

The
PUMPKIN



PROJECT

by

Karen GoatKeeper

GoatKeepers Press

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*Dedicated to
Those Who Love To Grow Pumpkins*

Acknowledgements

Over the years it took to complete this book many people have helped me along the way confident the book would become a reality. The people at Botanical Interests Seed Company in Broomfield, Colorado, and Farmers Market Foods in Corvallis, Oregon, were glad to answer my questions then correct my mistakes. Pumpkin Daze in Republic, Missouri, welcomed me answering my many questions about giant vegetables and weigh ins. Marv and Sally Meyer shared information and enthusiasm about their pumpkin patch. Country Mart Market in Salem, Missouri, let me take pictures of their pumpkins to use in various puzzles and stories.

Many thanks go to the people at BigPumpkins on the Internet for their information and answers. Through this site I entered the international world of giant pumpkins meeting Albin Helgesson in Sweden, Christy Harp in Indiana, Ben Surma and Philip McCauley in Australia who were glad to tell me about growing these giants.

What began as a simple botany science book with puzzles added was greatly enriched by what I learned from these and so many other people who love growing pumpkins.

Why Investigate Pumpkins?

Plants aren't interesting. They're dull. They don't move. Once you've seen a leaf, a stem, a root and a flower, you've seen all there is to a plant.

Say that to the hundreds of people worldwide who grow giant pumpkins, they'll know you've never really looked at plants. Botanists (scientists who study plants) have studied plants for hundreds of years and are still finding out new things about them. Now you have a chance to find out a little bit of what botanists, giant pumpkin growers and lots of other people find so exciting.

Why pick pumpkins?

There are lots of reasons. The big seeds are easy to work with. Pumpkin seeds are easy to find and grow. There are lots of different kinds of pumpkins.

Pumpkins are important commercial crops. They are eaten by people all over the world. They are grown on every continent except Antarctica.

Pumpkins can be used to make art. There are competitions for the largest pumpkins at county and state fairs. There are competitions to grow giant pumpkins in North America, Europe and Australia. Throwing or chunkin' pumpkins is a new competition starting in the United States.

This book is full of puzzles, stories and facts about pumpkins. You can do projects and basic investigations about seeds, sprouts, plants, flowers and pumpkins. Some are simple. Others are difficult. Finally, there are recipes so you can cook up part of your pumpkin crop.

When should you start investigating pumpkins? Because some of the investigations use pumpkin plants which grow best in warm weather, spring and summer may be the best time. Others take a week or more because seeds take time to germinate and grow.

So the best time to start is now. Then you will be ready to grow your best pumpkins ever.



A painted pumpkin display at Pumpkin Daze 2007, Republic, MO

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What Do You Need to Investigate Pumpkins?

It's easy to find most of these things you will need to do the Investigations. Here is a list and ideas where you can find the items. I may have forgotten one or two.

Item	Where to Find	Comments
Science Journal	Local store	I prefer a 3-ring binder so I can add extra papers.
Pumpkin Seeds	Seed company or local store	You will need 60 seeds for the Investigations. Those for medium-sized pumpkins work the best. You will need seeds for the pumpkins you grow.
Metric ruler	Local store	
Custard cups	Local store	A custard cup is a small glass baking cup for custard. You can use plastic applesauce cups or short Styrofoam cups.
Paring Knife	Local store or Kitchen	
Magnifying glass	Local store	Get the best one you can find
Paper Towels	Local store or Kitchen	
Plastic wrap	Local store or Kitchen	
Rubber bands	Local store	
Glass jars or glasses	Local store or Kitchen	I like empty clean peanut butter jars.
Cardboard		A piece of a box works well.
Scissors	Local store	
Styrofoam cups	Local store	Get both 8oz and 16 oz. cups
Potting soil	Local store	You will need a big bag. You can reuse some cups of soil.
Markers	Local store	
Flashlight	Local store	
Grow light	Local store	You can use a regular fluorescent light. It needs to be at least 24 inches (60cm) long.
Food Coloring	Local store or Kitchen	A dark color like blue works best.
Microscope, slides	Catalog company or local store	Perhaps you can use one at school. It should have 10 and 30 power lenses.
Stereoscope	Catalog company or local store	Perhaps you can use one at a school. It should have 30X or higher power.
Clear tape	Local store	
Coffee Filter	Local store or Kitchen	
Isopropyl or Rubbing Alcohol	Local store	
Scale	Local store	A digital scale that weighs to tenths of a pound will work well.
Balance	Catalog company	I found one on the Internet that weighs to 0.1g. It is a jeweler's scale and will weigh up to 4000g.
Bowls	Local store or Kitchen	Mixing bowls work fine.
Oven	Kitchen	

Getting Started

How do you keep track of 19 Pumpkin Investigations? And two Projects? With a notebook or journal! Maybe you can find pumpkin stickers to put on it.

Each Investigation has a question. You answer this question doing the Investigation.

Every Investigation has a list of materials, the things you will need to do it. I always check this list carefully to be sure I have everything before I start.

How do you do an Investigation? The Procedure goes step by step. I always read these steps before I start. As you read the steps, think: Will you have enough time to get done? Will you need help? What will you need to write down?

When you do the Investigation, you can read each step as you do that step.

Some Investigations use germinating or sprouted seeds. Unless you have magic seeds (Let me know where you found them, please.), a pumpkin seed takes about 5 days to germinate and up to a week after that to grow. That's a long time. Maybe you want to start seeds for several Investigations ahead of time.

Each Investigation is different and wants the seeds germinated differently. I found it's easy to mix them up. Read each Procedure and label which Investigation each seed is for.

What will you do with all these sprouts? Sadly, these sprouts will probably not grow into nice pumpkin vines. They will have long spindly stems that break easily. Even if you try to plant them, remember each vine takes a lot of room.

These sprouts should go into the compost pile.

Perhaps you are thinking "I can't draw!" as you read directions asking you to draw what you see. I'm not very good either but I try my best because when I draw something I really look at it. I take pictures too so I have a better picture than what I tried to draw.

You can see inside your house. A camera doesn't see as well as you do. What do you do? Use a tripod and set your ISO, if you can, to 400. A flash doesn't work very well for lighting up an Investigation.

Where do you get pumpkin plants for the Investigations? Your Project pumpkin vines are to grow pumpkins, not get cut up for Investigations.

When you plant your seeds, you plant more than the number of plants you will need. Let one grow three or four feet long and dig it up. Or cut off a side branch. Remember these wilt soon so use them right away.

I had a good time doing the Investigations. What I found out is in the Speaking Of sections. I hope you enjoy doing the Investigations too.



Where Did Pumpkins Come From? Pumpkin Story 1

People in the Oaxaca area of Mexico started growing pumpkins about 10,000 years ago. But these pumpkins were small squashes too bitter to eat. The seeds were what everyone wanted.

Once these people started growing squash and enjoying the seeds, everyone wanted some. People both north and south of Oaxaca started growing squash. Even then competitions started for bigger and better. The squash got bigger, better tasting and had more seeds inside. Evidence of squash is found in the eastern United States dating to about 4,700 years ago.

Not to be outdone, people in Mexico started growing other kinds of squashes. And these kinds too were soon growing in North and South America. By the time Columbus arrived in the New World in 1492, Indians were growing summer squash, winter squash, cushaw squash and pumpkins. The Incas liked growing giant pumpkins and kept these a secret. They also grew buttercup, banana, Hubbard and Turban squashes.

