

# Adapting Hands-On Activities for Children in Elementary, Middle and High Schools

Suzanne Cunningham

Purdue University-Agronomy Dept., Purdue University, Agronomy Dept. 915 W State Street, West Lafayette, IN 47907-2054

## Hypothesis

Hands-on science activities can be adjusted to meet the learning requirements of students at various grade levels.

## Objective

Illustrate how general science activities developed at one grade level can be adjusted to meet learning specifications at other levels.

## Introduction

Students at all grade levels enjoy taking part in science activities; in fact they learn more from doing science than from reading science. Eighteen years ago a hands-on education program for elementary students from suburban areas was developed to introduce students to plant science and show them the importance of plant science in every day life using corn as an example. "How Much Corn Have You Eaten Today?" used starch/agar gels, iodine, and field corn seeds to introduce students to plants, nutrients, digestion, and enzyme activity. A pictorial walk through a grocery store examining product contents illustrated the diversity of corn use in processed foods.

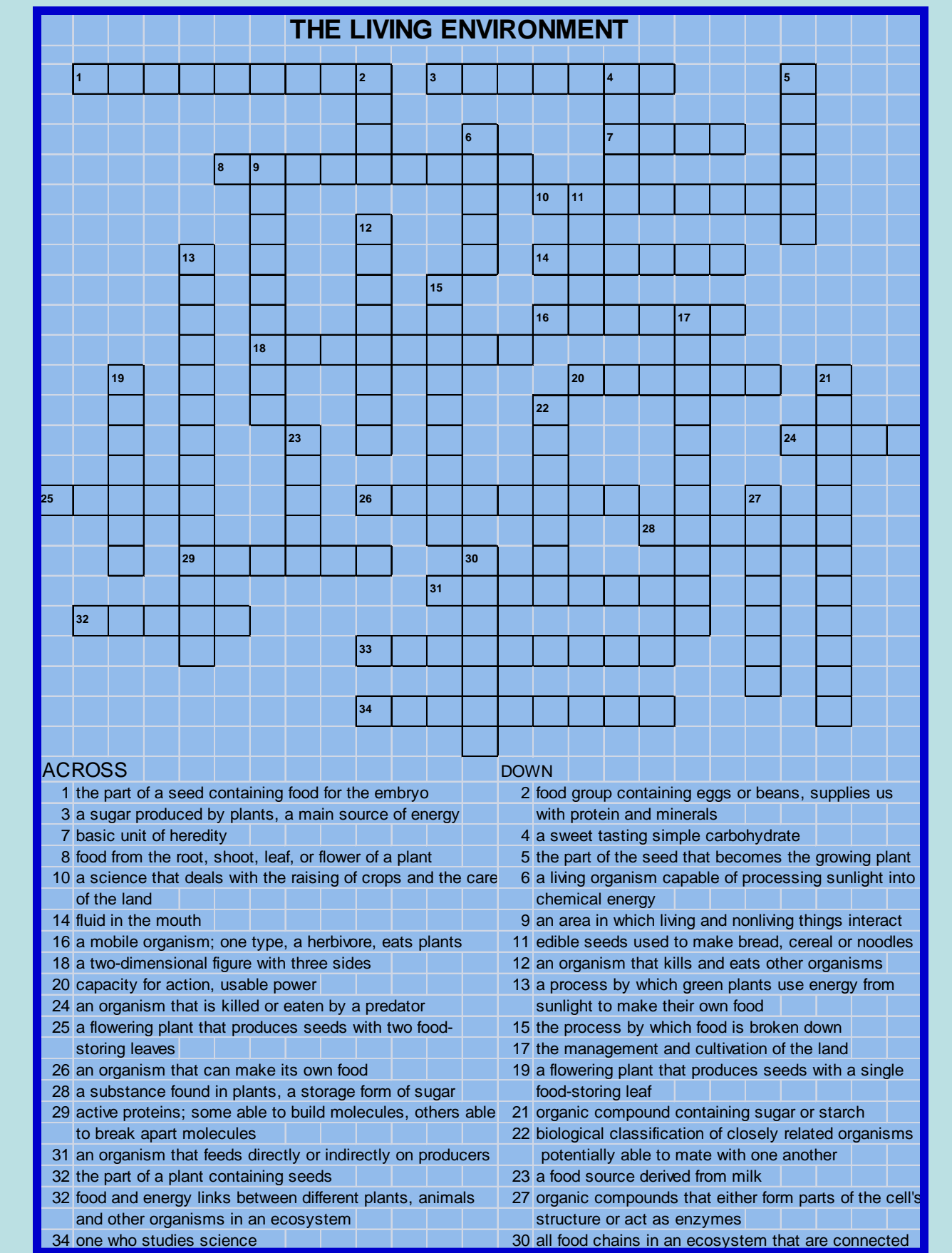


Figure 1. Young students pipette iodine into a solution to see if starch is present (above). Drops of iodine in water turn the water yellow. Iodine detects the presence of starch by turning blue (below).

