

# Cultivating your English Vocabulary through **STEM** Activities



Kevin J. Spence

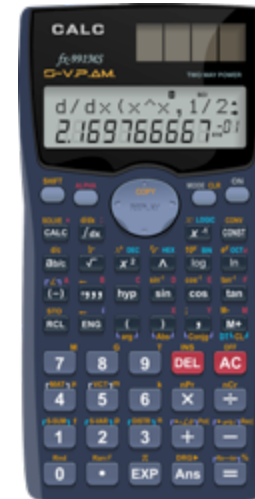
# Webinar Goals

- **Define** STEM English and examine how it relates to other key English language teaching concepts
- **Demonstrate** how to use Inquiry-based Instruction to teach STEM content – especially vocabulary
- **Explore** how to apply vocabulary learning strategies in the classroom



# What is STEM English?

**S**cience  
**T**echnology  
**E**ngineering  
**M**ath



## STEM English

**STEM English** is also referred to as

**STEAM** (Science,  
Technology,  
Engineering, the  
**ARTS**, and Math)



**STEMM** (Science, Technology,  
Engineering, Math, and **MEDICINE**)

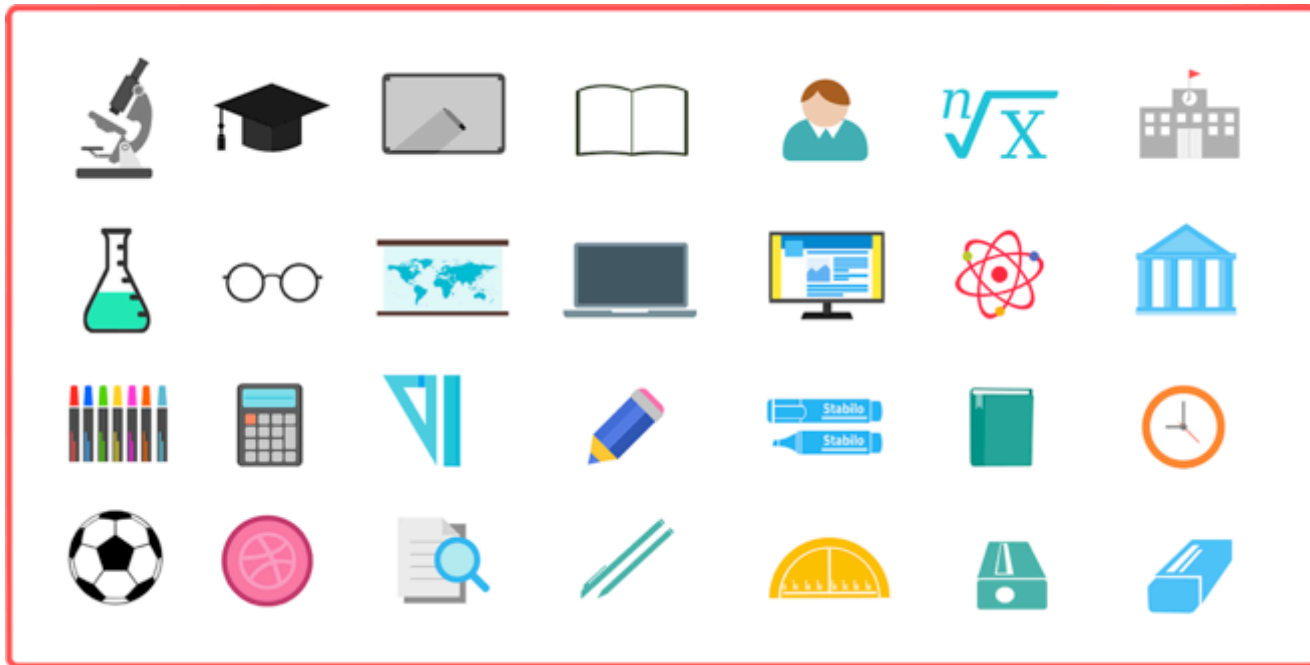


# What is General English?



# What is English for Specific Purposes?

English for Specific Purposes is also called ESP



Let's take a poll!

# STEM and ESP - Similarities

- STEM

Science, Technology, Engineering,  
and Math



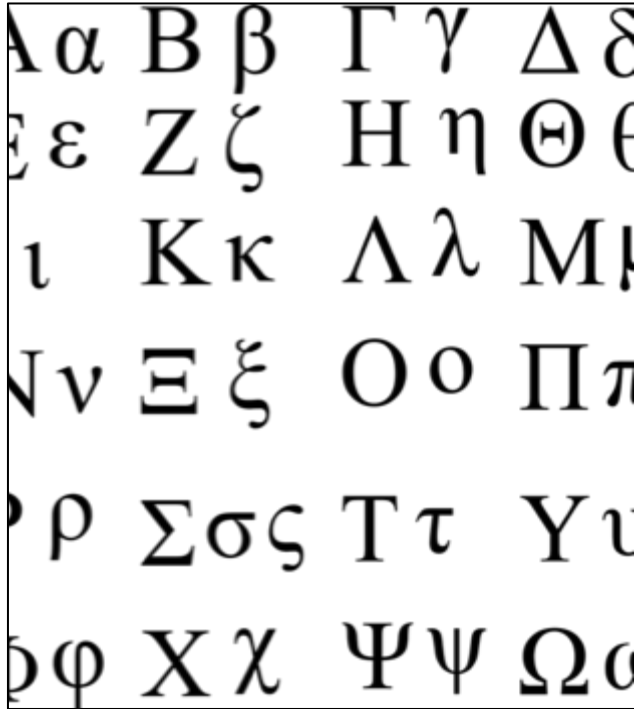
- ESP

English for Specific Purposes

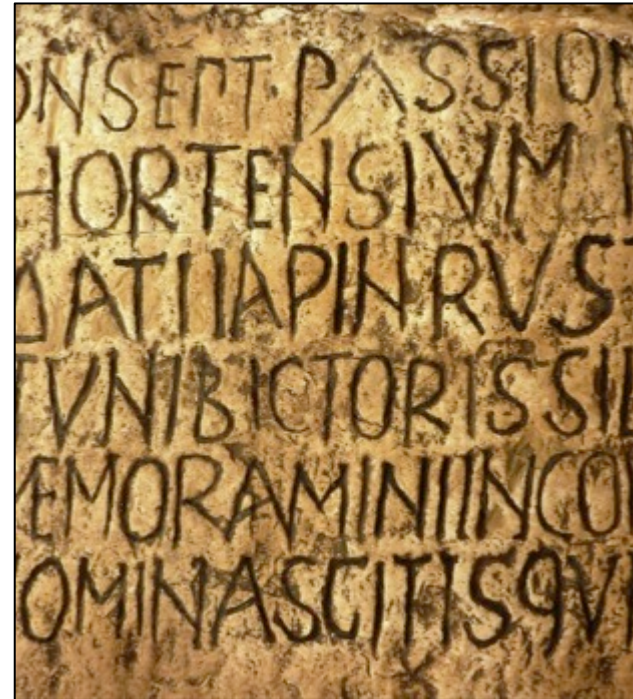


**Let's take a  
poll!**

# STEM English is different from General English



**Greek words**



**Latin words**



# Other examples of Greek or Latin words in English

**Bio** –  
life

*Autobiography* – a book about a person's life written by that person

*Biology* – the study of life

*Photobiology* – the study of light (photo) and life

**Rept** –  
to crawl

*Reptile* – cold-blooded animal with scales that often crawls

*Crept* – to crawl  
(past tense)

