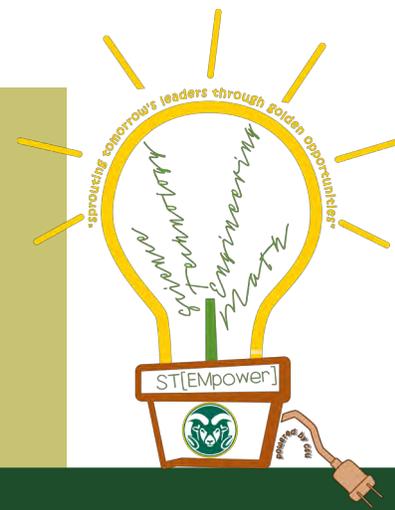


ST[EMpower]

“MAGIC” OF HOGWARTS!



VOLUME 10, ISSUE 1, OCTOBER 2020

School of Witchcraft and Wizardry

THIS MONTH

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- A New Broom! page 4
- **Cloverbud Fun!**
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 - Seventh Year: Bertie Botts Beans page 24
- **Cogitation Expedition** page 29

POWER WORDS

- **cogitation:** thinking deeply about something
- **format:** the way in which something is arranged or set out

This year ST[EMpower] issues focus on seasonal fun! The October Issue is inspired by Rio Blanco County's annual Hogwarts Night!

There are **format** changes:

- Cloverbud Fun: Activities for youth 5 to 8 years. Designed to do with an adult (parent).
- 4-H Fun!: Activities for youth 8 to 18 years.
- 4-H Teens: A specially designed project for teens.
- **Cogitation Expedition:** a deep dive in reasoning.

- In the past, each issue contained careers and career exploration. Those activities are now in one issue 62. Careers Special Issue located: <https://tra.extension.colostate.edu/stem-k12/stem-resources/>.

This year's ST[EMpower] will continue to have blazing fun with the full range of STEM projects, adventures, explorations, and experiments.

Happy October!



SCIENCE, TECHNOLOGY,
ENGINEERING, AND MATH
COLORADO STATE UNIVERSITY
EXTENSION

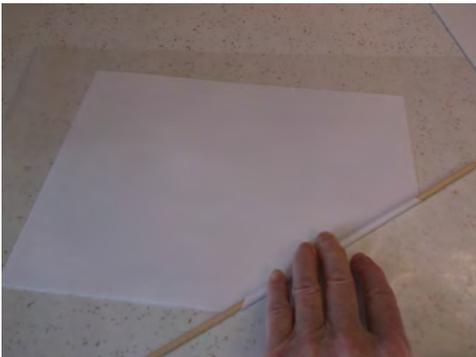
COLORADO STATE UNIVERSITY EXTENSION
4-H PROGRAMS ARE AVAILABLE TO ALL WITHOUT DISCRIMINATION

You can make your own Hogwarts's Wand with paper and glue! The directions are for the all paper wand. If you have a hot glue gun and glue sticks, you can further decorate your wand to be uniquely yours.

This issue is also exploring ideas of **make-believe**, **fact**, **fantasy**, and **imagination**.

Directions:

- Lay your paper on the table. Place the bamboo skewer at one corner diagonally. Start to tightly roll your paper diagonally towards the opposite corner around the bamboo skewer. As you roll, be sure that one end is tighter than the other, so the wand is **tapered**.



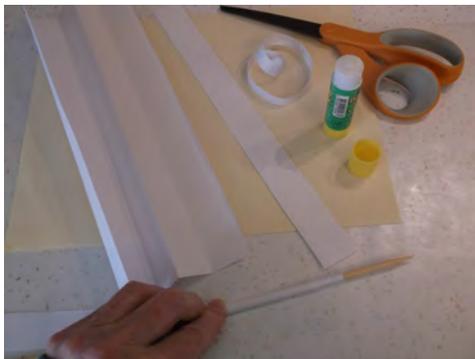
- When you have rolled about $\frac{2}{3}$ of the paper, add your glue to the remaining unrolled section of paper. Finish rolling your paper over the glue and hold until the paper sticks.



- Allow the glue to dry completely.
- Cut the tips of the paper on both ends of the wand, so the ends are straight.
- Form the ends of the wand with bits of paper. Tear two small pieces of paper (thin paper, like tissue or newspaper, works best). Crumple them tightly and tapered. Insert the tapered end into the wand, and add a bit of glue to secure.



- With another piece of paper, fold lengthwise in half. Fold in half again. Fold in half one more time. Unfold your paper and cut the 8 strips.



POWER WORDS

- **dowel:** a peg of wood, metal, or plastic without a distinct head, used for holding together components of a structure
- **fact:** a thing that is known or proved to be true
- **fantasy:** the faculty or activity of imagining things, especially things that are impossible or improbable
- **imagination:** the ability of the mind to be creative or resourceful
- **make-believe:** pretend; imagine
- **taper:** diminish or reduce in thickness toward one end

Now you have your own wand !

- Roll each of the four strips around the bamboo skewer from one corner



MATERIALS

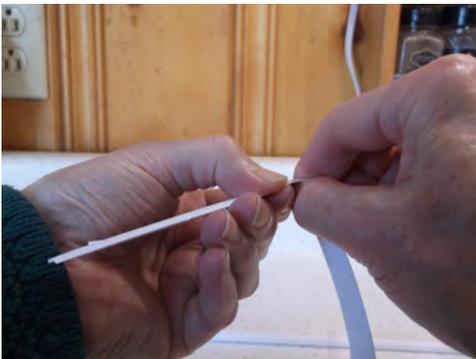
- 2 sheets 8½ x 11" paper
- glue stick or white glue
- wax paper (protect your table surface)
- bamboo skewer / thin **dowel**
- scissors
- tissue paper
- paint brushes
- paint (browns, golds, tans, or your favorites)
- cup for paint water
- optional—hot glue gun

of paper as tightly as possible.

- When you have rolled about $\frac{2}{3}$ of the paper, add glue to the unrolled strip. Finish rolling the strip and hold until the paper sticks.