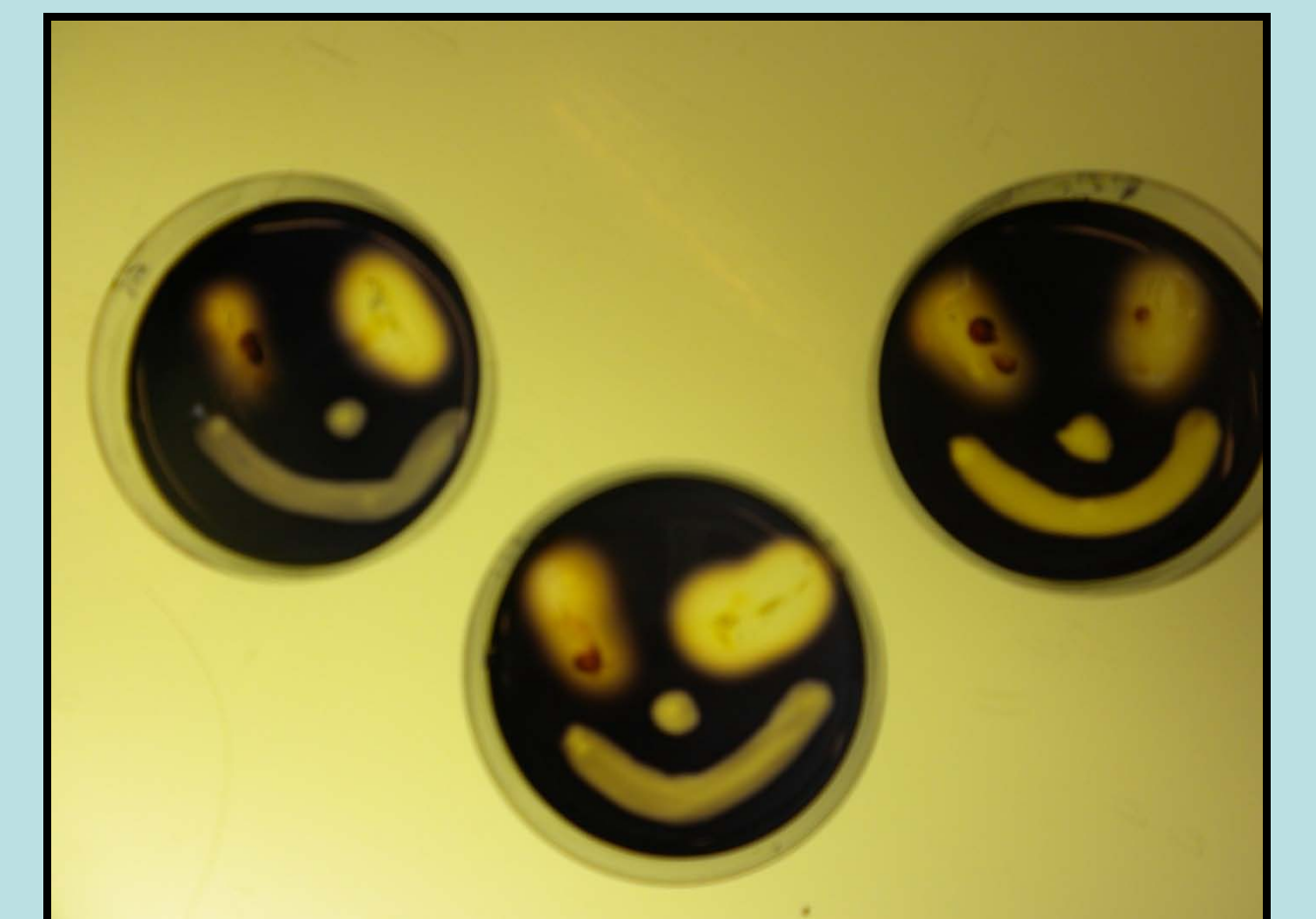
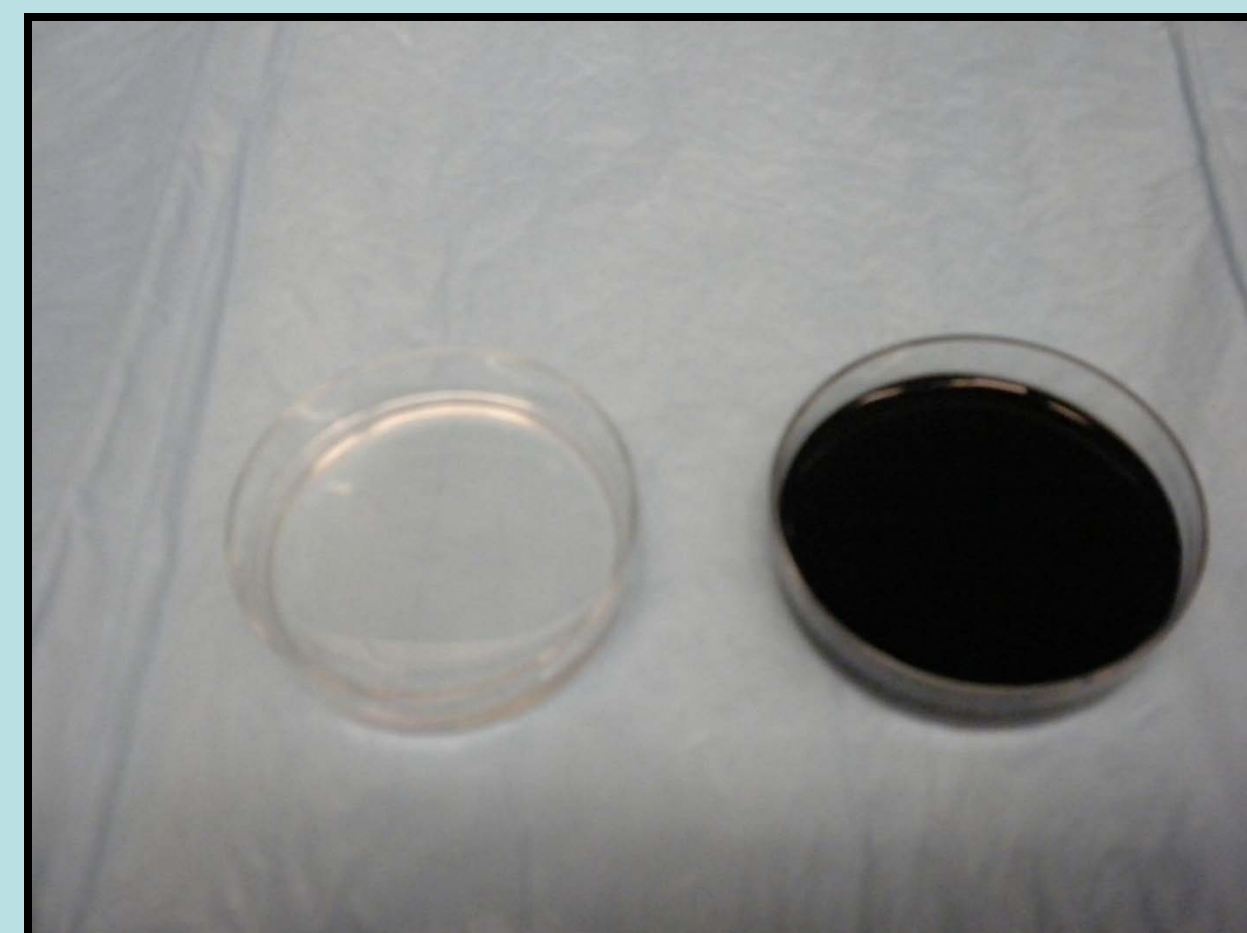


