Bioenergy Science and Engineering as Components of Agricultural Education Curricula

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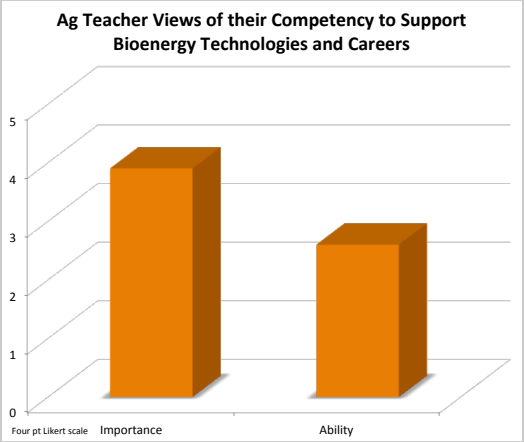
Summary

Bioenergy experts recommend the following concepts be taught in K12 settings:

1. Energy requirements
2. Energy consumption
3. Climate change
4. Nature of engineering
5. Energy fundamentals
6. Lifecycle assessment
7. Photosynthesis
8. Conversion principles
9. Chemical cycles
10. Ecosystems

These concepts provide a foundation for teaching new bioenergy crops to support the development of national energy security and a sustainable bio-economy (APLU Committee, 2010).



Introduction

Teaching about energy crops is new in the agricultural education field (Sallee, Edgar, & Johnson, 2013). Teachers recognize the importance of bioenergy careers but do not have confidence in their knowledge about these career choices (Christensen, Warnick, Spielmaker, Tarpley, & Straquadine, 2009). Additionally, teachers agree on the importance of biomass production and believe it should be taught in existing agricultural education classes (Han, 2014). However, curricula have not yet been developed to meet this need (Acker, 2008).

Goal

Determine key concepts important for teaching bio-energy to K-12 students.

Methods

Three round expert Dephi Study with a panel 21 scientists, engineers, and educators participating in the Agriculture and Food Research Initiative (USDA) bioenergy program. Out of 84 panelists approached, 21 participated in the study and 9 complete all three rounds.

Concept	Rating*	SD
Energy Requirements Quantity and type of energy needed	4.88	.35
Energy Consumption Current and historical energy sources	4.88	.35
Climate Change Historical record and consequences	4.88	.52
Nature of Engineering Role of engineering in bioenergy	4.62	.52
Energy Fundamentals Work, energy, conversions	4.63	.52
Lifecycle Assessment Environmental impacts cradle to grave	4.50	.52
Photosynthesis How light energy is stored in plants	4.38	.46
Conversion Principles Types of conversions	4.38	.52
Chemical Cycles Water, carbon, nitrogen cycles	4.25	.35
Ecosystems Ecology and human impact	4.25	.52

*Five point Likert scale

Importance

- Heavy emphasis on applied science (engineering) – Four of the top Five concepts (colored blue)
- Highlights value in understanding basic energy principles
- Includes key concepts linked to agriculture such as photosynthesis and chemical cycles.
- Supports curriculum development
- Enhances teacher confidence in their ability to teach bioenergy – Many of the concepts are covered in traditional Ag STEM classes
- Teaches principles of the sustainable bio-economy
- Aligned with National Research Agenda

References

Association of Public and Land-grant Universities (APLU), Experiment Station Committee on Organization and Policy—Science and Technology Committee. (2010). A science roadmap for food and agriculture. Retrieved from escop.ncsu.edu/docs/scienceroadmap.pdf

Acker, D., & National 25x'25 Agriculture/Forestry Steering Committee (2008). Research and Education Priorities in Agriculture, Forestry and Energy to Achieve the 25x25. *North American Colleges and Teachers of Agriculture Journal*, (March), 55–59.

Christensen, J., Warnick, B., Spielmaker, D., Tarpley, R., & Straquadine, G. (2009). Agricultural in-service needs of introductory level career and technical education teachers. *Journal of Agricultural Education*, *50*(4), 1-13. doi: 10.5032/jae.2009.04001

Han, G. (2014). *Perceptions of secondary school agriculture teachers regarding biomass production education in Iowa* (Unpublished dissertation). Iowa State University, Iowa.

Sallee, C. W., Edgar, D. W., & Johnson, D. M. (2013). Student perceptions of instructional methods towards alternative energy education. *Journal of Agricultural Education, 54*(2), 130–142. doi:10.5032/jae.2013.02130