*Surreptitiously* – to do something in a sneaky way, like a crawling animal

**Geo** –  
of the earth

*Geology* – the study of the history of the earth

*Geography* – the study of physical features of the earth

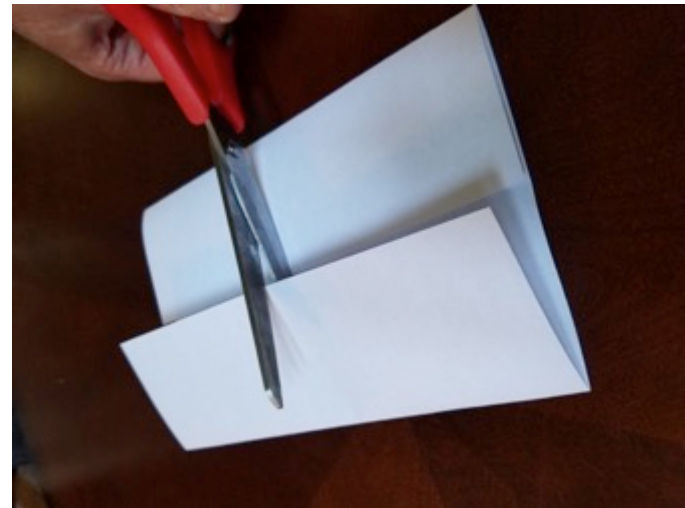
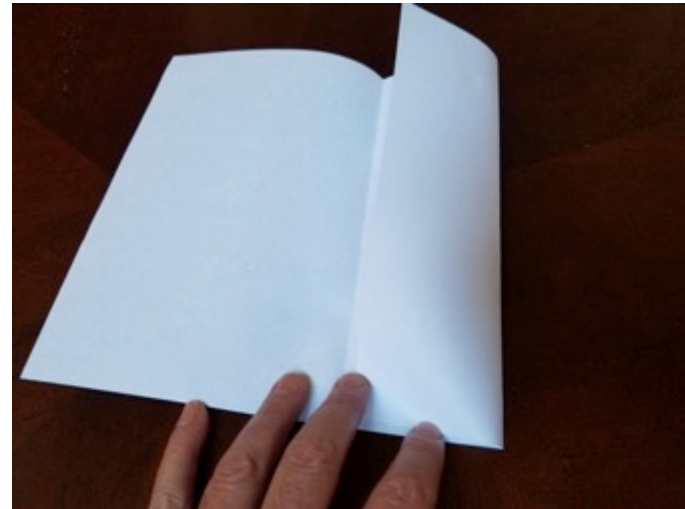
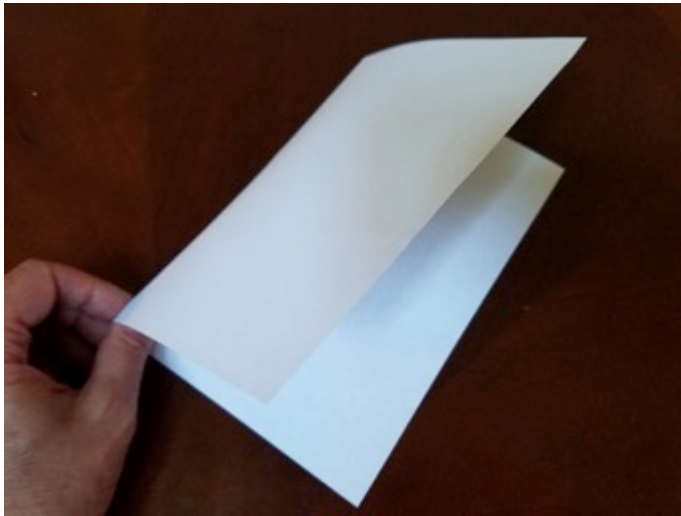
*Geopolitical* – international relations (of the earth)