Columbus saw these squash were a great crop. He and other explorers took seeds back to Europe. By 1550 squash was grown throughout Europe and even got included in paintings. The squash was usually green or striped in color. Most squash was grown by poor people and ignored by rich people.



Cushaw squash. I found this picture and do not know who took it.



Patty pan or scalloped squash growing in my garden. They start out green then turn white.

American colonists depended on squash and pumpkins. Patty pan squash was the most popular in summer. Colonists grew pumpkins in fields of maize (another name for corn) just like the Indians did. Much of the crop wasn't eaten by people but fed to livestock like cows, horses and pigs over the winter.

Winter squash and pumpkins are great crops for the winter. Kept in a cool, dry place pumpkins can stay firm for several months. They are packed with vitamins and minerals to keep animals and people healthy.

John Josselyn wrote about visiting New England in 1674. He saw housewives put big pots filled with water and diced pumpkin over their fires in the morning. As the pumpkin got soft and sank into the water, more pumpkin was added. At the end of the day butter, vinegar and spices like ginger were added before everyone had a big bowl of pumpkin soup for supper.

Other pumpkins were stewed the way apples were with vinegar and water. English housewives were making pumpkin pies. European colonists took seeds and their taste for squash and pumpkins with them to Africa and Asia.

By September of 1775 pumpkin seeds, probably Connecticut Field, were being offered for sale in the Virginia Gazette newspaper. Even Thomas Jefferson grew pumpkins. He fed them to his horses, cattle and sheep in the fall. He fattened hogs on them before turning the hogs into pork, bacon and ham.

Squash are still popular garden plants. There are lots of varieties. Summer squashes don't make vines. Their fruits are eaten small when the seeds and rinds are still soft.



Winter squashes grow on vines. They are left on the vines until they have hard rinds. These rinds protect the squashes so they will keep, sometimes for months, if they are kept cool and dry. Pumpkins are a kind of winter squash and are usually yellow, orange or red in color.



In Asia, Africa and Australia pumpkin is still cooked like a vegetable. In North America pumpkins are usually made into desserts. In Central and South America pumpkins can be eaten as a vegetable or as a dessert. However pumpkin is served, it is tasty and nutritious.

How Do You Say Pumpkin? Word Search 1

Circle or draw a line through each word as you find it. They can go across, up and down, diagonally, forward or backward.

Solution page 205



Word list:

- | | |
|--------------------------|-----------------------|
| Abobora [Portuguese] | Panpukin [Indonesian] |
| Boga [Swahili] | Pepon [Greek] |
| Calabaza [Spanish] | Potiron [French] |
| Hahl [Pima] | Pumpion [English] |
| Helvacı kabağı [Turkish] | Pumpkin [American] |
| Ipu pu [Hawaiian] | Pwnpen [Welsh] |
| Isito [Choctaw] | Sütötök [Hungarian] |
| Kuum [Mayan] | Tounasu [Japanese] |
| Labu [Malay] | Tung-kwa [Chinese] |
| Pampoen [Dutch] | Wagmu [Lakota Sioux] |

Pumpkin Note: The name pumpkin began as the Greek pepon for a large melon. The French changed this to pompon. In England it became pumpion. In the U.S. the name became pumpkin.

Investigation 1 How Big Is a Pumpkin Seed?

It's easy to say all seeds for one kind of plant are the same. They grow into the same kind of plant. They look a lot alike. Are all pumpkin seeds the same?

Question: Are all pumpkin seeds the same size?

Materials [What you need]:

10 Pumpkin seeds
Custard cup
Metric ruler [Scientists use the metric system.]
Piece of paper and a pencil
Science Journal

Procedure [How to do this investigation]:

Step 1: Open your Science Journal, write "Investigation 1" and the date. Then copy Table 1 into your Journal.

Step 2: Write down the kind of pumpkin seeds you are using.

Step 3: Dump ten pumpkin seeds out on a piece of paper.

Step 4: Pick out a pumpkin seed and draw it in your science journal. Describe the pumpkin seed. Is it shiny? Is it smooth? What color is it? Is the edge smooth? Is the edge the same all the way around? What does it smell like?

Step 5: Label a place '1' on the paper. Put a pumpkin seed under this and draw a short line above and below the seed and on each side at the widest place. Put the pumpkin seed in the custard cup.

Step 6: Repeat Steps 4 and 5 with another pumpkin seed but label it '2'.

Step 7: Keep repeating Step 6 until you have done all 10 pumpkin seeds labeled 1 to 10.

Step 8: Starting with the pumpkin seed 1 marks use the metric ruler to measure how many millimeters long the seed is. Write it down under the marks and label it 'L'. Then measure how wide pumpkin seed 1 is, write it underneath and label it 'W'.



Step 9: Do the same for pumpkin seeds 2 to 10.

Step 10: Write the 'L' measurements in Table 1 in your Science Journal for each seed.

Step 11: Write the 'W' measurements in Table 1 in your Science Journal for each seed.

Observations [What you see]:

Kind of Pumpkin Seeds:

Draw and describe a pumpkin seed:



Table 1		
Seed	Length	Width
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Total		
Average		

Seed	Length	Width
1	17	9
2	17	10
3	17	10
4	18	8
5	16	10
6	16	9
7	14	9
8	15	10
9	15	10
10	15	9
Total		
Average		

Analysis [Finding the size of an average seed]:

Step 1: Add up all the lengths and write it in the Table.

Step 2: Add up all the widths and write it in the Table.

Step 3: Divide the total lengths by 10 [the number of seeds]. This is the average length. Write it in the Table.

Step 4: Divide the total widths by 10 and write the average width in the Table.

Important Note about dividing: You only measured the seeds to a whole millimeter so the average length and width can only be a whole millimeter. If your quotient (answer) has a decimal, you should round it to the nearest whole millimeter. Your answer can not be more accurate than your original measurements which were in whole millimeters.

Seed	Length	Width
1	17	9
2	17	10
3	17	10
4	18	8
5	16	10
6	16	9
7	14	9
8	15	10
9	15	10
10	15	9
Total	160	94
Average	16	9.4

Looking at the Seed Averages another way:

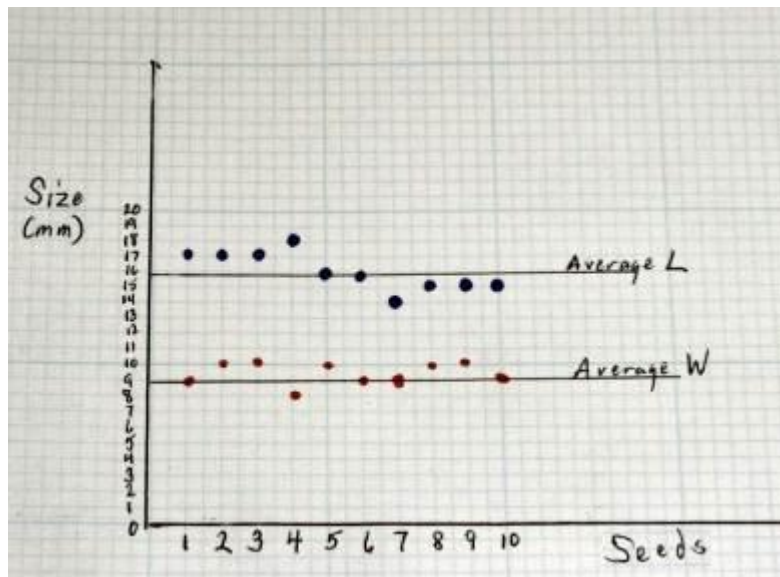
Step 1: Get a piece of graph paper. Label the x-axis (the one across the bottom) "Seeds" and number the lines 1 to 10 for the seeds.