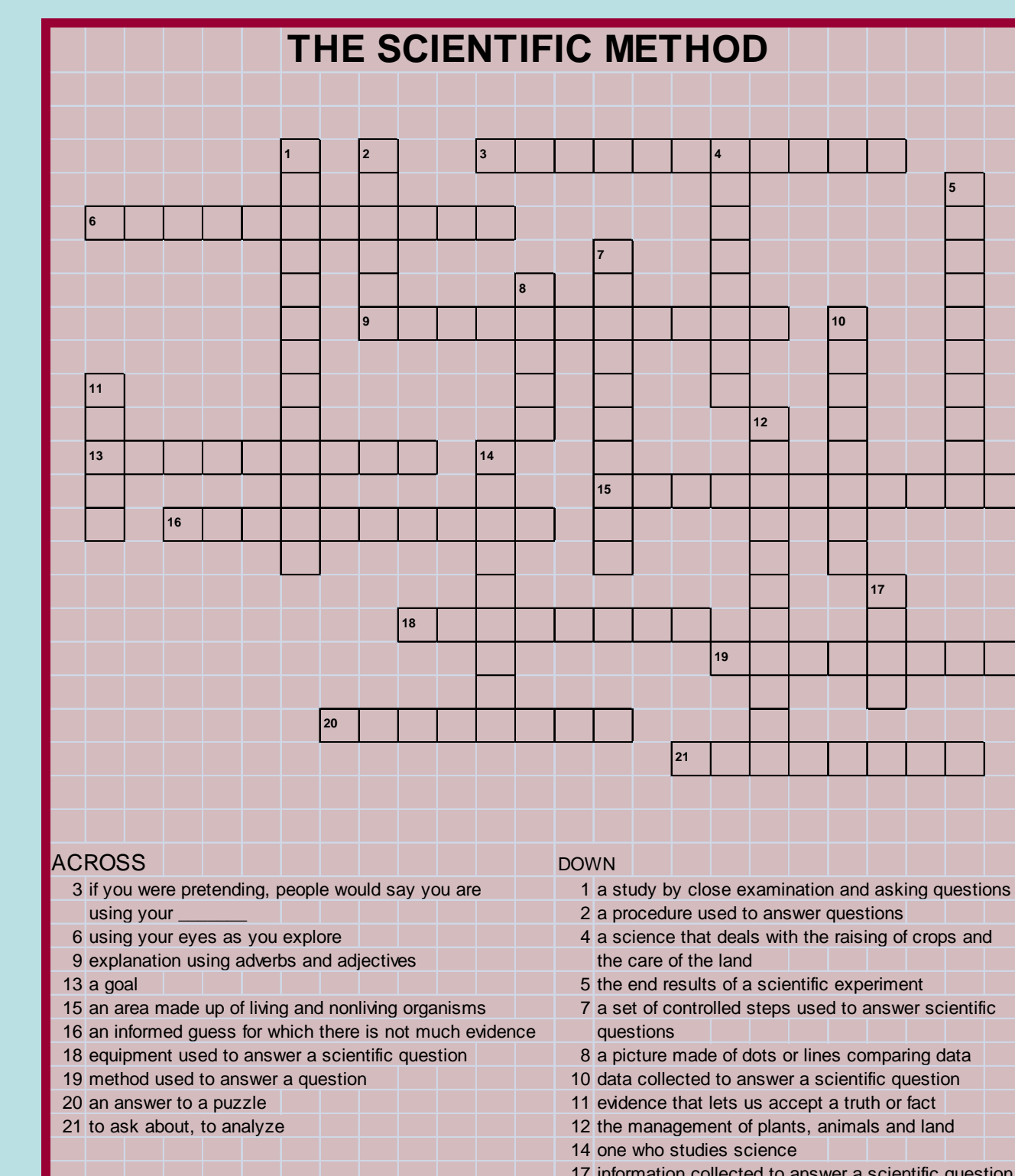
Figure 2. Young students learn that plants and animals eat the same food. A starch-agar gel turns blue if iodine is added to it (left). Students add saliva to the gels with cotton swabs (center). Imbibed corn and saliva on starch gels yields 'Smiling Faces' after iodine is added (right). The clear sections show where enzymes in developing corn embryos and in saliva have digested starch. Therefore, plants and animals eat the same food.