# **STEM Lesson - Hydroponics and Vocabulary**



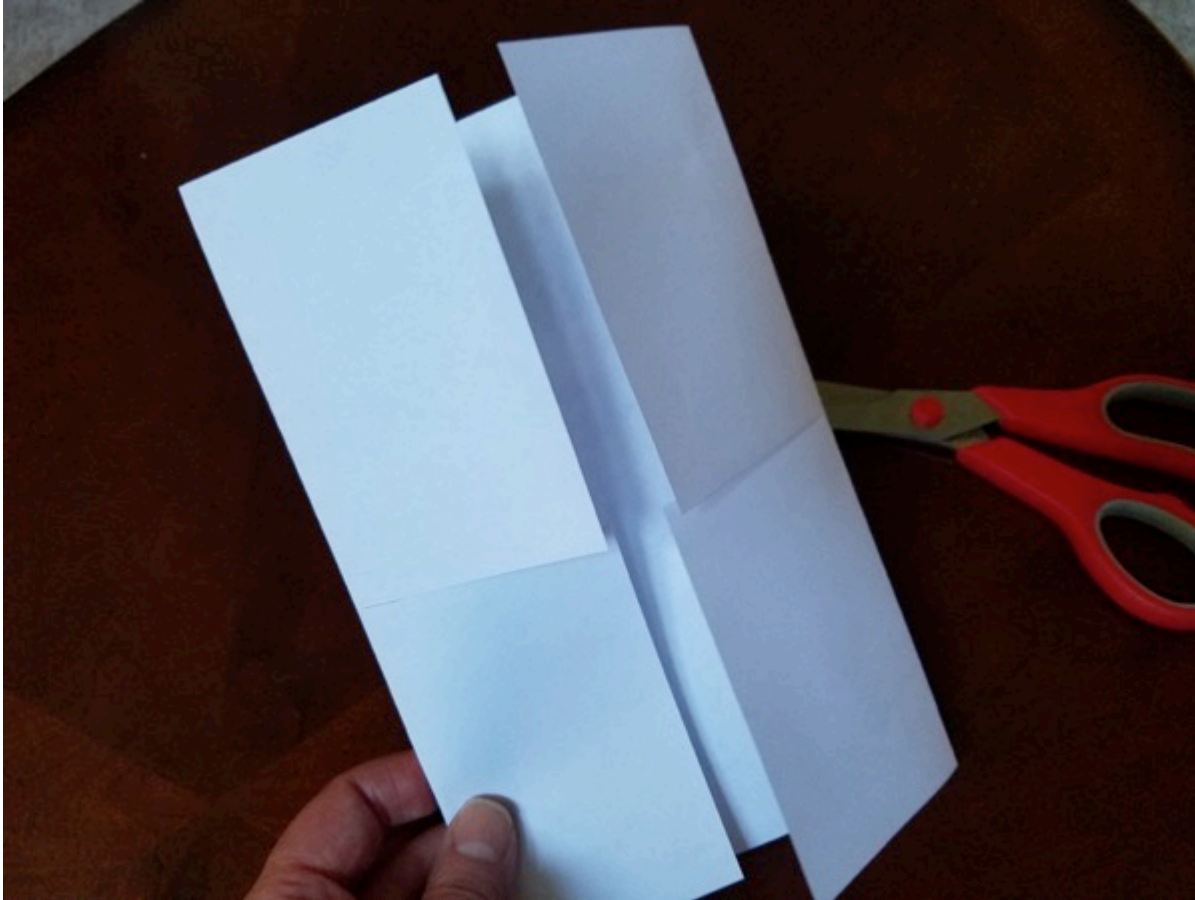
# Vocabulary Activity

## How to make a foldable vocabulary book

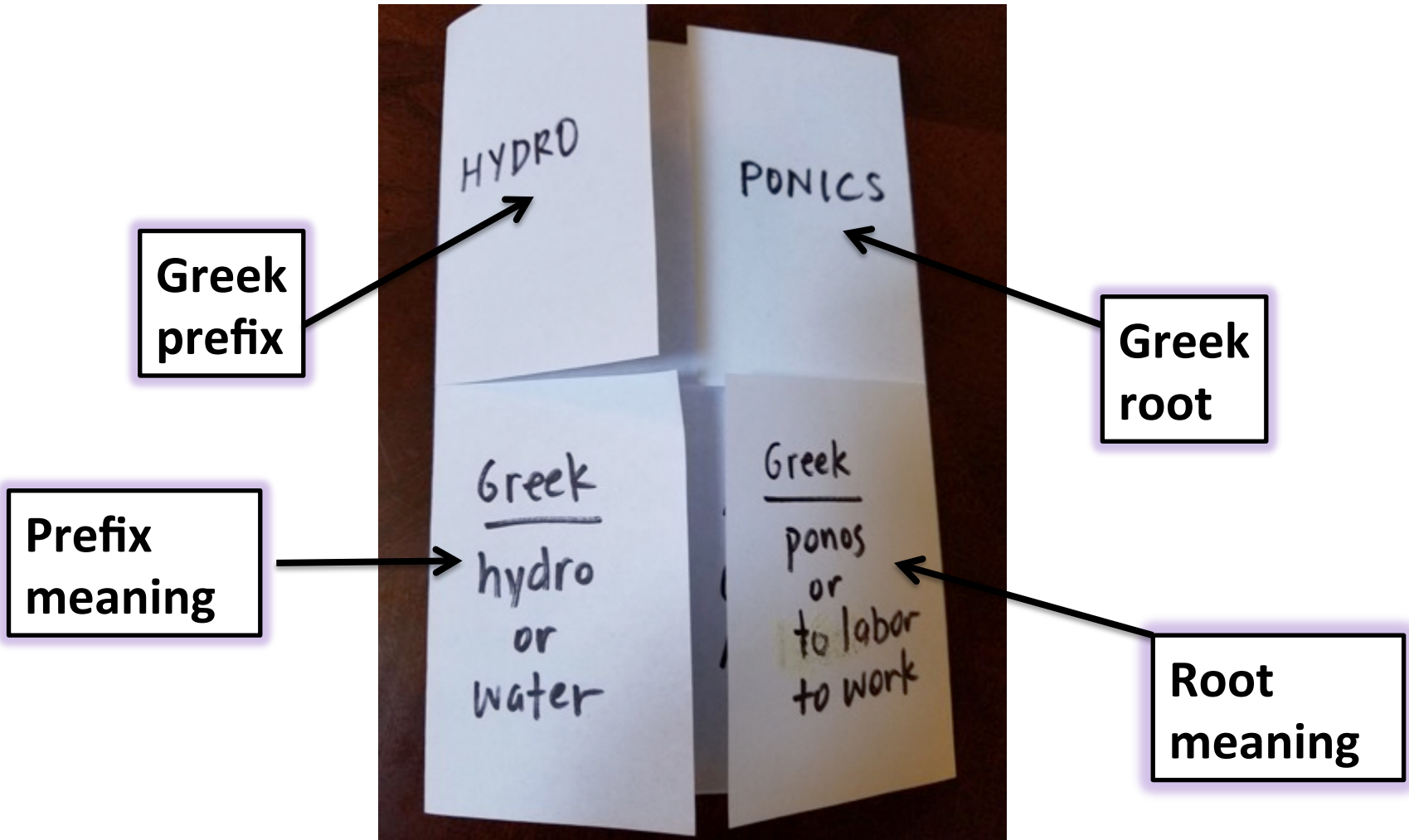


# Vocabulary Activity

## How to make a foldable vocabulary book

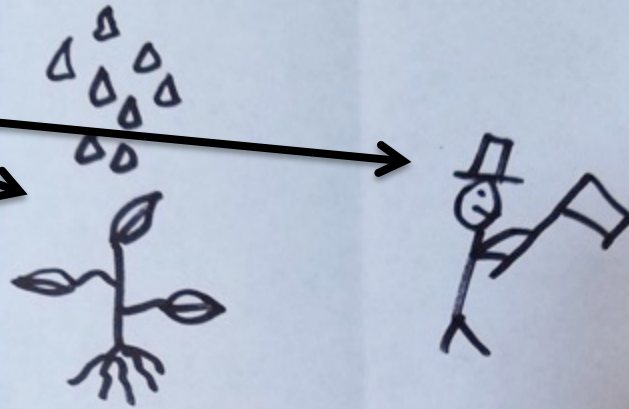


# Help students write in their new vocabulary foldable!



# Help students write in their new foldable!

Draw a picture of the word



A list of related words (hydro-)

hydrate  
dehydrate  
rehydrate  
hydration

Aeroponics

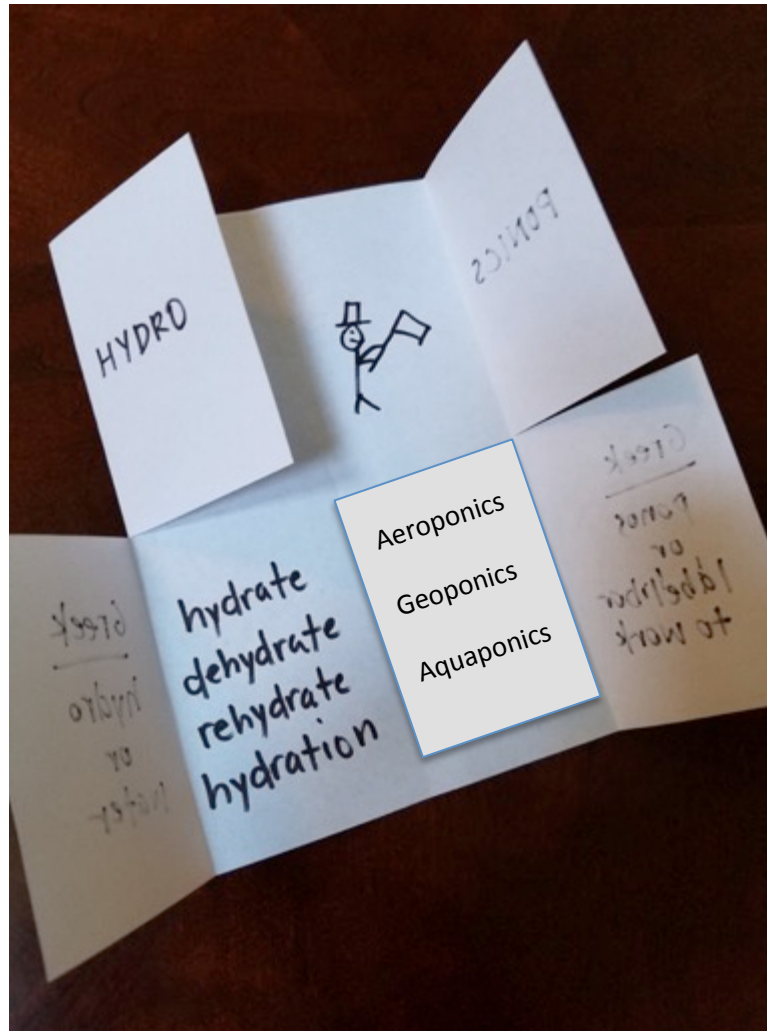
Geoponics

Aquaponics

A list of related words (-ponics)



# Your new foldable vocabulary page is complete!



# What is Content-based Instruction?



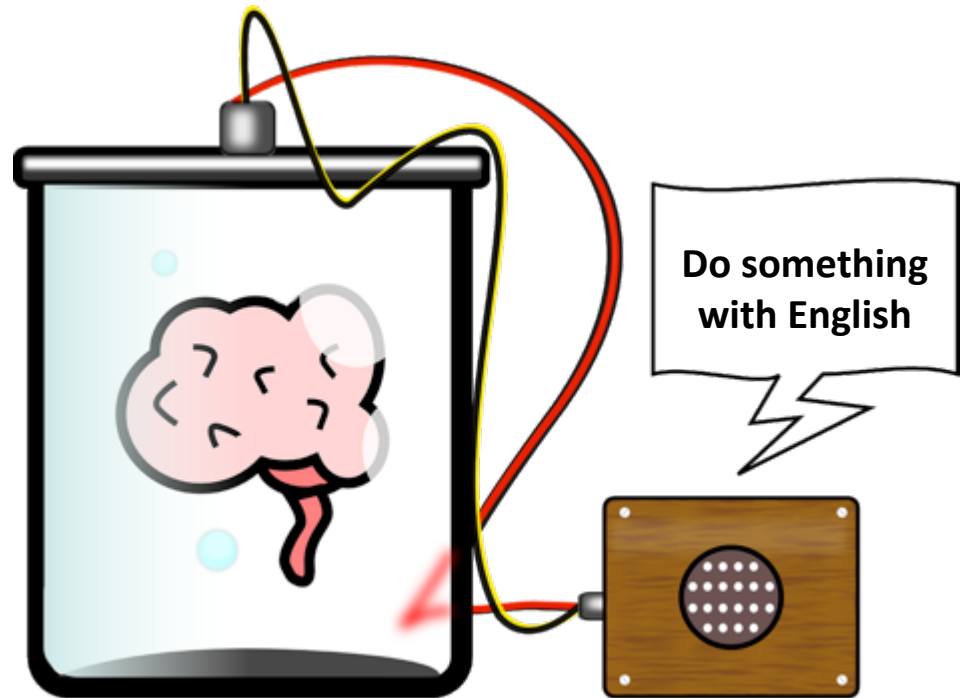
- **Meaningful**
- **Relevant content**
- **Contextual**
- **Authentic materials**