Step 2: Label the y-axis (the one that goes up) "Size in mm" and number it from 0 (at the corner) up for millimeters

Step 3: Count up the y-axis to the average height of a pumpkin seed. Draw a line across at that average.

Step 4: Put a dot for the height of 1 above the 1, height of 2 above 2, all the way to 10

Step 5: Repeat Steps 4 and 5 for the width of the seeds (Use another color.)



Conclusions [Thinking about the investigation]:

Did all the seeds look a lot like the one you drew and described?

Why would all of this kind of pumpkin seeds look a lot alike?

Were all the seeds the same size?

Look at your graph to see how the dots compare to the line. Were most of the seeds close to the average size?

Why do you think most seeds are close to average size?

Why do you measure ten seeds to get the average size?

Would measuring more or fewer seeds give a better average? How many is enough?

Take 2 more seeds out of the packet and measure them. Are they close to the average size?

Why would scientists use an average size?

Do you think seeds from another pumpkin of the same kind as these seeds would be about the same size as these? Why do you think this?

Do you think seeds from a very big or very small kind of pumpkin would be the same average size? Why? Try measuring seeds from other kinds of pumpkins and find out if your hypothesis [idea] is correct.

Was this an accurate way to measure the length and width of the seeds? Explain why you think so. Can you think of a better way? Try your method and compare your results. Does it change your conclusions about seed size?



These are four different kinds of pumpkin seeds. The Jack-Be-Little seeds on the right are much smaller than the others. The Giant seeds on the left are much larger. But the sugar pie second from the right and the Connecticut Field next to them are almost the same size.

Do You Know Which One?

Which seed is a pumpkin seed? [Use your Investigation 1 drawing]



How did you choose the pumpkin seed?

Are the other seeds similar to the pumpkin seed?

Do you think the plants from these other seeds would be similar to a pumpkin plant? Explain why you think this. Try growing these kinds of seeds to find out or look up what plants these seeds become.

Seeds from top left clockwise: OKRA; MARIGOLD; RUTABAGA; CUCUMBER; BEET; PUMPKIN

Packets of Pumpkin Seeds

Pumpkin Story 2

Every spring seed displays and catalogs try to interest people in growing a garden. Gardeners and farmers have swapped seeds for as long as people have grown plants. But those pretty catalogs and packets are much newer.

Fancy seed packets first showed up in the 1840s to 1860s. A lithograph company wanted to increase their business so the company printed seed packets with lithographs or colored pictures on them. People looked at the pictures and wanted to grow flowers and vegetables just like in the pictures.

These seed packets were so popular, companies put them in their mail order catalogs in the 1870s. Most of these companies are no longer in business but Burpee Seed Company put out its first catalog in 1878 and is still mailing them out today.

Originally seeds were put into the packets by people. It was easier to weigh out some seeds and pour them into the packet than to count out a certain number of seeds. If you get several packets of the same kind of seeds and count the seeds in each of them, they will not be exactly the same. Remember Investigation 1. The weight of a seed varies just as the size does.

Today seeds are packed by machine. The process starts with a printing company. The company gets pictures of different kinds of flowers and vegetables from a seed company or photo library. These pictures and other information like growing instructions are printed on paper which is folded to make the packets. If you look at your packet of pumpkin seeds, you can see these things printed on the packets. These empty packets are sent to a seed company like Botanical Interests Seed Company in Broomfield, Colorado.

Botanical Interests buys bags of different kinds of seeds from farmers called seed multipliers because they grow their crops until their seeds are ripe instead of selling their vegetables and flowers earlier. When Botanical Interests buyers look for seeds, they want kinds that will grow well for home gardeners. Home gardeners want seeds to grow healthy, flavorful vegetables and beautiful flowers.

Gardening starting plants from seeds is a great way to grow good food for just a little money. Nature starts plants from seeds all the time so it's much easier than many people think it is.



Seeds are tested in a special lab. Most of these special labs use a test where four groups of 100 seeds are rolled in a moist paper towel and put in an incubator to keep them at the right temperature with the right amount of water. After a certain number of days the paper towels are unrolled, the germinated seeds are counted.

An average of how many germinate is calculated like you did to find the average size in Investigation 1. This is listed as a germination percent on the packet. Think how disappointed you would be if you planted your pumpkin seeds and none of them grew. Botanical Interests wants a high germination rate for all of their seeds before any are put into the seed packets.

The bags of tested seeds and the seed packets arrive at Botanical Interests. Someone dumps a sack of seeds into a big hopper or bin on the seed packing machine. Someone puts the empty packets into a tray. The machine is set for the weight of seeds to go into each packet. Everything is ready so the machine is turned on.

Seeds pour into a cup to be weighed. The first packet moves up. When the right weight is in the cup, it dumps the seeds into a funnel which pours the seeds into the packet. The filled packet is glued shut and stacked in a tray. When the tray is full the packets are ready to put into a display or send to someone like you to grow a garden.



Seeds are poured into the red and blue hopper at the top. A set weight of seeds is let out of the bottom of the hopper. These are poured into the packet which is sealed and put into the tray. This picture was sent to me by Botanical Interests.

What's the Difference? Pumpkin Saying 1

Write the word for each definition on the blanks. Write each letter on its numbered blank. When all the letters are filled in, you can read the answer to the question. Some of the letters are used in more than one definition and have the same number and can help you think of more definitions. For example, letter number 22 is in definitions 1 and 3, number 16 is in 5 and 6.

Solution page 206

1. The pieces of glass in a window.....

22	1	28	19	8
----	---	----	----	---
2. Something you don't expect.....

12	10	17	25	32	14	30	6
----	----	----	----	----	----	----	---
3. A number only divisible by one and itself.....

22	32	29	24	18
----	----	----	----	----
4. A deep breath you can hear.....

15	3	35	13
----	---	----	----
5. The time of day before noon.....

24	31	7	4	27	20	16
----	----	---	---	----	----	----
6. The month before September.....

33	10	16	23	8	5
----	----	----	----	---	---
7. An old object people might collect.....

21	34	5	29	9	23	18
----	----	---	----	---	----	----
8. What your ears do.....

13	19	11	7
----	----	----	---
9. What you are when you're not asleep.....

11	2	33	26	36
----	---	----	----	----
10. What you hear when there is no sound.....

9	23	3	36	5
---	----	---	----	---

1	2	3	4	5	6	7	8	9	10	11	12	13		
14	15	16	17	18	19	20	21							
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

Pumpkin Note: A pumpkin is a cucurbit, a member of the gourd family along with gourds, melons, cucumbers and squash.

Investigation 2 What's In a Pumpkin Seed?

Lots of animals eat seeds, but a plant makes seeds to grow new plants. Each of the three main parts of a seed has a purpose. Let's look at these parts.

Note: You may want an adult to use the paring knife.

Question: What are the three parts of a seed?