Figure 3. Third and fourth graders examine various grains and legumes to see if these seeds contain starch as well as starch digesting enzymes.



Figure 4. Third and fourth grade students have fun searching for corn in various food products. They have fun with math as they calculate the amount of sugar found in beverages.



# Today this outreach program has been adapted for use at all grade levels.

A FIRST GRADE WORD WALL									
A	B	C	D	E	F	G	H	I	
	blue	clay	duck	ear	frog	green	hide	indicator	
	black	corn	dry	farm	grass	hole		iodine	
	bird	color		forest	gall				
	bean	corner	circle	food	four				
J									
K	L	M	N	O	P	Q	R	S	
	leaf	marsh	nest	old	Purdue	root	red	soil	
	land		number	one	potato	robin	rock	silt	
				oval	plant	rot	rain	sand	
					pond	rectangle	rectangle	seed	
					purple	square	square	starch	
								swamp	
								shape	
								shape	
								square	
T	U	V	W	X	Y	Z			
toad	under		wet		yellow	zero			
tree	up		water						
tract			white						
triangle			worm						
three			wetland						
two									

Suzanne M. Cunningham; scunningham@purdue.edu  
Sherry Falk-Bringman; sherryfb@purdue.edu  
Agronomy Dept., Purdue University



**Figure 5.** Kindergarten, 1<sup>st</sup> and 2<sup>nd</sup> graders see how indicators change colors and play 'Hide and Seek' assisting iodine to find starch in cereals, bread and noodles (left). As the indicator turns the foods dark blue one hears, "This is fun." They then find starch in the endosperm of a popcorn seed (right) and, as they discover its the starchy endosperm that expands when the seed is heated, "Wow!" and "Cool!" are heard.