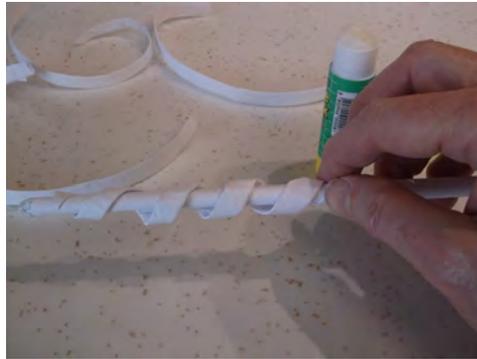
- Flatten and curl each of the paper rolls.



- Add glue one end of a paper strip. Hold at an angle on the handle end of your wand until it sticks.



- Wind the first paper strip around the top to form the handle end. Add glue several times to make sure the strip sticks to the wand.



- You can use the other strips of paper to loosely wrap around your wand. Glue and tuck the end into the strip already on your wand.
- Remember to add glue several times as you loosely wrap the strips around your wand to secure.



- Paint your wand. Be sure to get the paint in all the creases and **crevices**.
- Dry completely (image of a completed wand page 1).
- If you have a glue gun, you can decorate your wand with the hot glue gun glue instead of your paper strips (or with

POWER WORDS

- **channel:** direct toward a particular end or object
- **cogitation:** the action of thinking deeply about something; contemplation
- **crevice:** a narrow opening or fissure, especially in a rock or wall
- **quasi-:** prefix meaning partly or almost



- both). Hot glue can burn skin, so be careful. Paint your wand and dry. After the hot glue is dry, paint your wand.
- You can paint your wand any color. Are your favorite colors blue, purple, and pink? What about silver, black, and blue? Remember, the wand picks you!

COGITATION:

- J.K. Rowling included wands in her stories. They are quasi-magical instruments that help the witch or wizard can better **channel** their magic.
- J.K. Rowling writes about an amazing wizarding world. Is this fact, fantasy, make-believe, or imagination? Think about each term and if it applies to her books and/or the movies.

Brooms are very important equipment for budding wizards and witches. Your challenge is to build your own flying broom!

There are four forces in flight:

- lift vs. gravity
- thrust vs. drag

The shape of a bird or airplane wing moves the air differently between the upper and lower surface.

gravity is so small, especially compared to the Earth's, we can't feel it. Very sensitive instruments can test the difference in gravity when standing next to a cliff or standing on a plain. Too cool!

Thrust is the propulsive force of a jet or rocket engine. It can also be the downstroke of a wing. Propulsive means the quality of driving or pushing

POWER WORDS

- **airfoil:** the shape of the wing; a structure with curved surfaces designed to give the most favorable ratio of lift to drag in flight, used as the basic form of the wings, fins, and horizontal stabilizer of most aircraft
- **turbulence:** violent or unsteady movement of air or water, or of some other fluid

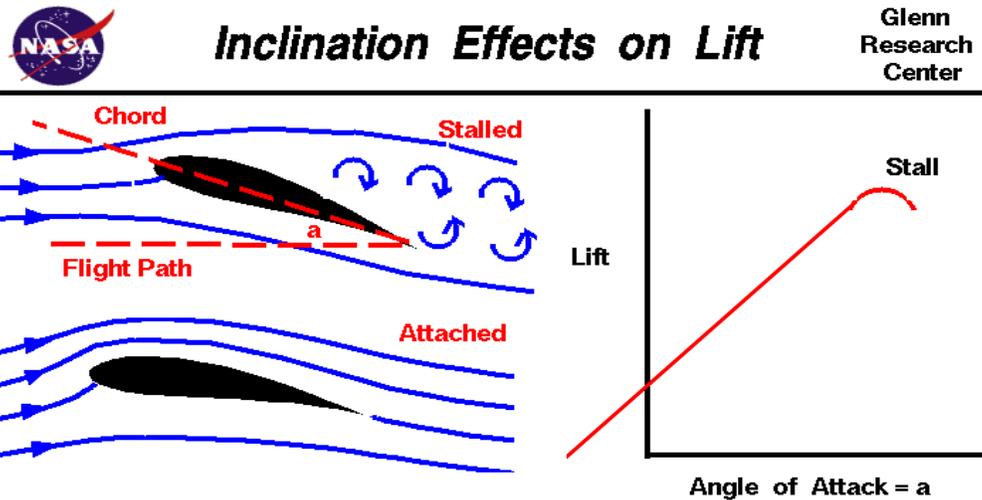


Diagram of the airfoil is from NASA: <https://www.grc.nasa.gov/www/k-12/airplane/incline.html>

Air moves faster as it climbs over the top of the **airfoil**. It spreads out the air molecules and causes low pressure on top of the wing. The air continues to move at the same speed as it travels under the wing. In relationship to the top of the wing, the air pressure is higher. A general concept is that energy flows from high to low. In an **airfoil**, the direction is under the wing pushes up, and the top of the wing doesn't push down as hard. That is lift.

The opposite force to lift is gravity. We all know what gravity is, but it is really hard to describe! The Earth pulls us towards the center. Believe it or not, we also have gravity! Our

forward. It is a powered force. Drag, the opposite of thrust, is anything that decreases thrust. Air molecules slamming into the edge of a wing causes drag. At the end of the wing, any **turbulence** also causes drag. Paper airplanes do not have thrust, at least after the initial thrust you provide when you throw the paper. It then glides

until drag and gravity bring it down to the ground.

So, how can a broom fly? Well, it can't. That is part of the fun fantasy of the Wizarding World! We can, design a really awesome hoopster that looks broom-like and is an amazing glider. Hoopster was developed by the Exploratorium.

MATERIALS

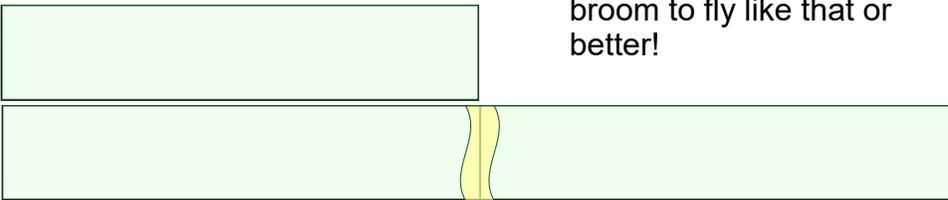
- 3x5" index card
- scissors
- pencil
- tape
- paper
- straw (best is a straight straw—no bendy part)
- print page 5 for the broom bristles (long and short) in the bottom right corner)

Directions:

- Cut your index cards into 3 equal strips lengthwise. With your ruler, measure 1" from the top edge and place a dot on the left and the right sides. Measure 1" from the bottom edge and place a dot on the left and the right sides. Using your ruler, draw a line between the upper dots. Using your ruler, draw a line between your lower dots. Cut on those lines for three equal strips 1" x 5".
- Tape two of the strips together end to end. Overlap the end slightly. Tape both sides. You will have two strips, one long and one short.