# More about Content-based Instruction

**E N G L I S H**

**WITH  
TASKS**



# More about Content-based Instruction



# 5 Steps for Creating Inquiry-based Instruction (The 5 E's)

1. ENGAGE



2. EXPLORE



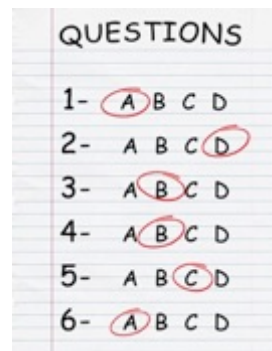
3. EXPLAIN



4. ELABORATE



5. EVALUATE



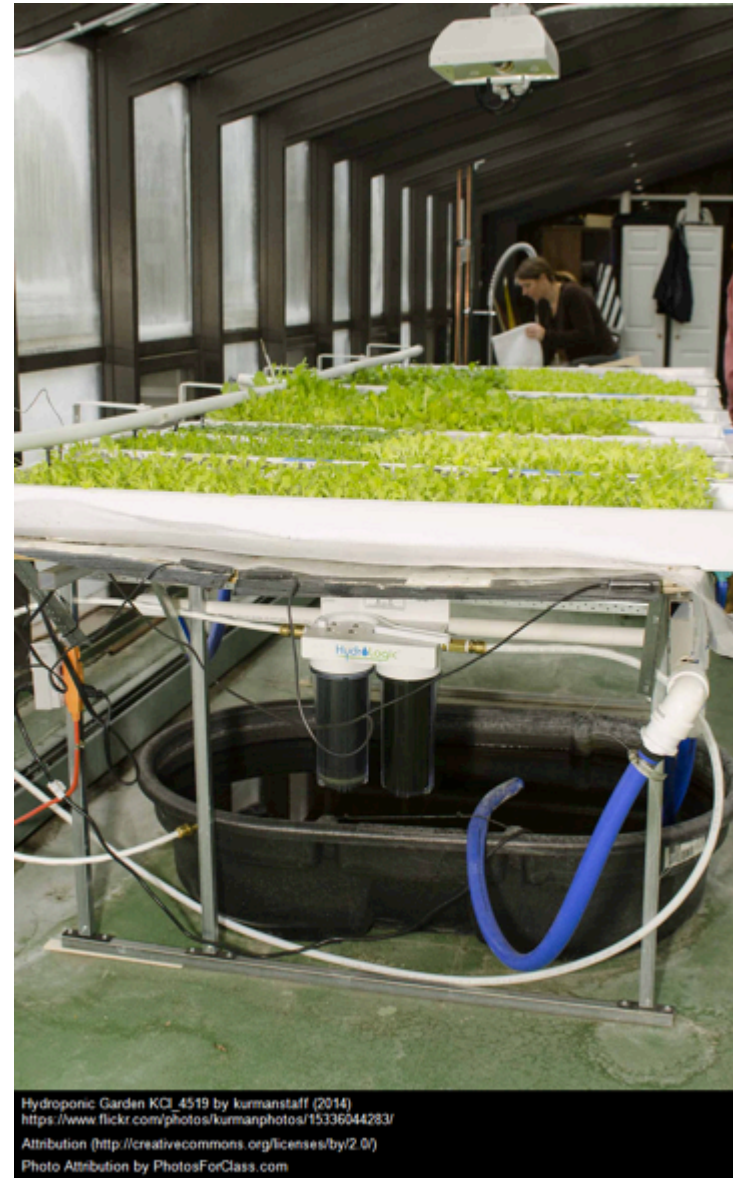
# 1. ENGAGE



- Curious students
- Background knowledge
- Personal connections
- Visual aids



# 1. ENGAGE - ACTIVITY



# 1. ENGAGE - ACTIVITY



K-KNOW	W-WANT TO KNOW	L-LEARNED
		Kinds of agricultural techniques in my country
Local vegetables		
	What are useful words to describe hydroponics?	

## 2. EXPLORE

### Cooperative Learning

- Investigate
- Observe



# Fun ways to group students



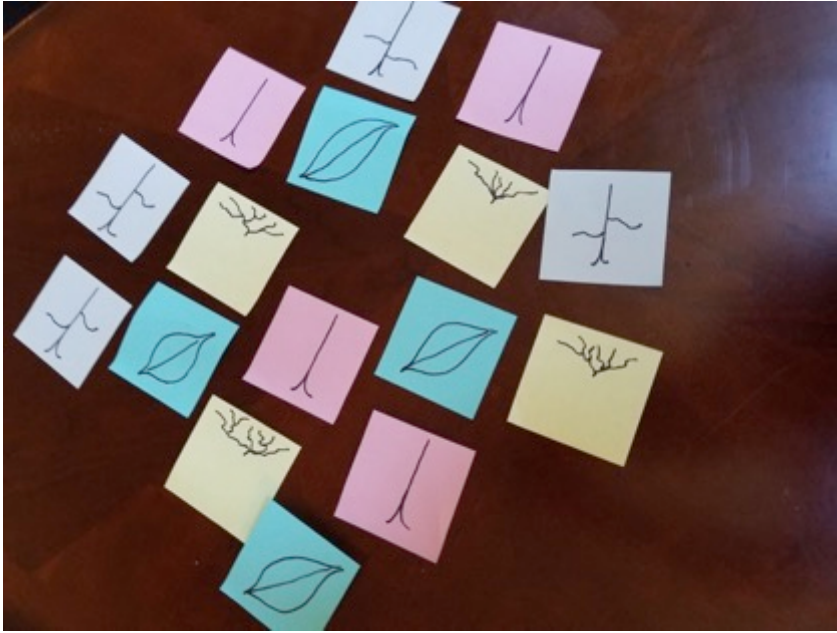
**1. Pass out a different colored piece of paper to each student**



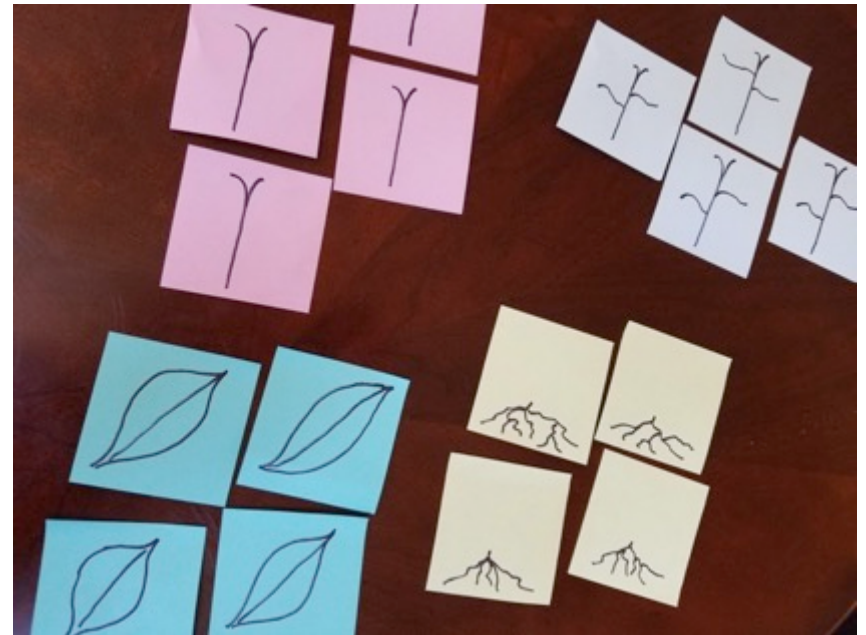
**2. Direct students to different corners of the room**