**STARCH WORD SEARCH**

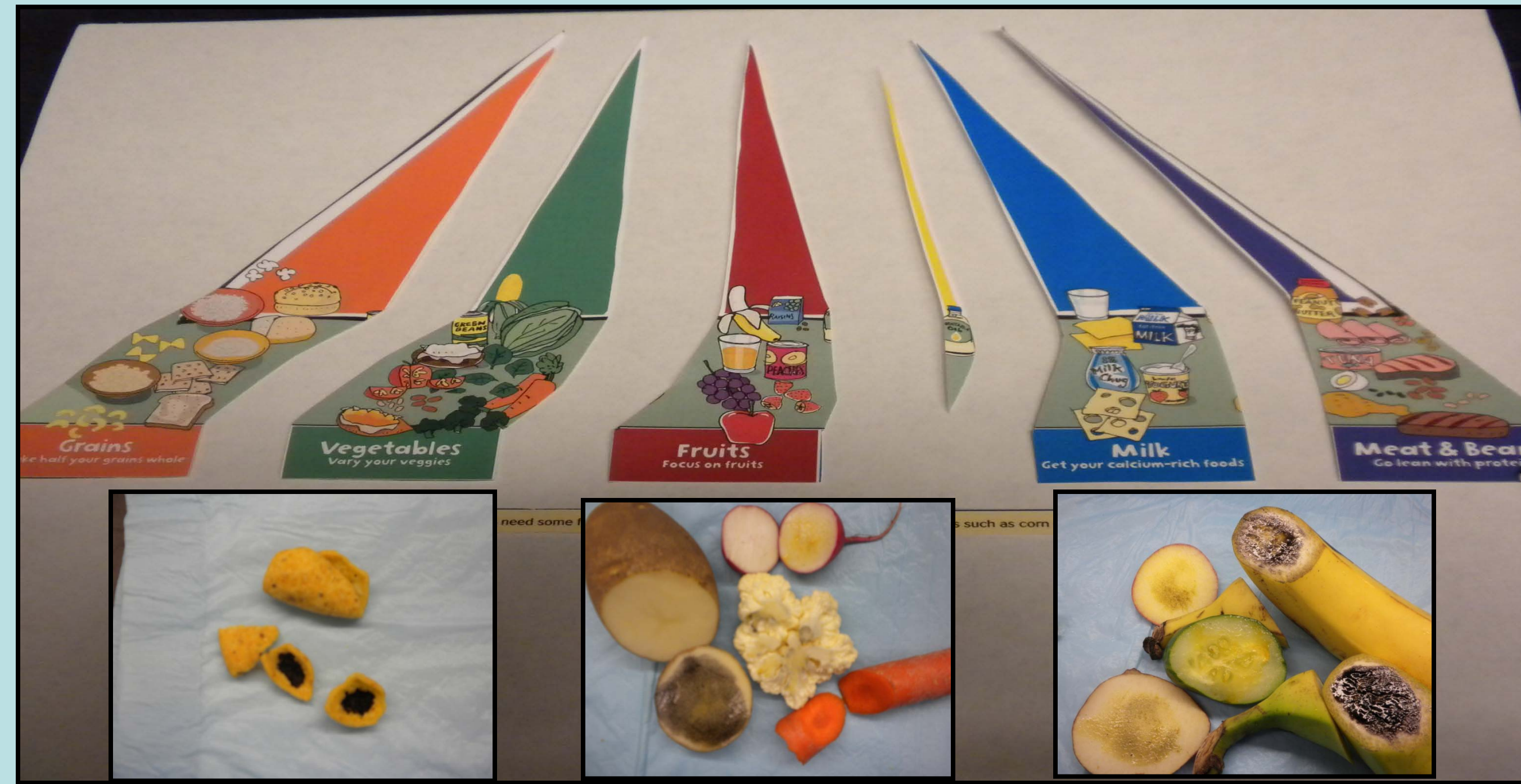
C	A	R	B	O	H	Y	D	R	A	T	E	F
O	P	O	G	L	U	C	O	S	E	I	M	O
S	P	E	W	C	R	O	O	T	T	F	B	O
W	O	N	I	N	D	I	C	A	T	O	R	D
E	C	Z	O	S	U	G	A	R	P	R	Y	P
E	O	Y	D	E	O	Q	S	C	U	C	O	Y
T	R	M	I	E	I	F	A	H	N	E	L	R
C	N	E	N	D	F	O	R	Q	Z	P	E	A
O	F	I	E	L	D	C	O	R	N	S	A	M
R	A	F	H	I	G	R	A	I	N	S	F	I
N	E	L	E	N	D	O	S	P	E	R	M	D

A major crop grown in Indiana is **FIELD CORN**. Corn **SEED** is planted in the spring into warm, moist soil. Field corn seed contains a lot of **STARCH**. The part of the seed where the starch is located is called the **ENDOSPERM**. Starch is a **CARBOHYDRATE**, one of the important nutrients found in **GRAINS**. Grains make up one of the building blocks in the **FOOD PYRAMID**.

In the lab we use **IODINE** as an **INDICATOR** to see starch. Drops of iodine in water turn the water yellow. If we mix starch in the water and then add iodine the solution turns blue. We hold a corn seed with **FORCEPS** and add a drop of iodine on the cut side. The corn seed turns deep blue-black where starch is located.

Note the section of the seed that does not change color. This is the **EMBRYO**. A corn embryo first grows a **ROOT** and then grows a **LEAF**. The growing embryo digests (breaks down) the starch in the seed. An **ENZYME** breaks the starch apart.