- cut off the bendy end.
- Tape the large hoop to one end of your straw, but let the straw stick out behind a little bit—about 1/4".
- Tape the small hoop to the other end of the straw.
- **HINT:** Line up the two hoops as best you can. It will fly better.
- Test fly your "broom" without the bristles. You want the broom to fly like that or better!



- Make two hoops, one small and one large, from the two index card strips. Put a piece of tape on the end of the short strip. Curl the index card strip into a little hoop. Tape the ends on both sides. Repeat these steps with the long strip made from 2 pieces, to make one large hoop.



- If you have a bendy straw,

Make into your broom:

- Cut out the broom straw bristles (pictured bottom right). Test each size separately.
- Wrap the long bristles on the large hoop end of the straw. Test.
- Remove the long bristles. Wrap the short bristles on the large hoop end of the straw. Test.
- Does it work better with the longer or shorter bristles?
- Use the bristles that worked the best.



HOW DOES IT FLY?

- The hoops form an airfoil with very little **turbulence**. A plane wing has **turbulence** at the trailing end of the wing. This means the hoopster has less drag.

Broom with long bristles in the image below.



Your flying broom bristles (short and long) below.



Professor Snape's Potion Class teaches the Hogwarts' students how to create healing and harming potions. In the very first class, Professor Snape is fairly easy on his students with the Swirling Colors potion. This potion will be amazing and fun!

Directions:

- Be sure that you have a parent there to help you.
- Carefully squeeze a small amount of dish soap into the bottle cap.
- Place 3 or 4 cotton swabs in the dish soap.
- Carefully pour a thin layer of milk in the plate.



- Add 4 or 5 drops of each food color to the top of your milk. You can place the dots anywhere. You can even



- place all the dots on top of each other.
- Wave your wand over the milk.
- Take the cotton swab soaking in the dish soap, and touch it gently to each dot.
- Get another plastic plate and fill it with a thin layer of milk.



- Try a different pattern of food color dots.
- Touch the dots with the dish soap soaked cotton swab.
- Repeat as many times as you like. Try different patterns of the food color drops.

How does it work?

- Milk has water, fat, and proteins.
- The food color likes the water.
- Dish soap breaks fat into smaller pieces
- Dish soap and proteins are attracted (like metal is attracted to a magnet).
- The movement of the fat and

FASCINATING FACT

- Do not pour grease down the sink drain. It will plug up your pipes. Even if you use dish soap, the grease broken into smaller pieces will later come back together.
- If you wash your dishes, be sure to pour the grease into a container and throw it away in the trash.

Image of Snape: <https://www.cinemablend.com/news/2475569/severus-snape-the-major-clues-he-wasnt-a-villain>

protein move the water in the milk around, carrying the food color into swirling patterns.



Swirling Colors Potion!

MATERIALS

- plastic plates (dinner or dessert size) with a rim
- whole milk
- food colors (red, green, blue, yellow)
- bottle cap (larger caps work a better, like milk jug lid)
- liquid dish soap
- cotton swabs

Astronomy is a course that Hogwarts students take from their first through their fifth year. Years six and seven are optional.

The **constellations** are used to identify parts of the sky, like a map identifies lakes and mountains, valleys and shorelines.

The first lesson in studying the stars is to identify the Big Dipper. This is an **asterism** in the **constellation** *Ursa Major* (Big Bear). The Big Dipper is in the sky all night long throughout the year. It is the brightest group of stars you can see all year long.

By **star hopping**, you can find all the Northern Hemisphere **constellations**. That is because the Big Dipper is in the sky all year long. The other easy to find **constellation** is *Cassiopeia*. It is on the other side of *Ursa Minor* (Little Bear)

Directions:

For your first Astronomy class, you will:

- Identify the Shapes of three **constellations**, *Ursa Major*, *Ursa Minor*, and *Cassiopeia*
- Make a Seasonal Sky Model
- Locate the **constellations** in the night sky
- Read a Story about the Stars

Identify the Shapes

- The Big Dipper moves in a circle around the North Star (Polaris). In April at midnight, it is directly overhead. In October, it is low in the north sky.
- The North Star, Polaris, is one-third of the way between

the horizon and directly overhead. Our Earth's North Pole points directly at Polaris. The NASA APOD (Astronomy Picture of the Day) to the right was taken by letting the camera stay open for about an hour. The dot in the center is Polaris! The gold arrow points to Polaris. The streaks are other stars moving around Polaris including the Big Dipper and *Cassiopeia*.

- *Cassiopeia* is another **constellation** you can see every night all year long. It has five bright stars that make a stretched "W" or "M."
- Carefully examine the shape of the Big Dipper, the shape of the Little Dipper, and the shape of *Cassiopeia* in the

POWER WORDS

- **asterism**: prominent pattern or group of stars, with a popular name but smaller than a **constellation**
- **constellation**: group of stars forming a recognizable pattern that is traditionally named after a mythological figure; modern astronomers divide the sky into eighty-eight **constellations** with defined boundaries
- **star hopping**: a way to go from known stars and **constellations** to stars and **constellations** not yet known



Astronomy Picture of the Day—NASA: <https://apod.nasa.gov/apod/astropix.html>

MATERIALS

- a clear night sky
- print page 9
- 1 black or dark blue paper plate
- tape
- scissors
- pencil
- nail
- corrugated cardboard (use a recycled mailing box)
- 1 light color (e.g. yellow or white) paper plate the same size as black plate
- white crayon
- markers or color pencils
- brass brad paper fastener
- flashlight for night time

first three images on page 10.

- The fourth image shows where they are located in the night sky. Basically, the Big Dipper is on one side and *Cassiopeia* on the other side of the Little Dipper. Examine their locations.
- The Big Dipper has the brightest stars of all the **circumpolar** stars.
- *Cassiopeia* has the next brightest stars.
- The North Star (Polaris) is not very bright. It is very important. For example, sailors used the North Star during the night for steering their ship.