# Fun ways to group students

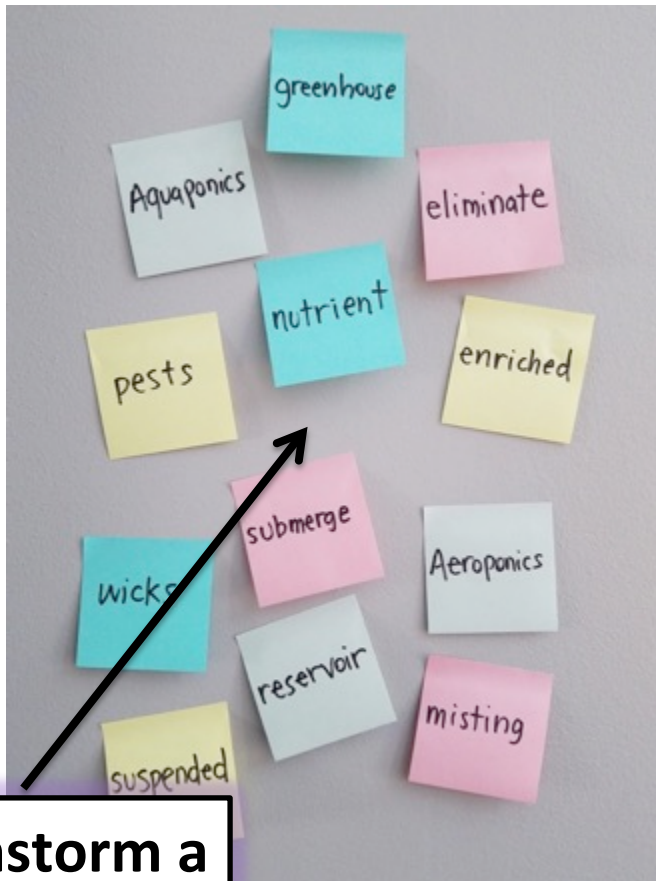


**Pink – stalks**  
**Green – stems**  
**Blue – leaves**  
**Yellow – roots**



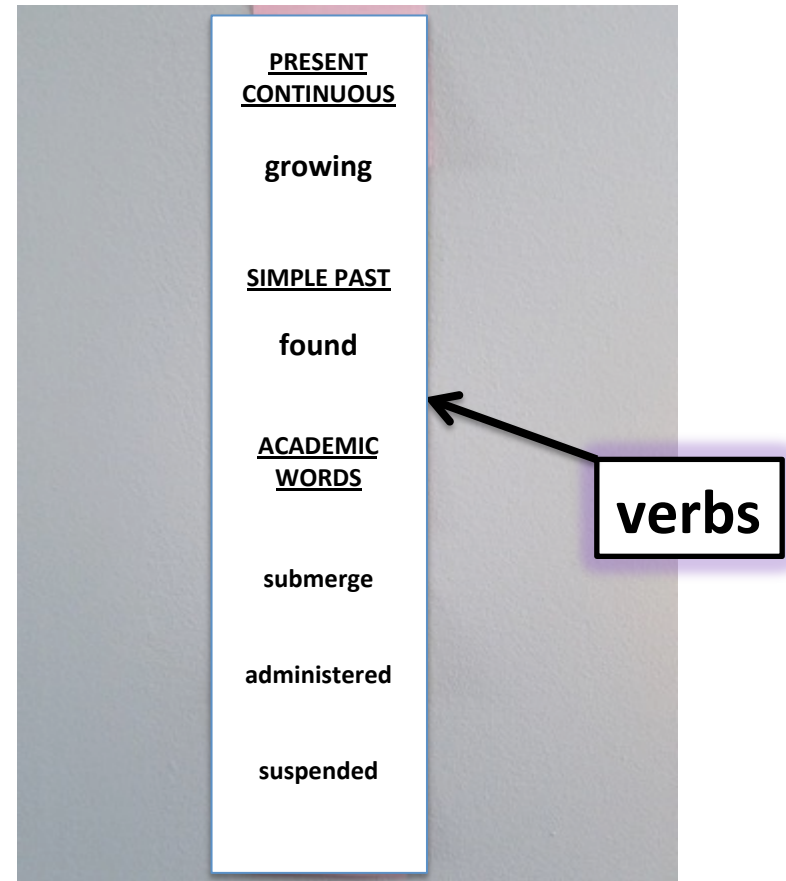
## 2. EXPLORE - ACTIVITY

### Make a word wall



**Brainstorm a list of words**

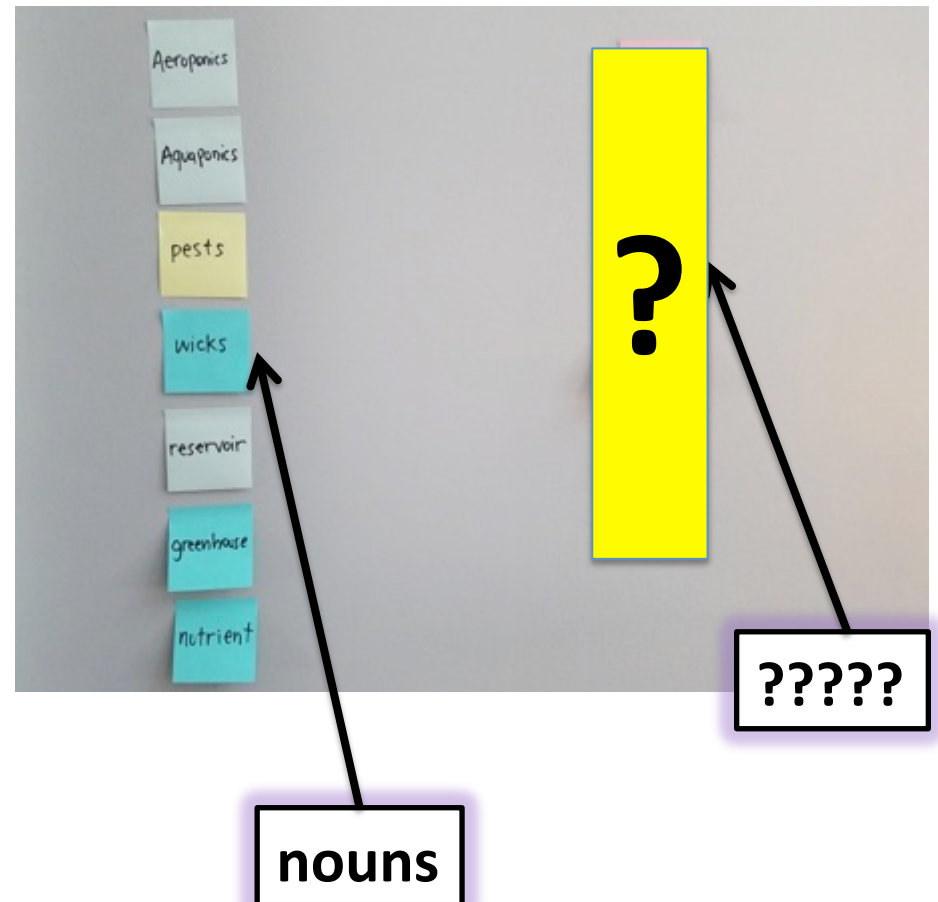
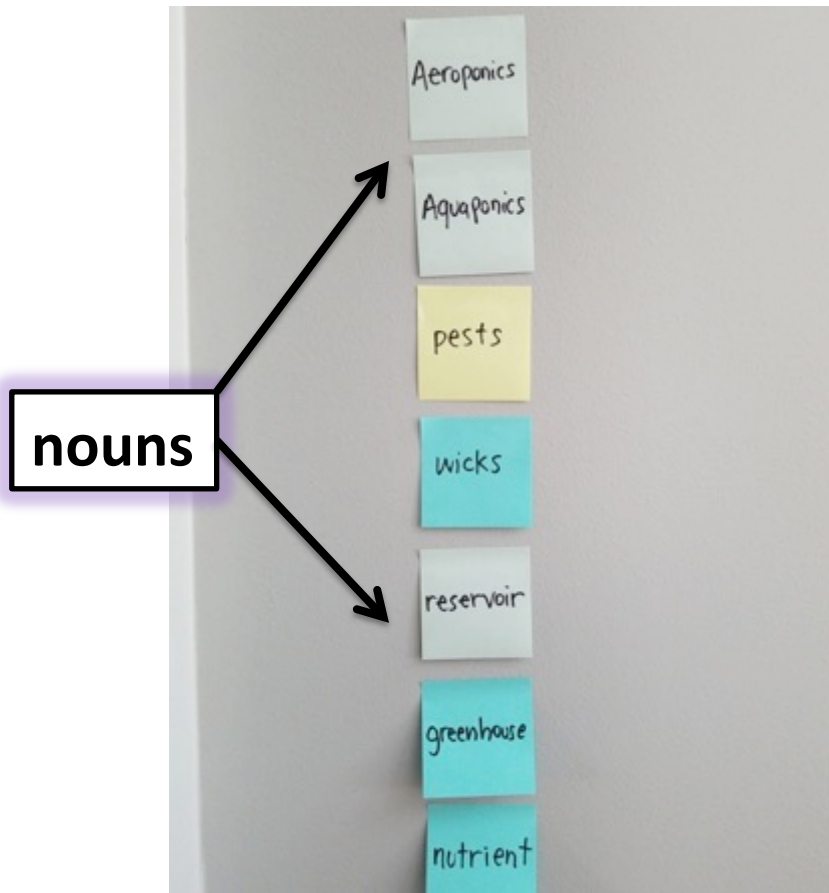
### Help students group words