Materials:

- 3 Pumpkin seeds
- Metric ruler
- Cup of warm water
- Custard cup
- Paring knife
- Magnifying glass

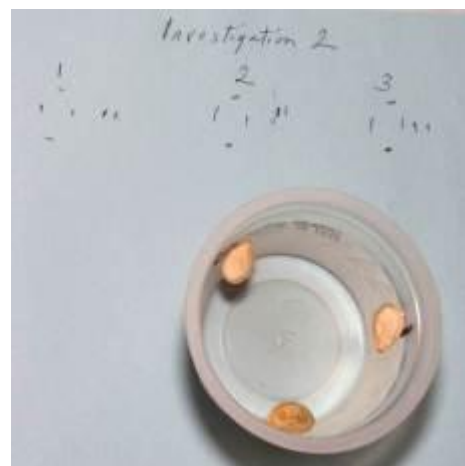
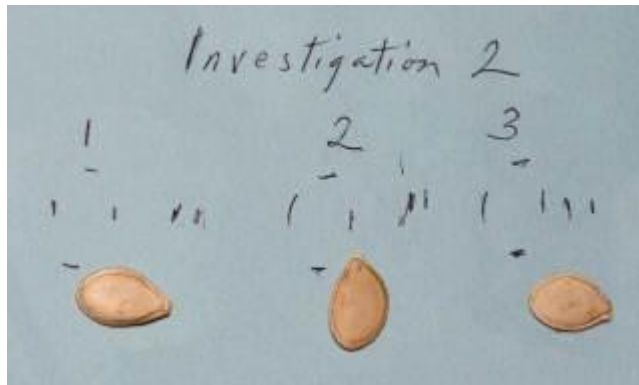
Procedure:

Step 1: Open your Science Journal, write "Investigation 2" and the date. Draw Table 1 in your journal.

Step 2: Measure the length, width and fatness of Seeds 1, 2, and 3 in millimeters. You can use the same method you used in Investigation 1. Record the measurements in Table 1.

Step 3: Mark 1, 2 and 3 at different spots on the custard cup. Pour water in it. Put the seeds in the water by their numbers to soak until the seed feels like it has air under the surface and bends a little [about an hour].

Step 4: Take Seed 1 out of the water and dry it. Mark its length, width and fatness below the first marks.

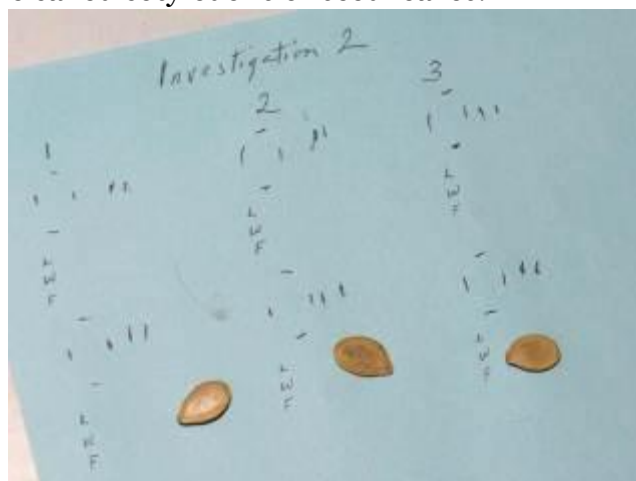


Step 5: Take the seed coat off. You may have to use the paring knife. Try to tear the coating. Describe how it feels on the outside and the inside.

Step 6: Look at the inside of the seed. Is it one piece or two? How does it feel? What color is it? The two pieces are called cotyledons or seed leaves.

Step 7: Use the paring knife to cut the blunt end off the cotyledons. Use the paring knife to carefully pry them apart. What do the insides of the cotyledons look like? What do you see at the sharp end of the cotyledons?

Step 8: It's very hard to do these steps well so repeat them with the other two seeds.

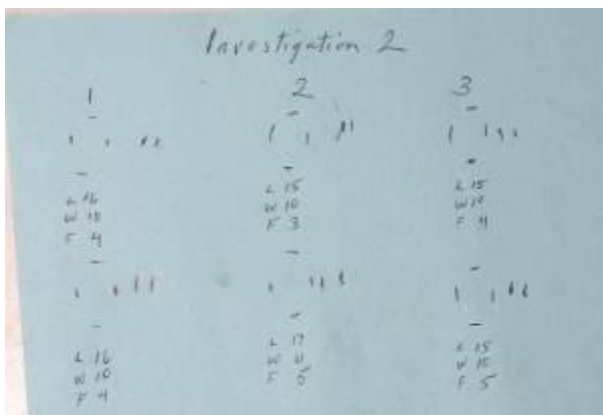


Observations:

Measure the beginning and ending length, width and fatness of each seed. Write the measurements in the table.

Table 1:

Measurements	Length			Width			Fatness		
	1	2	3	1	2	3	1	2	3
Seed									
Beginning									
Ending									
Difference									



Draw and describe the three parts of the seed: the seed coat, the cotyledons and the plant embryo.

Analysis:

Subtract the ending measurement from the beginning measurement for the length, width and fatness of each seed.

Conclusions:

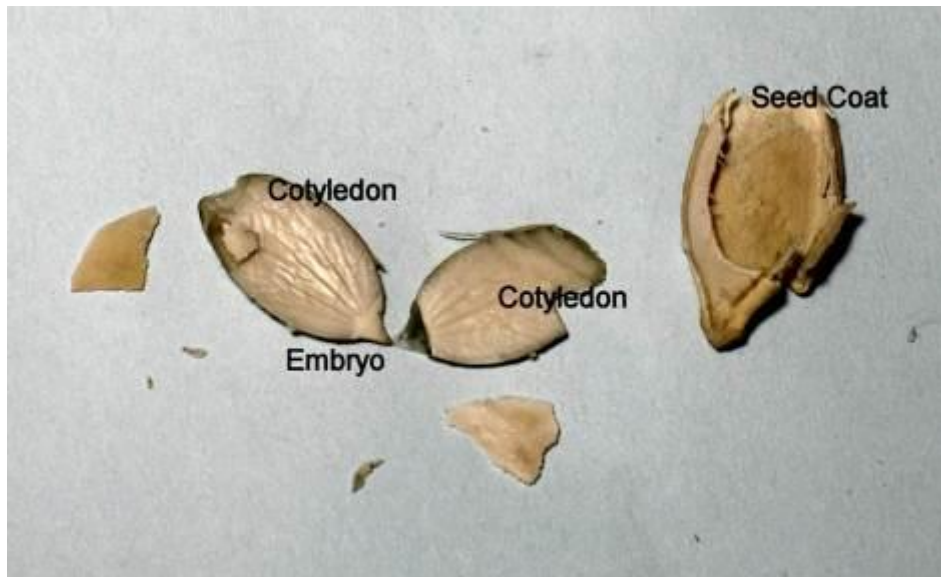
Did the length, width or fatness of the seeds change? Why do you think this is the case? Why is it important to know if these change?

Do you think three seeds is a big enough sample? Why?

Why did we soak the pumpkin seeds before trying to cut them open? [Try cutting a dry one open.]

What do you think each part of the seed does?

When you buy roasted pumpkin seeds, sometimes the seed coats are removed. Why?



Who Grew That Kind of Pumpkin? Pumpkin Deduction 1

To solve a pumpkin deduction read each clue. Put an 'X' in a box if that choice is not true. In Clue 5, Kevin did not grow Jack-B-Little pumpkins so find the box under Kevin and across from Jack-B-Little and put an 'X' in it. Do this until only one box across or down for What kind or the four friends is open. That must be who grew that kind of pumpkin. Do the same for how many plants each grew.

Solution page 209

Four friends wanted something to do for the summer. They decided to grow pumpkins. Each friend picked a different kind of pumpkin. Each had room for a different number of pumpkin plants. The clues will help you find out who grew each kind of pumpkin and how many plants they had.