Seasonal Sky Model

- The circumpolar stars are in a different location in the sky each season (Fall, Winter, Spring, and Summer).
- The Seasonal Sky Model has three parts to complete:
 - night sky plate
 - season plate
 - put it together
- The first part is the night sky plate (the black or dark blue plate). Print the star pattern on page 12. The blue dot is placed in the center of your black plate (the gold arrow points to Polaris).
- Lightly tape the star pattern on your black plate (face up) checking that the blue dot is in the center.
- Place the plate on your corrugated cardboard.
- With your nail, poke a hole on each red and blue dots.
- Poke a hole in the **trapezoid** shape with the blue lines. Insert your scissors in that hole, and cut out the **trapezoid** shape. Be careful

not to cut the last star in *Cassiopeia*. Leave a bit of plate between the **trapezoid** and that star.

- With a white crayon, connect the dots to form the different star shapes (Big Dipper, Little Dipper, and *Cassiopeia*) on your black plate.



- The second part is to make your Season plate on a light plate.
- With your color pencils or markers, you will draw a small picture that will fit inside the cut out trapezoid to represent summer, fall, winter, and spring.
- Place your black plate inside the last white plate, but right side up with the trapezoid on top.
- With a pencil, draw the outline of the trapezoid on the white plate.
- Shift the trapezoid to the right. With a pencil, draw the outline of the trapezoid on

POWER WORDS

- **circumpolar:** (of a star or motion) above the horizon at all times in a given latitude
- **trapezoid:** a four-sided figure with only one pair of lines having the same distance continuously between them

- the white plate.
- Shift the trapezoid to the bottom. With a pencil, draw the outline of the trapezoid on the white plate.
- Shift the trapezoid to the left. With a pencil, draw the outline of the trapezoid on the white plate.
- In each trapezoid, draw

NIGHT VISION

- When you first go outside at night, you can only see a few bright stars. Your eyes need to become adjusted to the dark.
 - The iris (color part of your eye) gets smaller, and the pupil (the dark part) gets bigger to let more light enter your eye
 - Your rods (eye receptors that “see” in low light, but do not see colors) work better
 - Don’t look directly at a faint star, but just a little to the side. It is amazing, because you will be able to see it!

your **symbol**. The top is winter. The right is fall, the bottom is summer, and the left is spring.

- Note: draw all the pictures without turning the plate.
- The image below is an example:
 - top—winter—snowman
 - right—fall—leaf
 - bottom—summer—sailboat
 - left—spring—flower
- The third part is to put it all together. Place night sky plate inside your season



plate. Set both of them on the corrugated cardboard. Find the center hole (the blue dot hole—representing the star Polaris), and push your nail through the season plate underneath.

- Insert your brass brad paper fastener through the center hole (Polaris) night sky plate then the season plate. Turn over the plates and separate the brass brad paper fastener arms to hold the plates in place.
- Spin your night sky plate to open the hole on the brass brad paper fastener.
- Your Seasonal Sky Model is set for about 7:00 or 8:00 PM, early evening.
- Notice the location of the Big Dipper, Little Dipper, and *Cassiopeia* each season.

Find the Constellations

- Dial your Seasonal Sky Model to the correct season (i.e. Fall). In the Fall, the Big Dipper is located in the North low near the **horizon**.
- Look at the top image on page 11. The distance between the Big Dipper stars Debhe and Merak (called the pointer stars) x 5 points to the North Star, Polaris.
- Examine the second image. It is an image of the stars as you will see when looking at *Ursa Major*. Locate the Big Dipper. Compare the lined photo to the starfield. Can you find the **constellation Ursa Major** in the stars?
- Go outside. You need to let

POWER WORDS

- **symbol**: a mark or character used as a conventional representation of an object
- **horizon**: the line at which the earth's surface and the sky appear to meet

VIEWING STARS TIPS

- Turn out all the lights before you go outside.
- The flashlight is for you to go outside, find a good, comfortable spot. Turn it off. When you are ready to go back inside, turn on the flashlight.
- When you are outside, do not turn on the flashlight. Try to keep your eyes adjusted to the dark.

your eyes adjust for about 15-30 minutes.

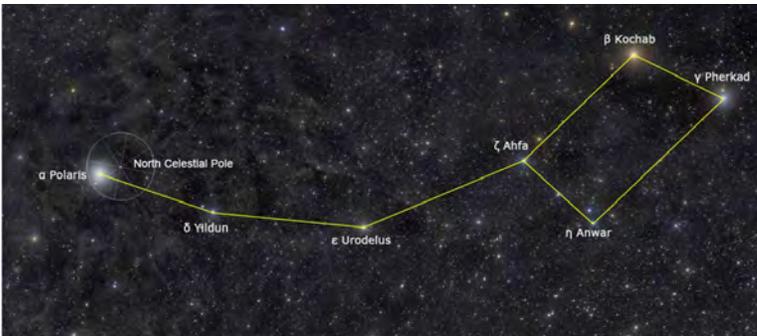
- Find the Big Dipper. Trace *Ursa Major*.
- Hold your arm straight out, and use your hand to estimate that distance. Follow the direction of the pointer stars to find Polaris. Can you see the Little Dipper?
- Remember where *Cassiopeia* is located? See if you can find the stretch "W" or "M."





The Big Dipper **asterism** in *Ursa Major* constellation (Big Bear)

Each star has a name. The stars have Arabic names. Abu 'l-Hussain 'Abd al-Rahman ibn Omar al-Sufi was an early Arab scientist who developed a catalog of stars, and named them. Dubhe (see arrow above) means “the bear’s back.”