What other types of corn do we eat? Do they all contain starch? If we drop some iodine on to a cut **SWEET CORN** seed we see very little starch in the endosperm. Instead the building blocks for starch accumulate. The building blocks for starch are called **GLUCOSE**. Glucose is a **SUGAR**, which is why sweet corn tastes sweet. Is starch in a **POPCORN** seed? We heat popcorn and watch it burst into a large puff of white. If we drop some iodine on to this puff it turns blue-black. Popcorn contains a lot of starch!



**Figure 6.** Students in 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> grades search for the presence or absence of starch in grains, vegetables and fruits using iodine as an indicator. Most blocks in the food pyramid contain plants, and, within a block, a fruit or vegetable might contain lots of starch or almost no starch. Students identify differences in starch content within a corn seed, between parts of plants and among crops. Discussions about the role of enzymes in digestion and the importance of balanced nutrition take place.

Let's Compare	
Enzymes	4 <sup>th</sup> Graders
<b>Similarities</b>	
Enzymes are active.	4 <sup>th</sup> graders cannot sit still, they are always wiggling.
Some enzymes build.	4 <sup>th</sup> graders build words from letters. 4 <sup>th</sup> graders build sentences from words.
Some enzymes digest or break things apart.	Check out a 4 <sup>th</sup> graders bedroom. What do little brothers and sisters do to 4 <sup>th</sup> graders Lego™ creations?
Enzymes do the job they are programmed to do.	4 <sup>th</sup> graders are good listeners. 4 <sup>th</sup> graders follow directions.
Active enzymes keep working.	4 <sup>th</sup> graders are good workers. 4 <sup>th</sup> graders finish the job.
<b>Differences</b>	
Each enzyme does one job.	A 4 <sup>th</sup> grader does many things.
Each enzyme is specific, it lacks an imagination.	All 4 <sup>th</sup> graders are imaginative.