1. Amanda lives in an apartment and grew two small plants on her balcony.
2. Robert grew the most plants. He didn't grow Jack-B-Little or Jack-o-Lantern.
3. Patricia grew one more plant than Amanda did and one less than Kevin.
4. Amanda didn't grow Lumina or Trick or Treat.
5. Kevin didn't grow Jack-B-Little.
6. Five Lumina plants grew and only two Jack-B-Little plants.
7. Patricia likes to eat pumpkin seeds but doesn't like the hulls so she grew Trick or Treat.

		Who				How Many			
		Robert	Kevin	Amanda	Patricia	2	3	4	5
What Kind	Lumina								
	Jack-B-Little								
	Jack o'Lantern								
	Trick or Treat								
How Many	2								
	3								
	4								
	5								

Pumpkin Note: Ken Walker found some pumpkin seeds in an old Michigan farmhouse. The label on the sealed jar said 1957 pie pumpkin seeds. He grew the seeds 45 years later. Most pumpkin seeds will only germinate within 5 to 7 years.

Speaking of Seeds

My pumpkin seeds looked a lot alike. They were light yellow, flat and oval with a little rim around the edge. One end had a flat spot in it. In Investigation 2 I saw the plant embryo was at the flat spot. Since they were all pumpkin seeds, they should probably look a lot alike.

Not all of the pumpkin seeds were the same size. Some were smaller. Some were longer. Some were wider. But they were all close to the average size. Because they were all the same kind of seed they would be about the same size.

Measuring more than ten pumpkin seeds to find an average size would probably not change the average. I think that because all the seeds I measured were so close to the average size.

Scientists like to use an average in case the single seed they pick out is one of the very big ones or very small ones. Using the average size makes their results good for all of that kind of seeds.

One year I grew very small pumpkins, sugar pie pumpkins, regular pumpkins and giant pumpkins. The seeds of each kind were different sizes. The very small pumpkins had the smallest seeds. The giant pumpkins had the largest seeds.

The next year I grew another kind of sugar pie pumpkin and another kind of regular pumpkin. Their seeds were about the same size as the sugar pie pumpkin and regular pumpkins I grew the year before. I had some left over seeds and could compare them. So pumpkins about the same size seem to have seeds about the same size.

Making marks around the seeds had to be done very carefully. I had to hold the pencil the same way each time so it didn't slant in or out. I think, if the marks are made the same way around each seed, this method is pretty accurate.

There is a measuring device called a caliper. It has a fixed top and a moveable bottom piece. It is adjusted exactly on the top and bottom of something like a seed. This would be more accurate but I don't think it would change the results very much.



Using a caliper would be much better for measuring how fat a pumpkin seed is. It's very hard to mark how fat a seed is on paper because it has a bulge on each side. I found it was more accurate to hold the seed against a ruler and line up the millimeter marks so I could see how fat the seed was.

Seeds seem very dry. Plants have lots of water in them. So seeds should soak up water if they are in some.

Before soaking a pumpkin seed breaks up when it gets cut with a knife. The soaked seeds are much easier to see inside. The cotyledons and embryo are bigger.

The parts of the pumpkin seeds were the same in all three seeds. Taking one apart was difficult but at least two came apart so all the parts could be seen. Three seeds were enough just to see the three parts.

If I wanted to measure how much a seed changed, three seeds would not be enough. With these three, some changed and others didn't. Which is right? Using only three seeds I don't know. Also, does the amount of time soaking matter to how much a seed changes? Again I would want to use more than three seeds.

The seed coat was smooth on the outside and rough on the inside. It was very hard to tear. It must protect the seed. It can do that well.

Some pumpkin seeds are roasted and sold with the seed coats on. I don't like those much because the seed coats are hard and don't taste very good. There are some kinds of pumpkins without seed coats or very thin ones on their seeds. These would be much better for roasted pumpkin seeds.

The cotyledons were the biggest part of the seed. There were two of them, one on each side of the embryo. They must help protect the embryo inside the seed too.

Cotyledons have starch in them called endosperm. Starch is a kind of food. Flour is made of starch. So the cotyledons have stored food in them to feed the embryo. We'll see more of what the cotyledons do when we look at pumpkin sprouts.

The plant embryo is a new plant waiting to grow. It has the beginning of a root called the radicle and the beginning of a stem with tiny leaves. When they get wet, they get bigger and break out of the seed. This is germination, the beginning of a new plant, if everything goes right.



Mini and Small Pumpkins

Word Search 2

Solution page 205



Word List:

Baby Bear	Orange Smoothie
Baby Boo	Small Sugar Pie
Baby Pam	Snackjack
Batwing	Spooktacular
Buckskin	Sugar Treat
Fairytale	Sweet Lightning
Jack Be Little	Sweetie Pie
Jack Be Quick	Wee B Little
Munchkin	Winter Luxury

Pumpkin Note: Pumpkins are grown on every continent except Antarctica.

Investigation 3 How Does a Pumpkin Seed Germinate?

A seed looks nothing like a plant. The parts of a seed must change for the seed to become a plant. Let's take a look at some of those changes.

Question: How does a seed change as it germinates [sprouts]?

Materials:

- 2 Pumpkin seeds
- Custard cup or other small shallow cup
- Paper towel
- Plastic wrap
- Metric ruler

Procedure:

- Step 1:** Open your Science Journal, write "Investigation 3" and the date. Draw Table 1 in your journal.
- Step 2:** Label the outside of the custard cup '1' and '2' on opposite sides.
- Step 2:** Put a double layer piece of paper towel in the bottom of the custard cup.
- Step 3:** Add enough water to make the towel wet but not soggy.
- Step 4:** Measure the length, width and fatness of the 2 seeds in millimeters. You can use the same method you used in Investigations 1 and 2. Write the measurements in for Day 0.
- Step 5:** Put Seed 1 on the side labeled 1 and Seed 2 on the side labeled 2 on the wet paper towel.
- Step 6:** Cover the top of the custard cup with plastic wrap. You may need to use a rubber band to keep the plastic wrap on.
- Step 7:** Measure the 2 seeds every day until they start to grow. Be sure the paper towel stays moist.

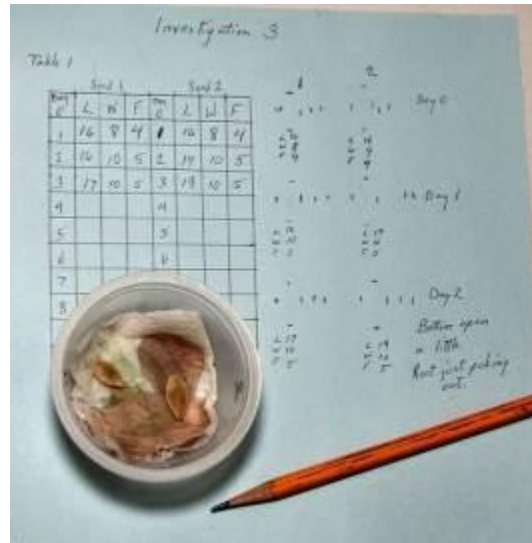


Observations:

Table 1:

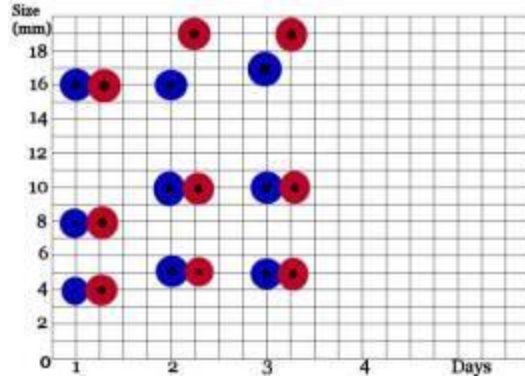
Day	Seed 1			Seed 2		
	Height	Width	Fatness	Height	Width	Fatness
0						
1						
2						
3						
4						
5						
6						
7						

Draw the germinating seed:



Analysis:

- Step 1:** Get a piece of graph paper. Label the x-axis (horizontal) 0 to 7 for the days.
- Step 2:** Label the y-axis (vertical) 0 on up for the millimeters
- Step 3:** Use different colors for each seed and mark the measurements for each seed for each day. This means each seed has three marks, for height, for width and for fatness.
- Step 4:** Connect each line of dots for each seed's measurements



Conclusions:

Why does the seed swell up?