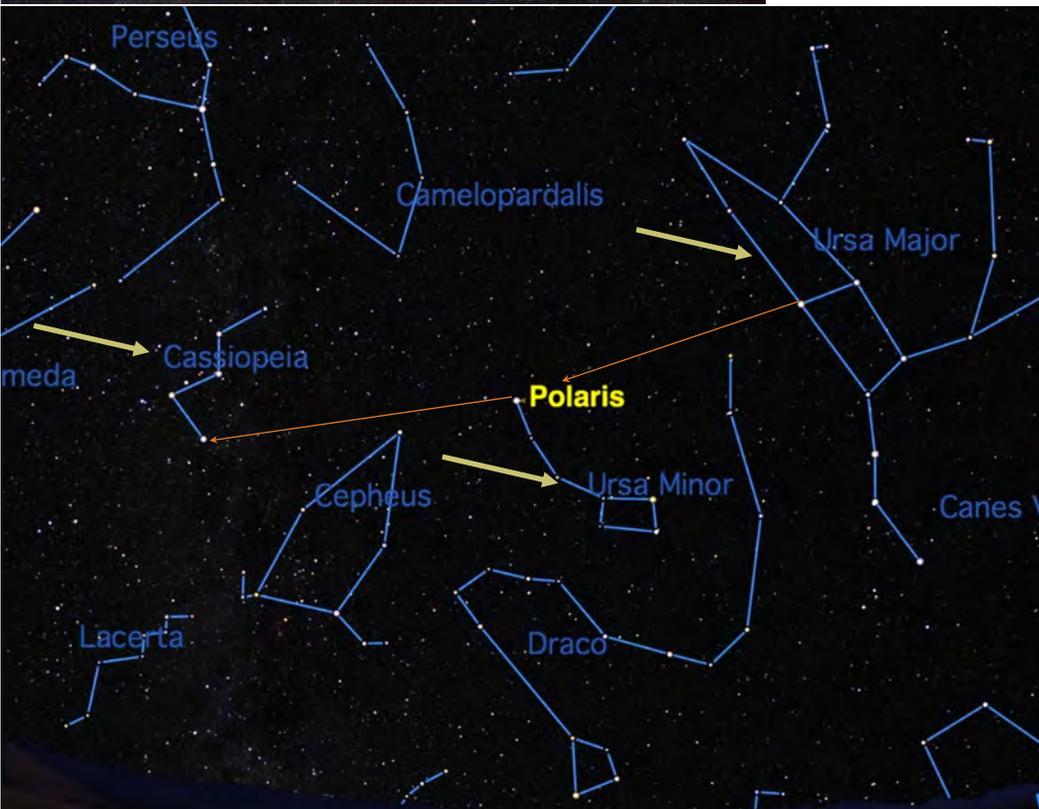
The Little Dipper **asterism** in *Ursa Minor* constellation (Little Bear)

The star Polaris means “pole star” or the star above our North Pole.



Cassiopeia is another **constellation** you can see every night all year long. It looks like a stretched out letter “W.”

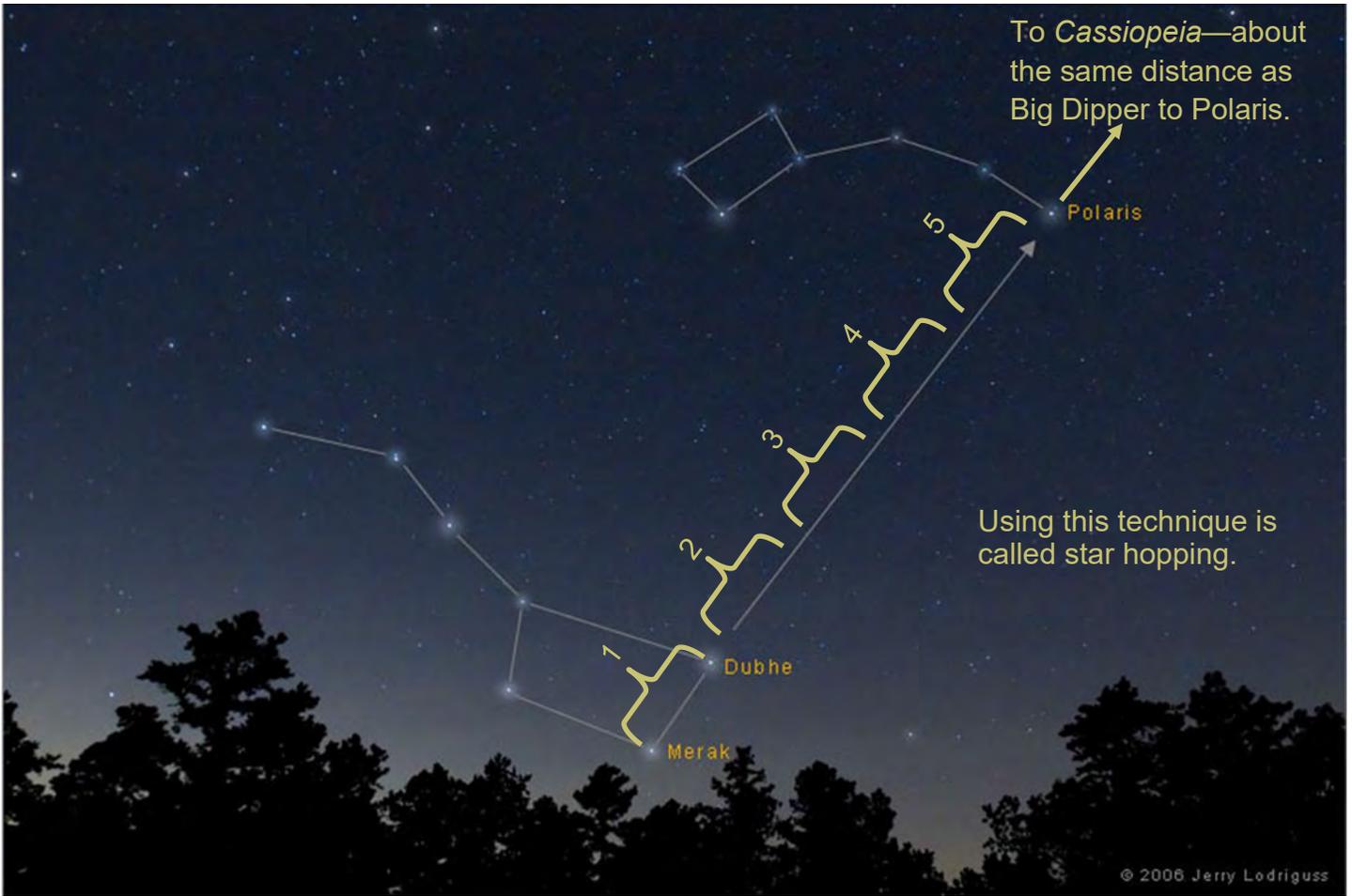
Images on page 10 and 11:
Astronomy Picture of the Day—NASA
<https://apod.nasa.gov/apod/astropix.html>