**verbs**

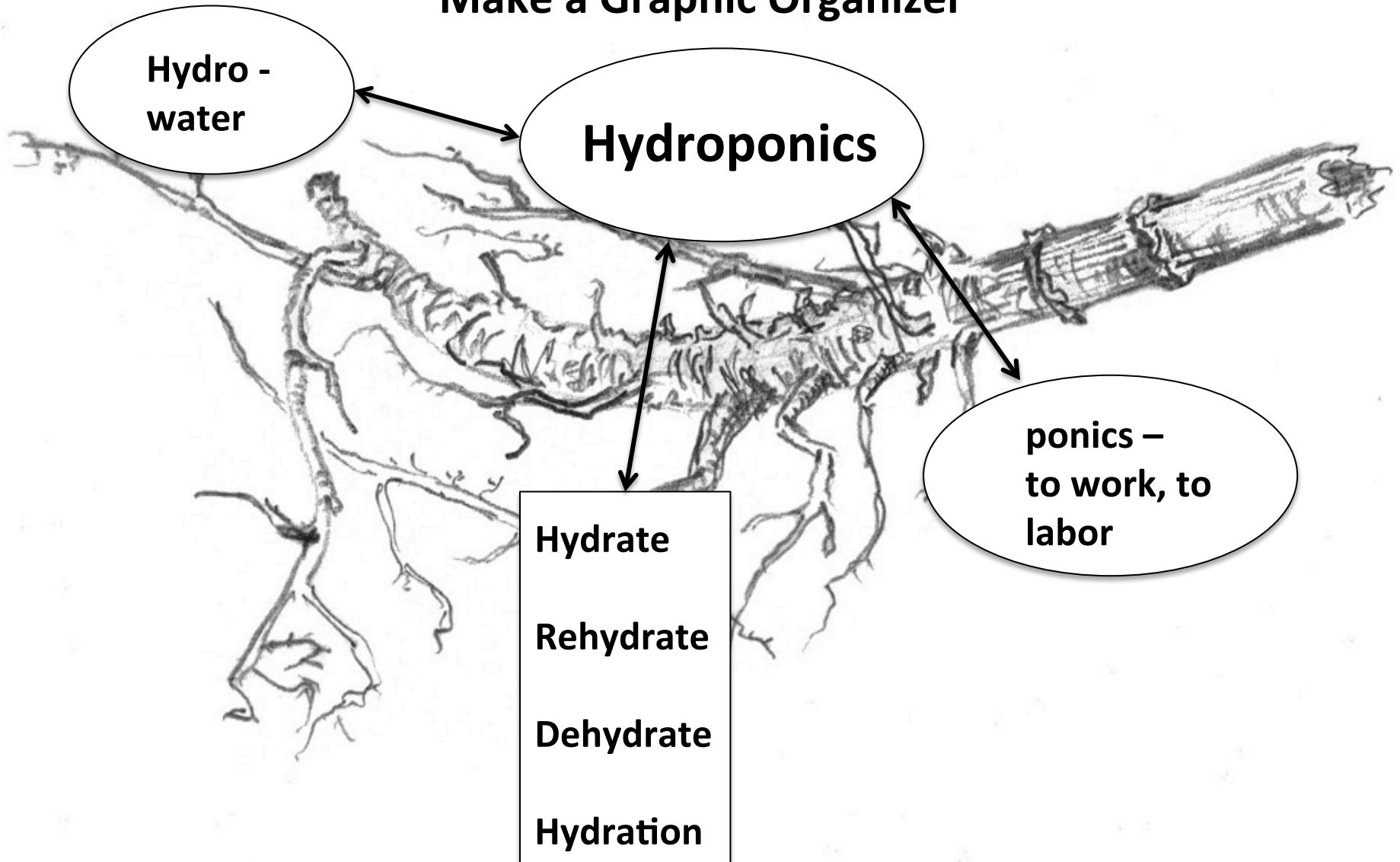
## 2. EXPLORE - ACTIVITY

Help students group words – make a word wall



## 2. EXPLORE - ACTIVITY

Make a Graphic Organizer



## 2. EXPLORE - ACTIVITY

### Hydroponics

From Open Source Ecology

Main > Food and Agriculture > Controlled-environment growing

Hydroponics is the practice of growing plants in nutrient-enriched water rather than soil.

Hydroponics is incredibly productive and requires little space. For example, Factor e Farm's experiments found that they could grow \$1 of lettuce per square foot per week. And the Institute of Simplified Hydroponics (<http://carbon.org/>) has found that they can grow 2kg of vegetables a day on 20m<sup>2</sup> of space [1]



An example of vertically stacked hydroponic installation. A system like this would allow a person to be self-sustaining for vegetables in just a few square meters. This makes it particularly useful for urban settings.

(<http://webcache.googleusercontent.com/search?q=cache:ezRcpPE6EGwJ:www.carbon.org/senegal/india1.doc&cd=4&hl=en>). Indoor growing in a greenhouse greatly reduces losses to pests.

There are 6 main techniques used in hydroponics. The Drip hydroponics system (<http://uponics.com/hydroponics-system/>) continuously drips nutrient solution onto the plants roots. The Ebb and Flow (Flood and Drain) system floods the grow bed and hydroponics growing medium (<http://uponics.com/hydroponics-system/>) with a nutrient solution, then this solution slow drains back to the reservoir. Roots benefit from these periods of wetness and dryness. Deep Water Culture simply submerges roots in a nutrient solution. Less common hydroponics systems include the Wick System (where a fabric material wicks nutrient solution from the reservoir up to the roots), Nutrient Film Technique (where nutrient solution runs down long channels or tubes and passes over bare roots), and Aeroponics (where nutrients are administered via misting suspended and bare-rooted plants).

See here (<http://www.hydroponicsonline.com/blog/easy-to-build-hydroponic-system>) for free instructions on building several different hydroponic systems. N55 have a design for a vertical hydroponic system here ([http://www.n55.dk/MANUALS/HOME\\_HYDRO/HOME\\_HYDRO.html](http://www.n55.dk/MANUALS/HOME_HYDRO/HOME_HYDRO.html)). See Wikipedia on hydroponics (<http://en.wikipedia.org/wiki/Hydroponics>) for more information.

Open source software for automating hydroponic systems (<http://hmeter.sourceforge.net/>).