Does the seed keep swelling the entire time? Why do you think it does this?

Do the height, width and fatness all change? Why do you think this is true?

Where does the radicle [baby root] come out? Why would it come out here? (Think back to Investigation 2.)

How is the seed edge different where the radicle comes out?

Why do you think the root comes out first?

Pumpkins In Books Pumpkin Saying 2

This saying is from "The Legend of Sleepy Hollow" written by Washington Irving in 1820.

Solution page 206

1. Something unexpected.....
15 31 13 41 34 4 28 11
2. To breathe out.....
17 32 24 7 30 43
3. Your idea about something.....
39 16 2 5 42 14 5
4. Not rough.....
20 8 27 36 19 24
5. The normal routine.....
33 44 37 7 10
6. Look something up.....
1 21 36 6 30 17 35 29
7. To write music.....
18 36 26 12 21 38 25
8. Not floppy.....
44 23 35 22 40
9. Stone age lifestyle.....
9 13 2 8 4 23 35 3 11
10. Wait for something.....
17 32 12 43 18 23

1	2	3	4	5	6	7	8	9	10	11				
12	13	14	15	16	17	18	19	20	21	22	23	24	25	
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44											

Pumpkin Note: Native Americans dried strips from pumpkins and wove mats from them.

Project 1

Part 1: Making Plans

It's easy to guess what the first big Project is in a book about pumpkins. Project 1 is growing a pumpkin!

Before you race to the store and buy some pumpkin seeds to grow, let's make plans.

What Kind of Pumpkin Should You Grow?

There are lots of kinds of pumpkins. Some are very small. Others can get extremely large. They come in different colors. Some have warts. Some have strange things on them.

Before you pick a kind of pumpkin, you must decide where your pumpkin will grow. The space needed is given as square like 10 feet by 10 feet but it can be longer and narrower as 5 feet by 20 feet, just have that much room. The place must get at least half a day of sunlight.

Small pumpkins need only a little space, even a big pot will do. They can grow on a trellis. If you have only a little place for your pumpkin plant, you should grow a little pumpkin.

Sugar pie pumpkins are a little bigger. These seven to ten pound pumpkins are the best kinds for eating. They need a space about ten feet square. They can grow on a big trellis but you will have to support the pumpkins.

Halloween pumpkins get ten to twenty-five pounds. These pumpkins can be eaten too. They are not as sweet as pie kinds and are stringier. These plants need a place twenty feet square.

Really big pumpkins need lots of room. Giant pumpkin plants need a place at least forty feet square. These plants need special care every day. They need lots of fertilizer and water. But growing one of these really big pumpkins is exciting.



What Kind of Pumpkin Will You Grow?

Once you know how much room your pumpkin plant will have, you can pick a kind to grow. Mini pumpkins come in orange, white and two colors. Pie pumpkins come in colors too but it is hard to tell when a white pumpkin is really ripe. Bigger pumpkins have even more choices. Pick out your favorite pumpkin of the size you can grow.

Getting Ready

Serious pumpkin growers start the year before. They add manure to the place their pumpkin plants will grow. They kill off the grass and weeds.

We are starting in the spring so we have to hurry to get ready. You need to till or spade up your pumpkin area. Add compost and mix it into the soil.

If the spot is covered with grass or weeds, you need to get rid of them. It takes more work but is better for your pumpkin plants if you mulch or till or pull those pesky weeds and grass. Herbicides do kill weeds but can kill lots of other things too including your pumpkin plants.



Keeping Records

Be sure to keep notes about your pumpkin plants. Write the date when you plant the seeds, what kind of seeds they are. Write when the seeds germinate and sprout. Draw what the sprouts look like and compare this to your Investigation drawings. Draw and measure the length of the cotyledons every day. Write down when the first leaves appear. Draw and measure them until they get big. Write down anything else interesting that happens to your pumpkin plants.

When Do We Start?

Even a little frost will kill a pumpkin plant. Small, sugar pie and Halloween pumpkin kinds are planted in the garden after spring really arrives. Giant pumpkins can be planted then, but many growers start them in the house earlier.

While we wait, we'll find out more about pumpkins.



How Many Seeds? Pumpkin Deduction 2

Solution page 209

“Who spilled all the pumpkin seeds?” asked Kristen. “Now they’re all mixed up.”
 “I’ll help sort them,” said Dylan. “My Jack-Be-Little seeds are the smallest ones.”
 “Aren’t all pumpkin seeds the same?” asked Natalie.
 “No!” said Kristen and Dylan.

The three friends sat down and sorted out the pile of pumpkin seeds into small, medium and large. Who collected which size of seeds? How many of each size were there?

1. Dylan sorted out his own seeds which were five fewer than the most seeds.
2. The smallest number of seeds was ten which were not the smallest seeds.
3. Dylan had five more seeds than Kristen.
4. Natalie didn’t sort out the biggest seeds.

	Seeds			Size		
				Small	Medium	Large
Dylan						
Kristen						
Natalie						
Small						
Medium						
Large						

Pumpkin Note: No pumpkins are mentioned in the Grimm’s fairy tale Cinderella.

Investigation 4 Does Direction Matter?

In nature a seed might fall on the ground or get buried in mud or by an animal. When a gardener plants a seed, that person can point the seed any direction. Let's find out if there is a best way to plant a pumpkin seed.

Question: Does it matter which end of a seed points down?

Materials:

- 6 Pumpkin seeds
- Small clear glass or jar with straight sides
- Paper towel
- Cardboard
- Scissors

Procedure:

- Step 1:** Open your Science Journal, write "Investigation 4" and the date.
- Step 2:** Cut a strip of cardboard 1.5cm shorter than the glass or the jar shoulder and 2.5cm longer than the circumference of the glass or jar.
- Step 3:** Roll up the cardboard strip and slip it into the glass or jar to make sure it fits. When you let it go, the cardboard should unroll against the glass. You may have to push it out a little. Take the cardboard out again.
- Step 4:** Fold the paper towel so it fits around the outside of the cardboard ring.
- Step 5:** Roll the cardboard and paper towel up and put them into the glass or jar so the paper towel touches the glass. It must be very tight. You may need to fasten the cardboard ring with a paperclip to keep it tight.
- Step 6:** Carefully slide the pumpkin seeds about half way down between the paper towel and glass so two point in each different direction, up, down and sideways. This can take patience and maybe a thin knife to push the seeds around. The seeds must be at least 3cm from the top and 3cm from the bottom.



Step 7: Pour 2cm water into the glass and set it aside. The water will soak up into the paper towel. Make sure about 1.5 – 2cm of water is left in the jar. You may have to add some water to do this. Set the jar aside.

Step 8: Check the seeds everyday until they germinate and start to grow. Draw them in your Journal.

Step 9: After the radicle comes out, watch for the cotyledons. Draw them in your Journal.