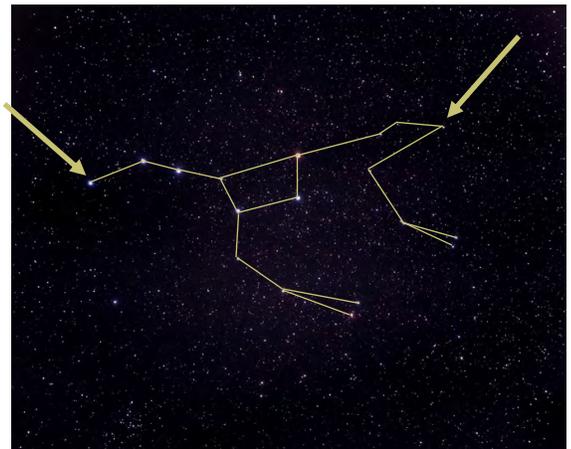
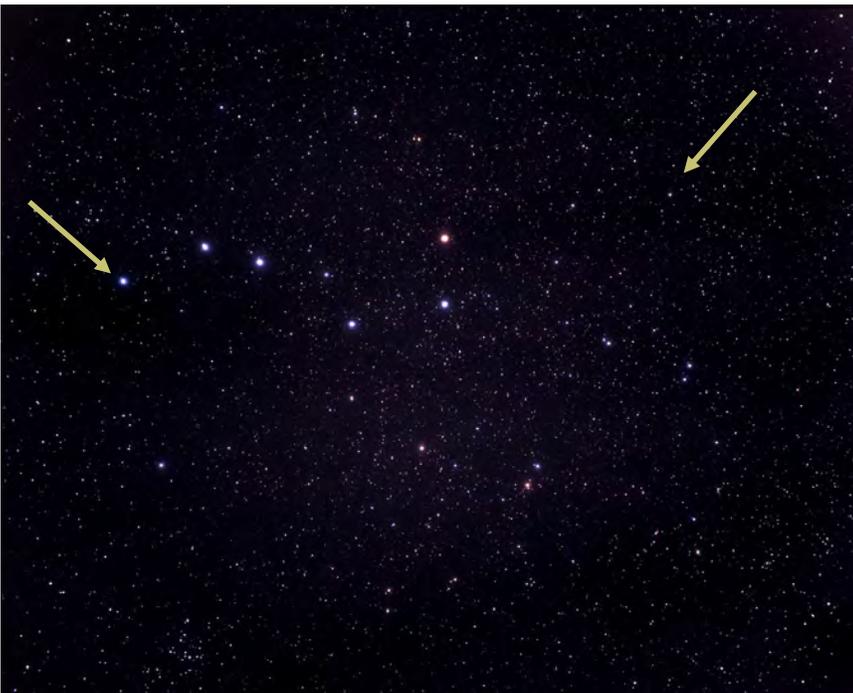
The stars on to the left form all the **constellations** you can see every night all year long. They are known as **circumpolar constellations**. Can you find the Big Dipper?

The introduction to Hogwarts Astronomy, you find the **constellations** (identified with gold arrows):

- *Ursa Major* (Big Bear)
 - Big Dipper
- *Ursa Minor* (Little Bear)
 - Little Dipper
- *Cassiopeia* (the queen)

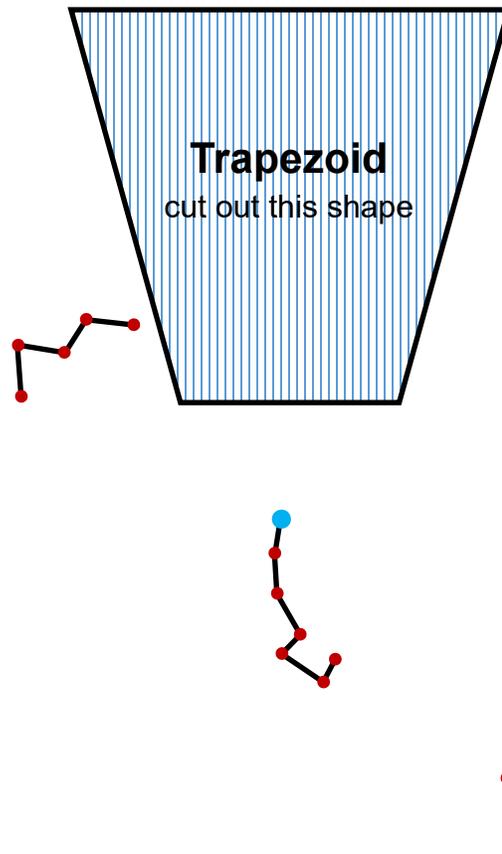


Locate the stars in the **constellation Ursa Major** (Big Bear). The Big Dipper forms the tail to the back. The legs stretch out towards the bottom right. Compare the picture on the right to the left, until you find the stars. The gold arrows point to the tip of the tail and the tip of the nose.



Go outside and locate the Big Dipper, then find *Ursa Major*.

AWESOME!



Big Bear and Little Bear

Callisto was a beautiful woman. Zeus, king of all the gods, fell in love with Callisto. She had a child named Arcas. Zeus was the father. Hera was Zeus' wife. She was jealous. She turned Callisto into a bear. Callisto did not want to harm her son, so she ran away into the forest.

Arcas was raised by Centaurs, half man half horse. They taught Arcas to hunt. When Arcas was a man, he went to hunt in the forest where his mother lived. He spied her. He snuck up on her to kill her.

Zeus saw that Arcas, his son, was going to kill his own mother, and he felt bad. He turned Arcas into a small bear. He grabbed both the mother and son by their short tails. Zeus swung them over his head, faster and faster. Each time he swung them, their tails stretched a bit more. He then let go and flung them into the night sky. That is why these constellations have long tails.

They were beautiful stars. Hera looked up one night. She saw Callisto was once again beautiful. She was very angry. She made sure that Callisto (Big Bear) and Arcas (Little Bear) could never meet. Instead, they forever circle in the sky, Arcas always following his mother.



POWER WORDS

- **pigment:** the natural coloring matter of animal or plant tissue
- **rune:** a letter of an ancient Germanic alphabet, related to the Roman alphabet
- **steep:** soak (food or tea) in water or other liquid so as to extract its flavor

The Study as Ancient **runes** is an elective course taught at Hogwarts starting in the Third Year. This class teaches the students to read ancient texts.

The first thing to do is learn the different **runes** (image above). You need to prepare your magic ink before you begin.