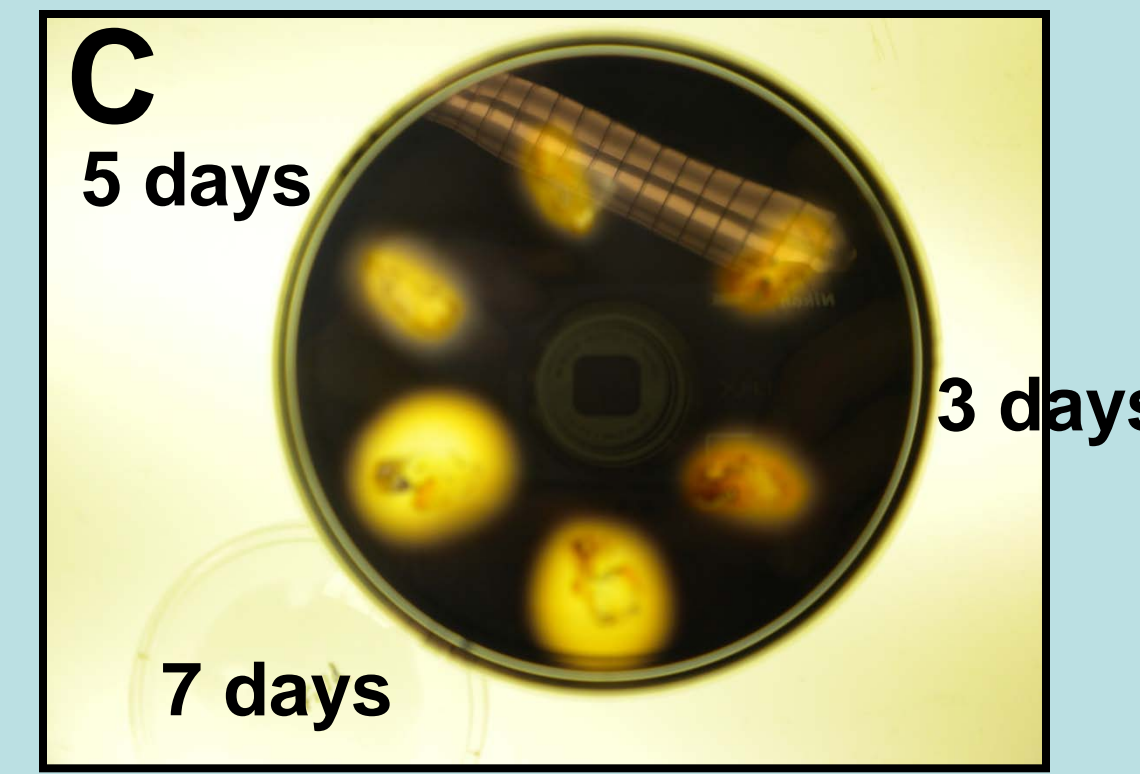
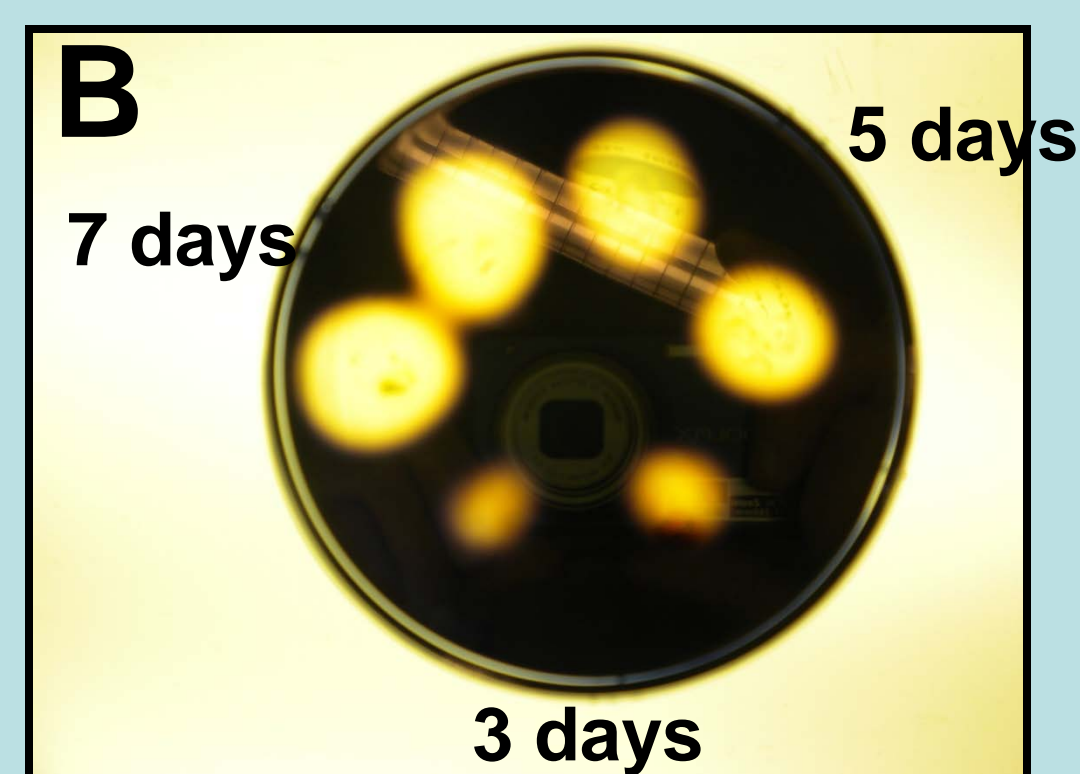
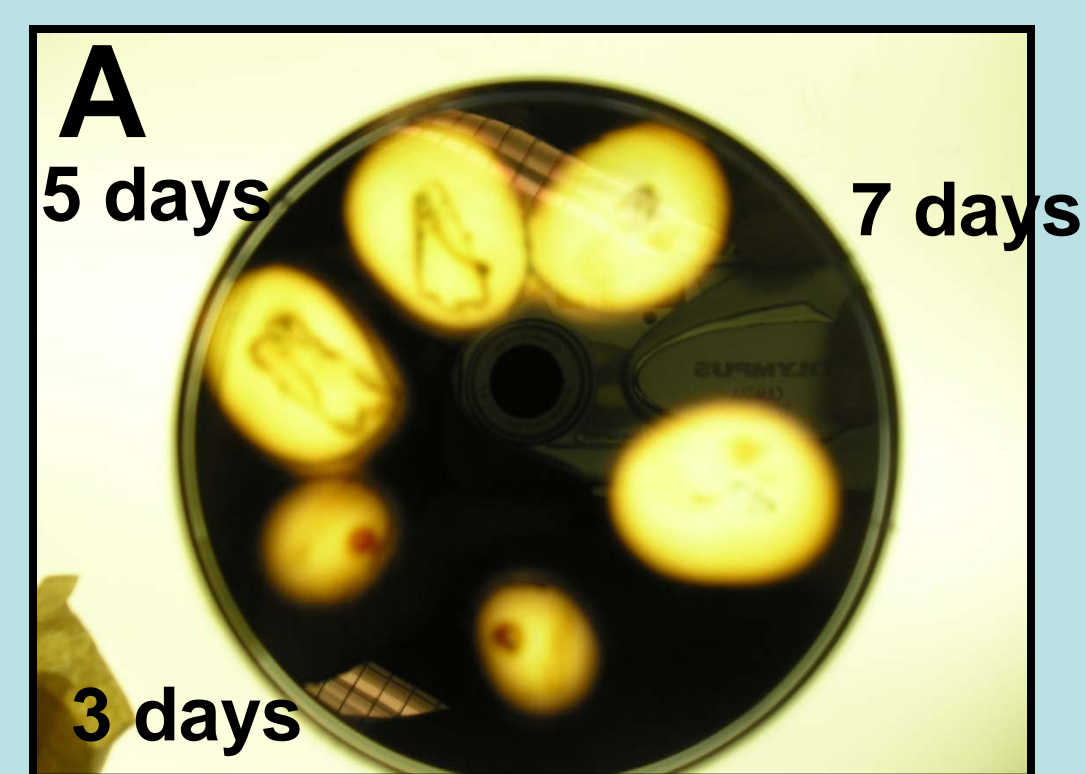
**SHERRY'S AND SUZANNE'S WORD WALL**