- 
- Read the text with students
  - Help students select words they don't know
- 

### New vocabulary

misting

submerge

aeroponics

reservoir

eliminate



# 3. EXPLAIN



- **Teacher-directed**
- **Introduce scientific and technical information**
- **Clarify students' misconceptions**

### 3. EXPLAIN

#### **Direct (explicit) instruction**

Hydroponics is the practice of growing plants in nutrient-enriched water rather than soil.

Hydroponics is incredibly productive and requires little space. For example,

## 3. EXPLAIN

# Hydroponics

From Open Source Ecology

**Main > Food and Agriculture > Controlled-environment growing**

Hydroponics is the practice of growing plants in nutrient-enriched water rather than soil.

Hydroponics is incredibly productive and requires little space. For example, Factor e Farm's experiments found that they could grow \$1 of lettuce per square foot per week. And the Institute of Simplified Hydroponics (<http://carbon.org/>) has found that they can grow 2kg of vegetables a day on 20m<sup>2</sup> of space [1]

## QUICK TIP!

**Use authentic materials,  
such as this article from  
Open Source Ecology**





### 3. EXPLAIN – Review word beginnings/endings with students

#### Common Prefixes and Suffixes – Group Words

##### NOUNS

SUFFIX	MEANING	EXAMPLE
-ion	action, condition	hydration
-ic	quality, related to science	hydroponic

##### VERBS

SUFFIX	MEANING	EXAMPLE
-ate	to cause to be	hydrate

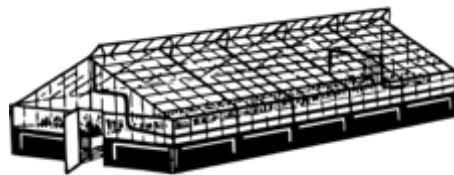
PREFIX	MEANING	EXAMPLE
re-	again and again	rehydrate
de-	remove, separate	dehydrate

Not

dis-  
un-  
mis-  
im-  
in-

### 3. EXPLAIN - Teach words in context

**“Indoor growing in a greenhouse greatly reduces losses to pests.”**



### 3. EXPLAIN - Teach words in context

#### DEFINITION CLUES

## autotroph

Many organisms cannot produce their own food, unlike autotrophs. (CONTRAST)

Autotrophs are organisms capable of nourishing themselves. (DEFINE)

*auto* - self

*troph* - to nourish

### 3. EXPLAIN - Teach words in context

#### SYNONYM CLUES

## tegmentum

The tegmentum, with many layers of tissue twisting under the cranium, provided us with an excellent medical example for class.

*teg* - cover

*ment* - refers to mind or brain

### 3. EXPLAIN – Using Critical Thinking

6 JUN 2017 | Ohio NewsWatch  
OhioFarmer.com

## Ohio farmer leads national aquaculture organization

THE U.S. is the second-largest consumer of seafood, yet it imports 85% of the seafood it consumes. This represents opportunity for U.S. farmers — especially soybean farmers, as soy is an excellent feedstock for many species of fish. However, growing an industry comes with challenges.

Bill Bayliss, a farmer from West Mansfield, has stepped up to tackle these challenges as chairman of the national Soy Aquaculture Alliance.

"The alliance acts as a hub for the soy-based aquaculture research cultivating high-value soy solutions for the global

aquaculture industry, growing a U.S. aquaculture industry and making U.S. soybeans one of the most utilized ingredients in fish and shrimp farming," says Bayliss, who also serves on the Ohio Soybean Council board of trustees.

"It's a calling," he says. "Providing

people with nourishing food, supporting communities, and stewardship of natural resources is what farmers do, and I'm happy to be able to be a part of this new budding sector of the industry in the U.S."

The SAA's board of directors is comprised of members of the soy, aquaculture and seafood industries. Since its formation in 2011, the board has focused on two primary goals: collaboration among members of the core industries it serves and facilitating essential aquaculture research.

"The opportunity for growth is there, both in the production of the fish and seafood products, as well as the soy and other feedstocks," says Bayliss. "We are doing some great work to help that growth along so that both farmers and consumers can reap the benefits."

To learn more about aquaculture, visit the SAA at [soyaquaalliance.com](http://soyaquaalliance.com).

Source: SAA



#### PROBLEMS

- Importing seafood
- Not enough food for fish
- Soybean shortage

#### SOLUTIONS

- Saving natural resources
- Aquaculture research

## 4. ELABORATE



## 4. ELABORATE - ACTIVITY



**Design a tourism brochure**



**Create an instruction manual**

## 4. ELABORATE - ACTIVITY



**Interview a local farmer**



**Create a recipe using  
local produce**



# 5. EVALUATE

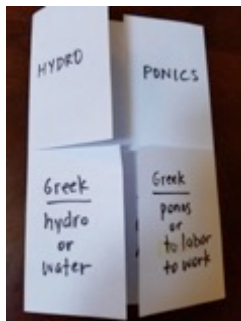
## INFORMAL EVALUATION



brochure



observation



vocabulary activities

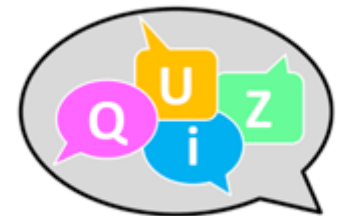
## FORMAL EVALUATION



test



report



quiz

# Phototropism

The experiment included the idea of phototropism because as the sun emerged, the plant directed itself toward the light.

Let's take a  
poll!

# Phototropism: A new STEM-related vocabulary lesson

**Content-based instruction**



Gather critical vocabulary related to Tropism (content-specific)

Students do something with the new vocabulary

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**Inquiry-based Instruction (5 Es)**



Engage, Explore, Explain, Elaborate, Evaluate

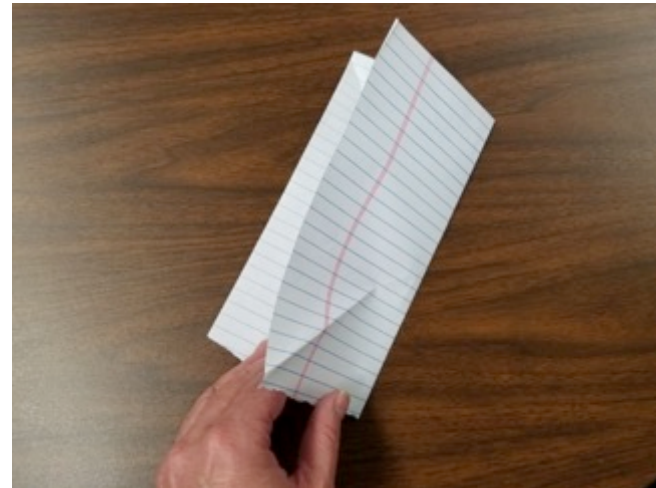
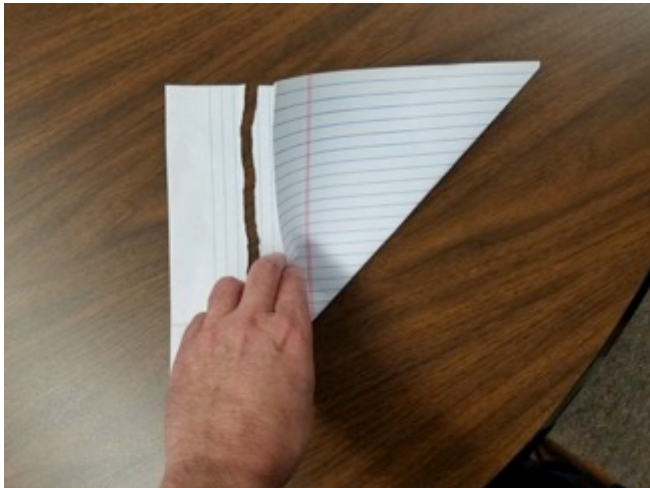
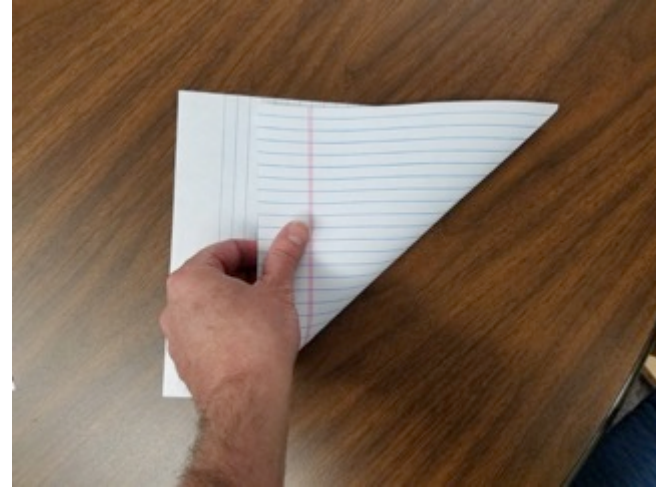
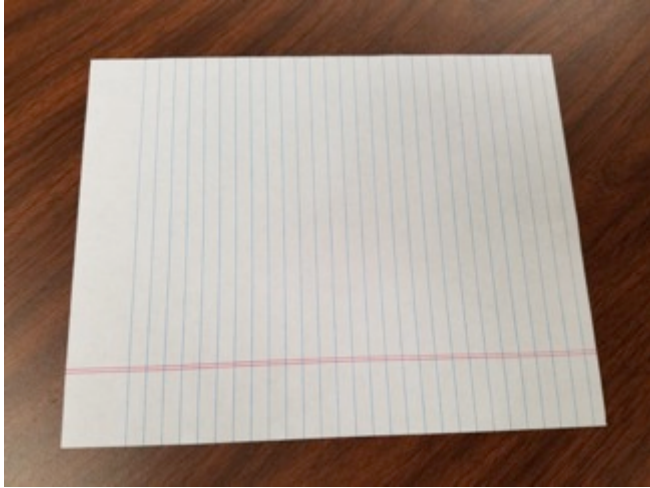
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**Authentic Materials**

