Linking the Science in Your Classroom to Career Paths for Your Students

KATS Kamp 2022 – Olathe, KS

HELLO!

Kimberly Williams, kwilliam@ksu.edu
- Horticulture faculty at K-State – Manhattan
- Parent of a sophomore at Manhattan High School who loves science (except physics)
- Huge, huge fan of Rockstar teachers!
The Plan

✓ How I landed here today
✓ Building blocks for career development
✓ 4 promising approaches to infuse career awareness into science classrooms
✓ Share ideas!

How I landed here today

- The bleak reality of youth choosing horticulture as a career path
- New graduates fill only 61% of available jobs (2015)
- National survey revealed that 54% of respondents (n=487) consider Horticulture Awareness the biggest challenge facing these industries

How I landed here today

- Involved with FFA at state and national levels, but broader and wider student exposure to horticulture as a career necessary

Teaching Methods

Relationship between High School Student Participation in State-level Future Farmers of America Career Development Events and Matriculation at the Host University: A Case Study in Horticulture at Kansas State University

Kimberly A. Williams¹, Chad T. Miller², and Ward Upham³

²Southern Illinois University, Birdsboro, IL, USA

³University of Illinois

How I landed here today

- USDA-SPECA Award granted: Online Modules for High School Teachers that Hybridize Horticulture and Science Curricula while Promoting Horticulture as a Career

USDA

National Institute of Food and Agriculture

Secondary Education, Two-Year Postsecondary Education, and Agriculture in the K-12 Classroom Challenge Grants Program (SPECA)
How I landed here today

- KATS Kamp (and three other) surveys in 2018-19

Science teachers somewhat agreed (4.52±1.25 out of 6.0) that they were familiar with careers in horticulture in which the knowledge of STEM concepts is critical.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Response Mean</th>
<th>Response Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently teach...</td>
<td>5.03±1.13</td>
<td>3.90±1.14</td>
</tr>
<tr>
<td>Ag Teachers (n=63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Teachers (n=22)</td>
<td>3.10±1.29</td>
<td>2.70±1.49</td>
</tr>
<tr>
<td>...about careers in horticulture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...content related to cutting-edge tech. in horticulture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

KATS Kamp survey 2018

<table>
<thead>
<tr>
<th>Statement (n=22)</th>
<th>Science and Technology in Horticulture(^1)</th>
<th>Hydroponic Food Production</th>
<th>Light Quality and Plant Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposed instructional unit would be innovative and novel</td>
<td>5.2±0.60</td>
<td>5.3±0.65</td>
<td>5.5±0.52</td>
</tr>
<tr>
<td>Easy to adopt</td>
<td>4.4±1.51</td>
<td>4.4±1.50</td>
<td>4.9±1.16</td>
</tr>
<tr>
<td>Fit well with the Next Generation Science Standards</td>
<td>5.2±0.98</td>
<td>5.4±0.67</td>
<td>5.5±0.52</td>
</tr>
<tr>
<td>Relevant to students’ everyday lives</td>
<td>5.6±0.52</td>
<td>5.4±0.67</td>
<td>5.4±0.51</td>
</tr>
</tbody>
</table>

\(^1\) 1=Strongly disagreed, 6=Strongly agreed.
How I landed here today

- Pandemic
- Daughter in Noah Busch’s freshman biology class at Manhattan High School
- Storylines!!!

Horticulture Storylines

- hnr.k-state.edu/horticulture-storylines/index.html
Horticulture Storylines

- hnr.k-state.edu/horticulture-storylines/index.html

Overview: These lessons explore a phenomenon associated with light quality and its role in development of purple lettuce leaf color and plant morphology. Lessons may augment modules in, for example, Photosynthesis or the Biology of Skin Color (Melanin), and serve as a way to introduce careers in controlled-environment horticulture to high school students. The storyline uses data sets from published research.

<table>
<thead>
<tr>
<th>Lesson &amp; Question</th>
<th>Student Activities and Key Resources</th>
<th>Vocabulary</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What inputs for plant growth can be managed when plants are grown in a greenhouse or plant factory?</td>
<td>Introduction videos: <a href="https://www.youtube.com/watch?v=Ov6u6aBbS0c">Hydroponics</a> Discovery Channel, how it’s made (4.45) or <a href="https://www.youtube.com/watch?v=Vmcg999p1Ec">Verticle Farm</a> <a href="https://www.youtube.com/watch?v=1G60l50RI0I">Introduce plant factories (vertical farms, controlled environment agriculture):</a> Vertical Farms Could Take Over the World</td>
<td>Hydroponics, Plant factories, Vertical farms, CEA (controlled environment agriculture)</td>
<td>Developing and using models</td>
</tr>
</tbody>
</table>

Horticulture Career Resources

- hnr.k-state.edu/horticulture-storylines/careers-and-technology/
Colleagues
Chad Miller
Michelle Kjer
Noah Busch
Gaea Hock

Brave Beta Tester
Science Teachers
Shannon Ralph
Liz Lusher
Andrew Ising
Noah Busch
Jenny Karr
Robert Hamilton
Benjamin George
Brad Fabrizius

Student acquisition of science career information is “random” at best…Science teachers play an increasingly important role in encouraging students to explore science-related career options.