A	B	C	D	E	F	G	H	I
agronomy	blue	clay	dam	experiment	farm	gritty	hypothesis	imagination
alfalfa	black	charge	dark	ear	forest	green	habitat	indicator
amylase	beta	corn	dirt	embryo	food	grass	iodine	iodine
alpha	base	canola	dicot	endosperm	flask	glacier	imbibe	imbibe
alphabet	bog	color	down	enzyme	filter	gel	ice	ice glass
agriculture		chromatograph		erosion		Greek		
		carbohydrate		evaporation		gene		
K	L	M	N	O	P	Q	R	S
kernal	leaf	magnet	negative	opposite	Purdue	question	rain	scientist
	lazy	minus		organic	plus		red	soil
	Latin	minerals		oxygen	positive		ribbon	silt
		marsh		observe	prairie		rainbow	sand
		metal			pollution		root	seed
		monocot			plant		repel	saliva
		moist			petri dish			starch
		mica sheets			protein			sugar
								soybean
								sorghum
T	U	V	W	X	Y	Z		
texture	under	vermiculite	water	x-horizon	yellow	Zea mays		
tracts	up	vegetation	wheat					
		vegetable	wetland					
			worm					

Suzanne M. Cunningham; scunningham@purdue.edu  
Sherry Falk-Bringman; sherryfb@purdue.edu  
Agronomy Dept., Purdue University



**Figure 7.** Middle school students are introduced to the concept of enzymes using time-course and volume experiments with  $\alpha$ -amylase and saliva. Students compare levels of starch and total enzyme activity in field, sweet, Indian and pop corn seed, as well as other grains and legumes. Seeds were placed on gels composed of 1% Bacto-Agar and 0.5% soluble potato starch. The gels were stained with 20 mM  $I_2$  in 0.5 M KI 24 hr later.



**Figure 8.** High school students undertake enzyme assays using starch/agar gels and field (A), pop (B) and sweet (C) corn seed incubated for 2, 3, 5, or 7 days to measure total and specific enzyme activities. Corn seed was imbibed for 2, 4 and 6 days. Growing leaf and root tissues were removed, and the seeds were divided in half and placed on gels containing 1% Bacto-Agar and 0.5% soluble potato starch. The gels were stained with 20 mM  $I_2$  in 0.5 M KI solution 24 hr later. The clear area on these gels denotes the digested starch and is proportional to the amount of enzyme present in the embryos. This lab experiment incorporates algebra, geometry and graphing into students' lessons.

**Plants and the Food Pyramid**

**ACROSS**

- a vegetable from the flower of a plant
- a nutritional chart categorizing what we eat
- a vegetable from the stem of a plant
- a seed used to make Cheerios
- a block in the food pyramid; brook and beets are found in this food category
- a grain used to make bread and noodles
- a vegetable which grows on a vine
- a block in the food pyramid; cheese and ice cream can be found in this category
- a fruit which grows on a vine
- a plant that grows an 'ear'
- a block in the food pyramid; seafood and chicken can be found in this category
- a synonym for macaroni; a food made of wheat
- can be made from wheat and toasted
- a yellow fruit which we peel
- the part of a plant that makes energy from the sun and turns from green to yellow and red in autumn

**DOWN**

- a seed we eat after heating; most people enjoy it with butter and salt
- a vegetable from the root of a plant
- a grain used in making Chex cereal
- the part of a plant growing underground; it collects water and minerals from the soil
- the part of a plant which grows from a flower; it contains seeds
- the part of a plant found in the grain category of the food pyramid
- 11 a block in the food pyramid; wheat and oat seeds are found in this food category
- 13 a fruit that can be red, yellow or green; it is used in making pies
- 15 the part of a plant connecting leaves to roots; seeds are found in this food category
- 17 seeds which grow in pods; can be meats or vegetables in the food pyramid
- 19 Cocoa Puffs are an example of this food
- 20 a vegetable found underground; French fries are one way we eat this vegetable
- 25 parts of the meat group; may grow on trees or underground

Suzanne Cunningham; Sherry Falk-Bringman; Department of Agronomy; Purdue University

**Altering experiments in small ways, while maintaining a central theme, adapted them to various grade levels, met specific learning objectives and prepared students for standardized year-end exams.**