Directions:

- Ask a parent to help you with this step. Cut the red cabbage in half. Cut one of the halves in half.



- Tear the cabbage into tiny pieces. The smaller the pieces, the better.



- Place the torn cabbage bits into one of the bowls.

- Heat the tap water as hot as it will go. Be careful not to burn yourself. Add hot water into the bowl until the red cabbage bits are barely covered. Do not add extra water. You want the “red” in the cabbage as concentrated in the water as possible.



- Allow the cabbage to **steep** for about 30 minutes.
- Place the second bowl in the sink. Place the sieve over the bowl.
- Carefully pour the cabbage bits and water into the sieve. Lift the sieve out of the red cabbage liquid and drain



all liquid from the red cabbage bits in the sieve.

MATERIALS

- print page 15
- red cabbage
- baking soda
- cream of tartar
- vinegar
- lemon or lime juice
- ammonia
- dish washing soap

EQUIPMENT

- 6 fine paint brushes
- 1 broader paint brush
- 7 mason jars with lids
- 2 large bowls
- knife and cutting board
- sieve
- mixing spoon
- sharpie

- You no longer need the red cabbage bits, and you can compost them.
- Do this next step in the sink. If you spill, clean-up is a breeze! Place one of the mason jars in the sink. Carefully pour the red cabbage juice into the jar. Screw on the lid.



- Label the jar and lid “cabbage juice” with the sharpie. Store in the refrigerator.
- Label the six remaining mason jars:
 - baking soda
 - cream of tartar
 - vinegar
 - lemon or lime juice
 - ammonia
 - dish washing soap
- Place about 1/4 cup of baking soda in the mason jar. Add warm water about half full. Screw on the lid and shake to mix.
- Place about 1/4 cup of cream of tartar in the mason jar. Add warm water about half full. Screw on the lid and shake to mix.
- Place about 1/4 cup vinegar into the mason jar. Add warm water about half full. Screw on the lid and shake to mix.
- Place about 1/4 cup lemon or lime juice into the mason jar.

- Add warm water about half full. Screw on the lid and shake to mix.
- Place about 1/4 cup ammonia into the mason jar. Add warm water about half full. Screw on the lid and shake to mix. **DO NOT SMELL THE AMMONIA.**
- Place about 1/4 cup dish soap into the mason jar. Add warm water about half full. Screw on the lid and gently rock the mason jar to mix. Try not to make bubbles.

Practice Writing Runes:

- The inks you use to write your runes are:
 - baking soda
 - cream of tartar
 - vinegar
 - lemon or lime juice
 - ammonia
 - dish washing soap
- Place one fine paintbrush in each of your inks, and line your jars in a row.
- On page 15, there is a set of Ancient **Runes** and a space to write the **runes**.
- Use a different ink for each **rune**. For example, if your first jar is baking soda, use that for the first **rune**. Put the paintbrush back into the baking soda jar. Go to the next jar, cream of tartar, and use that paintbrush for the second **rune**.

ANCIENT RUNES

- Runes are letters in the ancient Germanic speaking people. They were written and read from c. 160 AD onwards in Scandinavia to the Middle Ages.
- They made their way to England, and were used until the 1200s.
- They were inscribed on wood, metal, and stone. They are still shrouded in mystery!

- Continue until you have completed all the **runes**.
- Allow to dry.
- Wave your wand like this: over the paper and utter:
REVELIO! 
- Paint your words with the red cabbage juice with the wider brush.

SCIENCE OF APPEARING INK

- Red cabbage juice contains a **pigment** called anthocyanin. When it is in a pH neutral solution, it is purple. When it is in an acidic solution, it is pink to dark pink. When it is in base, it is blue to green.
- You use inks that are acidic or basic. When you paint the paper with cabbage juice, it indicates if your ink is acidic or basic. Cool!

F B K O X M Y X H I I K F A

T F E K E R H ↑ N N Y E A I

In Charms class, you will learn how to cast a spell that will cause the object to do something. If you cast a charm on a teapot, you can make the teapot dance. The other type of spell is called transfiguration. Those spells can change an object into something else. If you cast a transfiguration spell on the teapot, you can change it into a frog.

ADULTS must supervise this activity. **Neodymium** (rare earth) **magnet** is perfectly harmless to use, but if swallowed, it can be fatal. Be careful when adding the iron oxide powder not to breathe it.

Directions:

- Wash your hands before starting.
- Measure 1/4 cup white school glue. Pour into your zip lock baggie. You may have to use the spoon to scrape all the glue out of the



- measuring cup.
- Add 2 Tablespoons of iron oxide powder. Add to your zip lock baggie. Remember to pour it carefully, and do



- not breathe in any of it.
- Zip the baggie closed. Knead the baggie's glue and iron power with your fingers. Do not twist the baggie. That can tear the baggie. Continue kneading until the mixture looks like cookie crumbs.
- Open your baggie. Measure 2 Tablespoons liquid starch



- and add into the baggie.
- Knead the glue/iron power mixture and liquid starch with your fingers. Do not twist the baggie. That can tear the baggie.
- Continue kneading until

POWER WORDS

- **alloy:** combination of metals or metals combined with one or more other elements
- **neodymium magnet:** an allow of neodymium, iron, and boron

- completely mixed.
- If there is some unmixed starch in the baggie and



MATERIALS

- neodymium (rare earth) magnet (google search to purchase—a large bar works best)
- black or red iron oxide powder (google search to purchase)
- liquid starch
- white school glue
- 2 zip lock bags quart size
- 1/4 measuring cup
- 1 measuring Tablespoon
- plastic plate

- on the slime, take out the slime and rinse it for a few seconds under cold water.
- Knead the slime with your hands.
- Wash your hands before playing with it. This helps to make the slime less sticky.
- Store in a clean zip lock baggie.
- **Troubleshooting:**
 - If your slime is too sticky knead in a tiny bit more starch. If it's too stringy, knead in a little glue.
 - If your slime does not move to your magnet, the problem is the magnet's strength.
 - **Neodymium magnets are extremely strong!** Fingers can easily get pinched when trying to separate the magnets.
 - Be sure to keep the magnets away from cell phones, computer, and other electronics.
 - If you order the smaller disc magnets, make sure that no one puts them in their mouth – these are very dangerous if swallowed. This is not a project for kids who still put things in their mouths.