Cohen and Patterson, 2012. The Emerging Role of Science Teachers in Facilitating STEM Career Awareness.
Cognitive-Behavioral Building Blocks of Career Development

- **AWARENESS**: understanding STEM careers (e.g. skills & education needed)
- **RELEVANCE**: students find content meaningful
- **ENGAGEMENT**: students show interest in learning & experiencing more
- **SELF-EFFICACY**: students develop confidence & comfort using tools of science

Horticultural Careers

Aerial Applicator
Aeroculture Specialist
Agricultural Engineer
Agronomist
Application Designer
Aquaculture Specialist
Aquatic Botanist
Arborist

Horticulture Careers

Horticulture is the art, technology, business, education and science of plants. It is the food we eat, the landscapes we live and play in, the environments we thrive in. It is the business of managing and using what we grow, while maintaining the health of our soil, air, and water, and the well-being of our children, our communities, and our world. In short - it's all about plants!

There are hundreds of career pathways. Here are some of them to get you started exploring. Click on your interest below to show a list of plant careers in that area. And, at the left is an alphabetical list of careers in horticulture.

Click on any one of them to learn more.

www.teachfoodscience.org/

Looking for more resources?
Get great resources designed with you in mind.
Find Them Here
4 promising pedagogical approaches to infuse career awareness into science lessons

1 Incorporate both formal and informal approaches
Infuse in existing units, not as a separate unit
e.g. Horticulture Storyline

6.6b Effects of Light

1. Explore

Based on a conversation that we had at the end of 6.6a, it seems that we think maybe would could SAFELY explore the effects of light on organisms IN the classroom by taking closer look at plants. Watch the following video and engage in a class discussion about the future of farming.

Help students see scientists as real people

Aids students in envisioning themselves as a scientist
e.g. Horticulture Storyline

7. Future thoughts?

Interested in the things that we discovered in this lab. Want to know more about becoming a horticulturist? Check out this interview with Dr. Meng!

Zoom in guest speakers from a variety of careers

- E.g. Biomedical careers
  - County crime scene investigator
  - Person with a disease who can discuss all the scientists who helped them
“Ask an Expert”

- [https://www.ag.k-state.edu/outreach/ask-an-expert/](https://www.ag.k-state.edu/outreach/ask-an-expert/)

**Connect the dots**
Make explicit connections for students
We can’t assume that just exposure to information on scientists or science careers will translate to career motivation. It is important to connect the dots.

Cohen and Patterson, 2012. The Emerging Role of Science Teachers in Facilitating STEM Career Awareness.

Discuss individual jobs relevant to each unit

- E.g. In studying cholera epidemic in 19th-century London, set the tone by telling students they “will all be epidemiologists for the next two days.”

- E.g. Talk informally about what it would be like to do this kind of work for a job, such as what it would be like to work in a Biosafety Level 4 Lab after showing a film on Hantavirus
Incorporate authentic research

5. Investigation (Day 14 - ?)

At this point in time you will move 2 of your cups to 2 different types of light that you would like to experiment with (see list below). Sorry! You only have enough funding to experiment with 2 of the 4 different lights available! Why not move all 3 cups?

Check out Dr. Qingwa Meng from the University of Delaware discuss with Dr. Kimberly Williams from the Kansas State University published research on this very topic. This might help provide some light insight!

- Types of light
  - LED lamp with high blue and UV-A spectral quality
  - Desk lamp with 50% UV-B bulb
  - LED lamp with high red/far-red spectral quality
  - Desk lamp with red/far-red bulb

Design a data table that can be used to gather data from this point forward. There is no set amount of time that this may take.

Incorporate authentic research

- Jenny Karr’s classroom at Manhattan High
Incorporate authentic research

- Apply to skills necessary for specific careers

**Light Quality Lab**

**Background:**
We have been growing plants in the garden for a quarter, but what makes some plants green, others red, and some orange? Remember back to biology class when you learned about photosynthesis. Photosynthesis is the method plants use to convert light energy to chemical energy:

\[ 6CO_2 + 6H_2O + light \rightarrow C_6H_{12}O_6 + 6O_2 \]

Also recall, visible light is only a small part of the electromagnetic spectrum. Visible light starts at about 400 nm with blue light and runs through the rainbow until red light at about 740 nm. Chlorophyll I uses blue and red light for photosynthesis. Other, auxiliary pigments, use light at other wavelengths. One such pigment is called Anthocyanin. Anthocyanin gives plants a red or purple hue. Many believe purple and red fruits, like blueberries, beets, and blackberries, have health benefits due to their high anthocyanin concentration.

**Procedure:**
Week 1:
- Dissolve one fertilizer packet into one gallon of water

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**e.g. Horticulture Storyline**

- CER:
  - **Claim**
  - **Evidence**
  - **Reasoning**

6. Conclusion (Day 2):
Develop a CER whiteboard to answer the question: How can we make our green leaves look purple?

<table>
<thead>
<tr>
<th>How can we make our green leaves look purple?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Claim</strong></td>
</tr>
<tr>
<td>Colored</td>
</tr>
</tbody>
</table>

Let’s take a moment and see what Dr. Ming found out while conducting his research.

**Interview with the Scientist**

How does your research compare to that of Dr. Ming? Hopefully, you have some insight as to how to make plants purple, but did you find out any other information that might help your vertical farm? Were there any other advantages/disadvantages to changing lights? Think about the data you may have collected; not just color information. How can we relate this learning back to human diet choices?
4 Embed reflection

Reflection & exploration

- E.g. Share your personal experiences
- E.g. Extra-curricular activities like Envirothon connect students to careers that are off-the-beaten-track
THANKS!
Resources e-mailed for posting

What works for you?
Share your ideas!