Observations:

Seed 1: Which direction does it point?

How many days until it germinates?

What does the radicle do?

What do the cotyledons do?

Seed 2: Which direction does it point?

How many days until it germinates?

What does the radicle do?

What do the cotyledons do?

Seed 3: Which direction does it point?

How many days until it germinates?

What does the radicle do?

What do the cotyledons do?

Seed 4: Which direction does it point?

How many days until it germinates?

What does the radicle do?

What do the cotyledons do?

Seed 5: Which direction does it point?

How many days until it germinates?

What does the radicle do?

What do the cotyledons do?

Seed 6: Which direction does it point?

How many days until it germinates?

What does the radicle do?

What do the cotyledons do?



Conclusions:

What happens to the radicle [baby root] when it starts to grow?

Why is it important for the radicle to do this?

What do you think causes the radicle to do this?

What happens to the sprout when it starts to grow?

Why is it important for the sprout to do this?

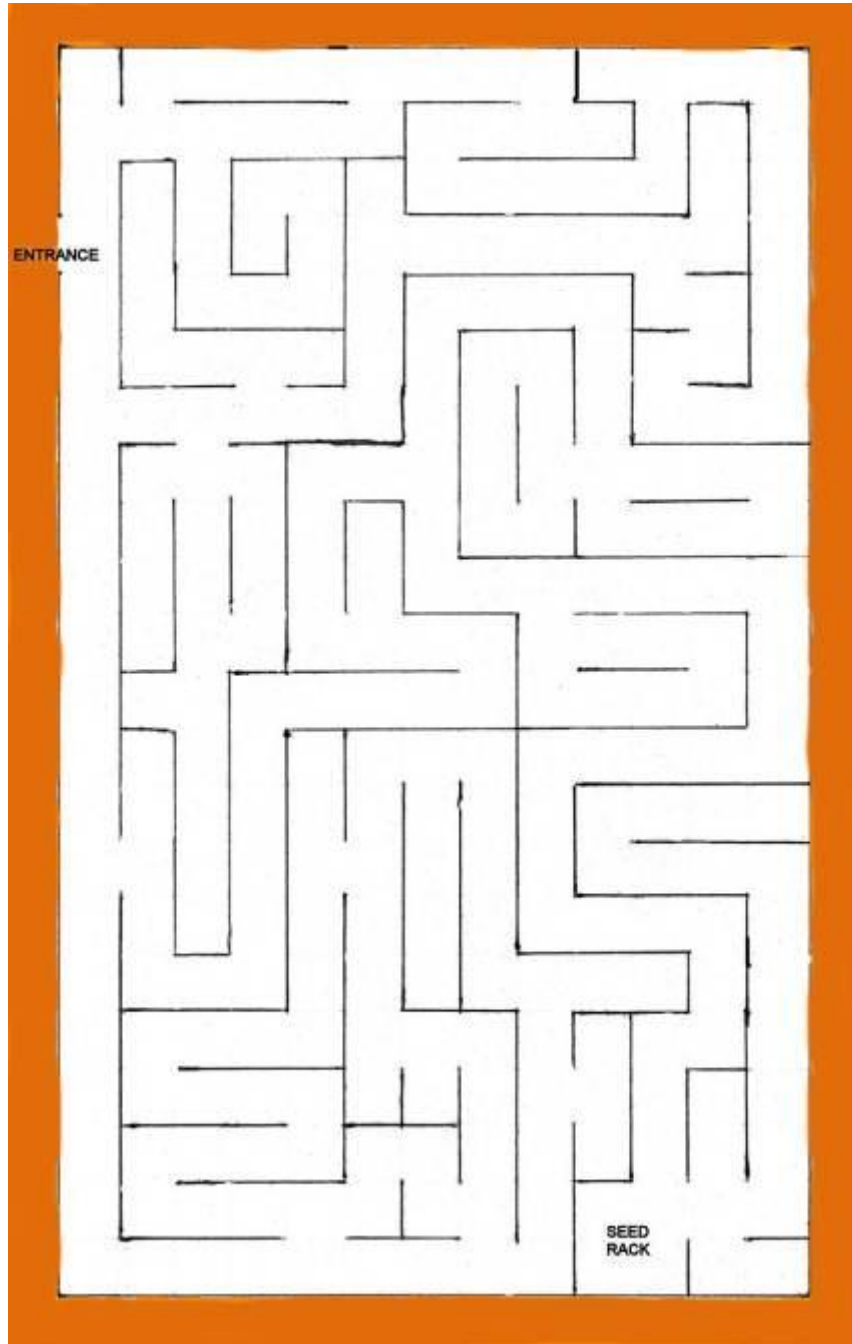
What do you think causes the sprout to do this?

Which is the best way to plant a pumpkin seed?

Buying Pumpkin Seeds Pumpkin Trail 1

Jason has gone to the store to buy pumpkin seeds to plant. He doesn't know where to find the seed rack. Can you show him the way?

Solution page 211



Investigation 5

What Does a Pumpkin Seed Need to Grow?

In nature pumpkin seeds end up on the ground when an animal eats them or the pumpkin rots. Once on the ground, how does a seed know when to grow?

Question: Do light, water and temperature matter to a pumpkin seed and sprout?

Materials:

- 3-Styrofoam cups filled with dry potting soil (Let the soil sit out in a tray to dry, stirring it every day until it is very dry.)
- 3-Styrofoam cups filled with potting soil
- 24-Pumpkin seeds
- Water
- Plastic wrap
- Flashlight
- Metric ruler
- A dark closet or box, a refrigerator [ask first], a warm, light counter

Procedure:

Step 1: Open your Science Journal, write “Investigation 5” and the date. Draw Tables 1 and 2 in your journal.

Step 2: Label the cups DW, DY, LW, LY, CW, CY [D dark, L light, C cold; Y dry, W wet].

Step 3: Add water to all the cups with a W label so the dirt is damp but not muddy.

Step 4: Push two seeds 2cm deep in each cup, cover them and firm the dirt. Remember the best way from Investigation 4.

Step 5: Lay two seeds on top of the dirt in each cup.

Step 6: Cover the cups with plastic wrap.

Step 7: Put the two cups with a D label in a warm, dark closet or under a box.

Step 8: Put the two cups with an L label in a warm light place.

Step 9: Put the two cups with a C label in the refrigerator.

Step 10: Check the seeds everyday until the first seeds start to germinate. Take the plastic wrap off.



Step 11: Check and measure the sprouts everyday for seven days. Measure only the length of the stem. Try to do the ones in the closet quickly and use a flashlight with the door closed so they stay in the dark as much as possible. If the cups are under a box, wait until the room is dark and use a flashlight. Don't shine the flashlight on the sprouts.

Note: Some of the seeds may not sprout. Start counting the seven days from when the first seeds germinate.

Observations:

Write down how long each sprout is in the table and what it looks like in your notes.

Table 1													
Cup	Day	1	2	3	4	5	6	7					
DW	In												
	Top												
DD	In												
	Top												
LW	In												
	Top												
LD	In												
	Top												
CW	In												
	Top												
CD	In												
	Top												

Conclusions:

Are the seeds pushed into the dirt in the light or in the dark? Why do you think so?

Is this the same as putting the seeds in a dark closet? Why do you think so?

Why are some seeds pushed into the dirt and others left on top?

Does it matter if seeds are in the light or dark to germinate? Why do you think so?

Does it matter if sprouts are in the light or dark? Why do you think so?

Does it matter if seeds are wet or dry to germinate? Why do you think so?