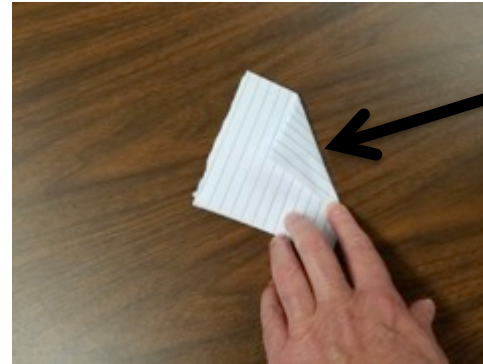
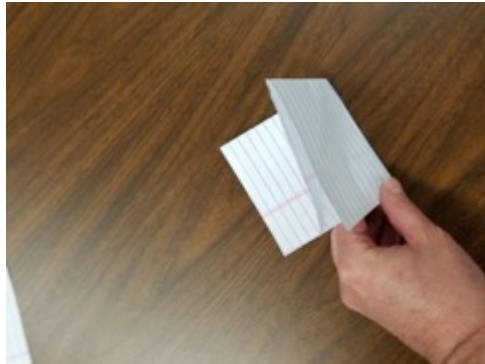


- Science textbook
- Videos
- News articles

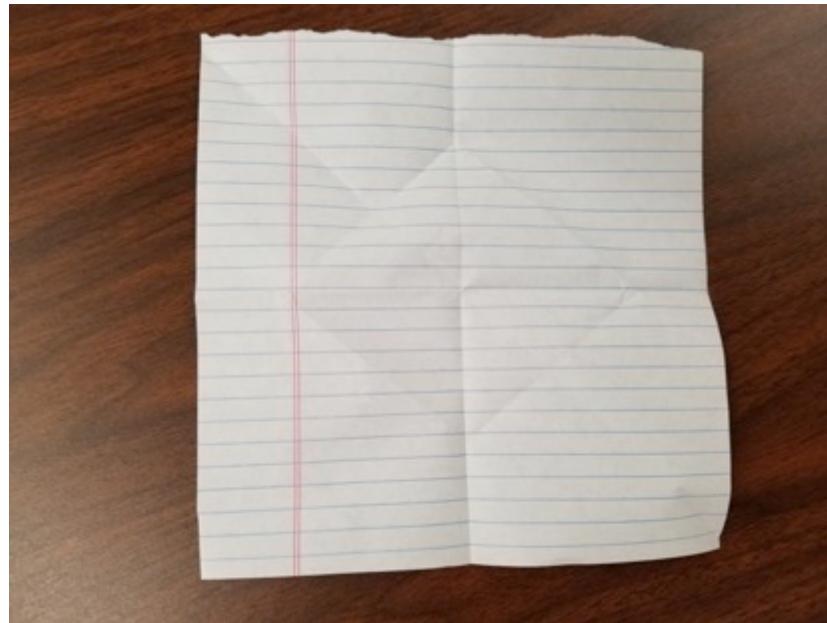
# Vocabulary Notebook – a second way



# Vocabulary Notebook – a second way



**Fold the  
corner**

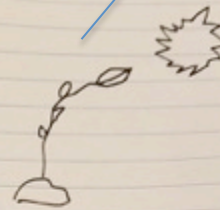


Write a sentence in context

## Phototropism

Provide many ways for students to encounter words (rich, deep contexts)

Phototropism is when a plant moves toward the sun.



## phototropism

noun

photo  
(Greek)  
light

-tropism  
(Greek)  
organism  
responds to  
positive or negative  
energy

SYNONYM

luminous

SYNONYM

react

Define word parts

List synonyms



# Design and conduct an experiment

## Phototropism



### Materials

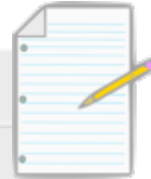
- 1 small container
- 2 rubber bands
- 1 small wild plant
- 1 napkin
- Water
- Classroom shelf
- 2 pieces of plastic



Adapted from Loeschig, L.V. (1996).  
Simple earth science experiments with  
everyday materials

# Create a lab report with your new STEM-related vocabulary

## LAB REPORT



- **Title**
- **Introduction**
- **Hypothesis**
- **Materials**
- **Procedures**
- **Results**
- **Conclusion**

Academic words

- excessive
- vegetation

General English

- too much
- plants

<b>Title:</b> Effects of <b>excessive</b> water on phototropism in classroom <b>vegetation</b>
<b>Introduction:</b> Objectives, purpose, Why?
<b>Hypothesis:</b> Explanation, theory
<b>Materials:</b>
<b>Procedures (Experiment):</b>
<b>Results:</b>
<b>Conclusion:</b>

If...then statements

<b>Title:</b> Effects of <b>excessive</b> water on phototropism in classroom vegetation
<b>Introduction:</b>
<b>Hypothesis:</b>
<b>Materials:</b> List of items (soil, nutrients, container)
<b>Procedures:</b> Describe the steps
<b>Results:</b>
<b>Conclusion:</b>

**Use adverbs of time**

today, later, after, frequently

**Use adjectives**

First, second, third, etc.

**Units of measurement**

Kilogram

<b>Title:</b> Effects of <b>excessive</b> water on phototropism in classroom vegetation
<b>Introduction:</b>
<b>Hypothesis:</b>
<b>Materials:</b>
<b>Procedures:</b>
<b>Results:</b> Shares the findings of the experiment
<b>Conclusion:</b> A summary; very short



- According to...
- My results indicate...
- conclude
- identified

**Give yourself a hand!**



You've successfully helped  
students learn new STEM-related  
vocabulary through:

**Content-based Instruction,  
Inquiry-based Instruction  
and vocabulary activities!**

**Let's take a final poll!**



# Cultivating your English Vocabulary through **STEM** Activities

## **Thank you!**



# Sources

- American Heritage Dictionary: <https://ahdictionary.com/>
- Biology Online: [biologyonline.com](http://biologyonline.com)
- Graves, M., August, D., & Mancilla-Martinez, J. (2013). Teaching vocabulary to English language learners. New York, NY: Teachers College Press.
- Loesching, L.V. (1996). Simple earth science experiments with everyday materials. New York, NY: Sterling Publishers.
- National Academy of Science. National Science Education Standards. (1996). <http://www.nasonline.org/?referrer=https://www.google.com/>
- Open Source Ecology - Hydroponics: <http://opensourceecology.org/wiki/Hydroponics>