ingredient?

The leader has the interest of the children to experiment with yeast, and they are leading the way to scientific discovery. Simply put, knowing the science is not enough to teach it. Knowing the children will make the teaching far more productive and enjoyable!

Web sites:

North Carolina 4-H: <http://www.ces.ncsu.edu/depts/fourh/>

Field of Genes: <http://www.fourhcouncil.edu/ycc/ffg/FSCI.html>

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Cite this article:

DeBord, Karen. "Review of a 4-H youth curriculum: field of genes, making sense of biotechnology in agriculture." *The Forum for Family and Consumer Issues* 6.1 (2001): 12 pars. February 2001.