Does it matter if the sprouts are wet or dry to grow? Why do you think so?

Do you think how wet a seed is would matter? Can you think of a way to test your opinion? When you have, try it and find out if it matters how wet a seed is.

Does it matter if seeds are warm or cold to germinate? Why do you think so?

Does it matter if sprouts are warm or cold to grow? Why do you think so?

Do you think these results would be true for all seeds? Why do you think so?

Which two cups do you think these are? Why do you think so?

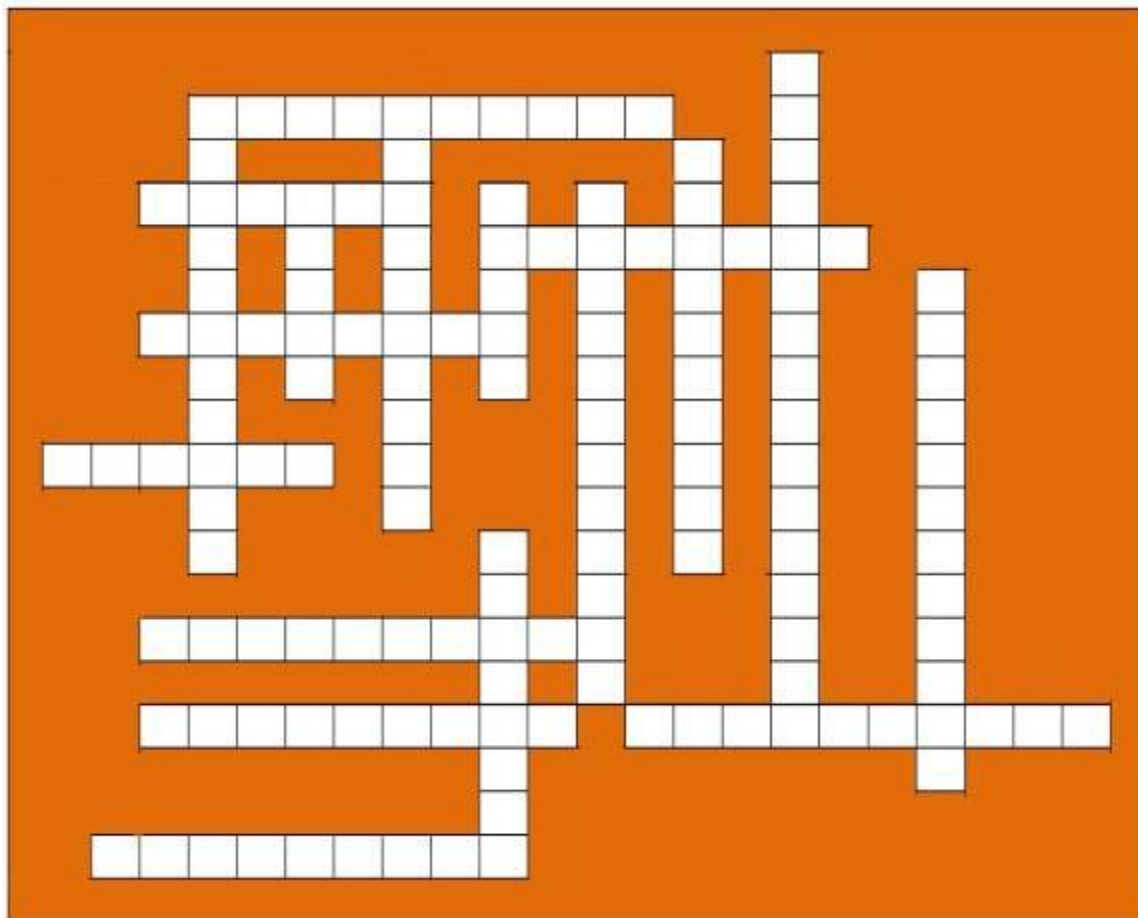


Why do you think the tips of some cotyledons in the cup on the right are green when the rest is yellow?

The green sprouts are in the light, wet cup. The yellow sprouts are in the dark, wet cup. The yellow sprouts were under a box. The tips of the cotyledons poked out under the edge and started turning green.

Favorite Halloween Pumpkins Word Skeleton 1

Solution page 208



Word List:

Aspen
Rumbo
Lumina
Spirit
Sorcerer
Jamboree

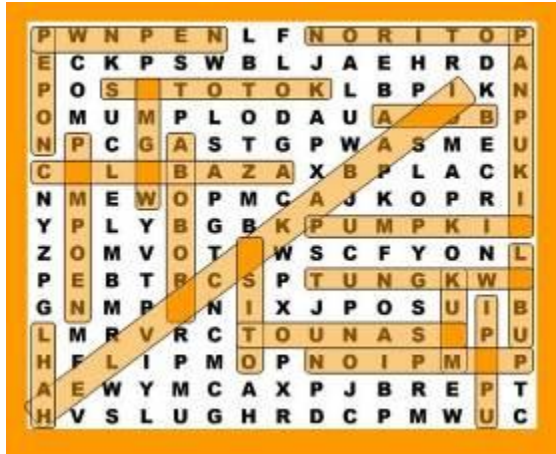
Half Moon
Big Autumn
Autumn Gold
Cinderella
Gold Strike
Mother Lode

One Too Many
Appalachian
Jack o'Lantern
Trick or Treat
Halloween
Connecticut Field

Pumpkin Note: Native Americans roasted strips of pumpkin over a fire to eat.

Solutions

1. How Do You Say Pumpkin?



2. Mini and Small Pumpkins



1. What's the Difference?

Definitions:

1. Panes
2. Surprise
3. Prime
4. Sigh
5. Morning
6. August
7. Antique
8. Hear
9. Awake
10. Quiet

Saying:

A winter squash is green.
A pumpkin is orange.

2. Legend of Sleepy Hollow

Definitions:

1. Surprise
2. Exhale
3. Opinion
4. Smooth
5. Usual
6. Google it
7. Compose
8. Still
9. Primitive
10. Expect

Saying:

Giving ample prospects of the most
luxurious of pies

1. Who Grew That Kind of Pumpkin?

Patricia grew 3 (clue 3) Trick or Treat (clue 7) plants. Amanda grew 2 (clue 1) Jack-B-Little (clue 6) plants. Robert grew 5 (clue 2) Lumina (clue 6) plants. Kevin then grew 4 Jack o'Lantern plants.

		Who				How Many			
		Robert	Kevin	Amanda	Patricia	2	3	4	5
What Kind	Lumina	•	X	X	X	X	X	X	•
	Jack-B-Little	X	X	•	X	•	X	X	X
	Jack o'Lantern	X	•	X	X	X	X	•	X
	Trick or Treat	X	X	X	•	X	•	X	X
How Many	2	X	X	•	X				
	3	X	X	X	•				
	4	X	•	X	X				
	5	•	X	X	X				

2. How Many Seeds?

Kristen collected the fewest seeds (clues 1, 3) which was 10 (clue 2). These were the biggest seeds (introduction, clue 4). Dylan collected 15 (clues 1, 2, 3) of the smallest seeds (introduction). Natalie collected 20 (clue 1) medium (introduction, clue 4) seeds.

	Seeds			Size		
	10	15	20	Small	Medium	Large
Dylan	X	•	X	•	X	X
Kristen	•	X	X	X	X	•
Natalie	X	X	•	X	•	X
Small	X	•	X			
Medium	X	X	•			
Large	•	X	X			

1. Buying Pumpkin Seeds



1. Favorite Halloween Pumpkins