- Move your **neodymium magnet** close to the slime until it starts to move towards the magnet. How far away is the magnet from the slime?
- Slowly lift the magnet, keeping the slime following.



- How high can you lift the slime without it touching?
- Place the magnet on the table and inch towards the slime until it moves towards the magnet. How far will it travel along the table following the magnet?
- How high can you lift the slime touching the magnet?
- Hold your plate. Place the magnet under the plate. Can



SCIENCE OF MAGNETS

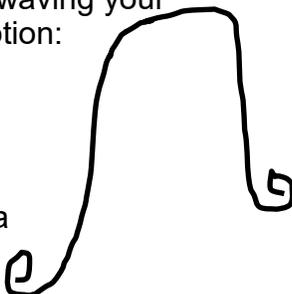
- Magnetism is the force when magnets attract or repel another magnet.
- Magnetism is caused by the motion of electric charges. Every substance is made of tiny units called atoms. Atoms have electrons, tiny particles that spin around the atom.
- In substances like iron cobalt, and nickel, most of the electrons spin in the same direction. This makes the atoms in these substances strongly magnetic.
- To become magnetized, another strongly magnetic substance must enter the magnetic field of an existing magnet.

- you make your slime dance?
- Place your magnet on top of the slime and wait. What happens?
- What else can you do with your slime?
- Why do you think the slime moves without touching it? Explain to your parent.
- Keep your slime in the sealed baggie.

The Charm Spell

- Place your slime on a plastic plate.
- Cast your "Dancing Feet" charm spell by waving your wand in this motion:

and say:
Tarantallegra
 pronounced
 ta-RON-ta-LEG-gra



SCIENCE OF MAGNETS (continued)

- All magnets have north and south poles. Opposite poles are attracted to each other, while the same poles repel each other.
- When you rub a piece of iron along a magnet, the north-seeking poles of the atoms in the iron line up in the same direction. The force generated by the aligned atoms creates a magnetic field. The piece of iron has become a magnet.



“Screaming mandrakes,” Harry Potter said to Neville Longbottom, “That is a brilliant use of leaves!”

Directions:

- **Gather leaves.** Go for a color hike and select beautiful leaves that are still on trees. Use the sharp scissors or pruning shears to snip your leaves. You need to gather 10 or so.



- Pour 2 parts water into your pan. Example 1 cup water.
- Add 1 part glycerin into the pan and mix thoroughly. Example 1/2 cup glycerin.
- Add 4 drops of surfactant for each cup of water and mix.
- One at a time, place the leaves in the bath,



submerging them completely in the water solution.

- Place a weight, like pebbles or marbles in the top pan.



- Allow 2-3 days for the leaves to absorb the glycerin.
- Check the leaves. They should be **supple**. If they are not, continue soaking them in the glycerin solution.
- When **supple**, remove and dry flat on paper towels, about 2 hours.
- You can **incorporate** your leaves in a variety of ways.
 - Frame them. Secured to a piece of matboard with a few dots of hot glue. Put them in a frame.



MATERIALS

- glycerin
- surfactant
- water
- fall leaves
- paper towels

POWER WORDS

- **incorporate:** take in or contain (something) as part of a whole; include
- **ratio:** how much of one thing there is compared to another thing
- **submerge:** descend below the surface of an area of water
- **supple:** bending and moving easily and gracefully; flexible

Image of Harry and Neville: <https://www.tor.com/2013/11/19/neville-longbottom-is-the-most-important-person-in-harry-potter/>

Ratios:

- 2 parts to 1 part is a **ratio**. For example, when you make salad dressing, use 2 parts oil to 1 part vinegar. That means you use twice as much oil.

<https://food52.com/blog/14782-how-to-preserve-and-press-leaves-ideas-for-using-them>

- Use modge-podge to



EQUIPMENT

- 2 shallow pans that can stack inside each other
- measuring cup
- spoon for mixing
- sharp scissors or pruning shears
- weights (like pebbles or marbles)

adhere them to a mason jar. Add a candle in the mason jar. Beautiful!

<http://sparkandchemistry.com/blog/leaf-mason-jar-candle-holder/>

- Tie a string to the stem, and string homemade paper beads (directions page 20). Hang in a window to catch the light. <http://munchkinsandmayhem.blogspot.com/2012/11/autumn-leaf-mobile.html>



- Make a notecard. Write a note to someone you love and mail it to them. The card picture below was made by layering burgundy then beige paper, and paper ribbon. <https://www.motherearthnews.com/diy/crafting/using-dried-leaves-to-decorate-cards-ze0z1610zcbu>.
- Create art using your leaves in your art. <https://www.lushome.com/20-wonderful-fall-leaves-crafts-kids-room-decorating/90745>



- What else can you do with your autumn leaves?

The Science

Why does glycerin and surfactant preserve a supple leaf in the fall color?

- *Why leaves change color:* During the Spring and Summer, a leaf is green because of green **chlorophyll pigment** found in **chloroplasts**. **Chloroplasts** are the **organelles** that make sugars through a process called **photosynthesis**. In the Fall, the length of daylight shortens and temperatures become cooler. Leaves stop their food-making process. **Chlorophyll** breaks down, and green color fades. There are other **pigments** in a leaf that can start to show through. These pigments are brown, yellow, orange, and red, and show through to give the leaves Fall colors.
- Glycerin is absorbed into the leaf, replacing the water. This slows the process of all the pigments present in a leaf from breaking down. If you preserve a green leaf, the leaf will remain green. If the chlorophyll has broken down, it will preserve the remaining leaves.
- A **surfactant** is a chemical compound that tends to

POWER WORDS

- **chlorophyll**: green **pigment** present in all green plants responsible for the absorption of light for **photosynthesis**
- **chloroplast**: (in green plant cells) **organelle** that contains chlorophyll and in which **photosynthesis** takes place
- **organelle**: organized or specialized structures within a living cell
- **pigment**: the natural coloring matter of animal or plant tissue
- **surface tension**: effect where the **surface** of a liquid is strong. This property is caused by the molecules in the liquid being attracted to each other (cohesion)

reduce the **surface tension** between a liquid and a gas, solid, or another liquid. **Surfactants** help the glycerin chemical stick to the plant, penetrating the waxy cuticle to allow the plant to absorb the chemical and increase the product's effectiveness.

FUN FACTS

- Leaf color depends on the tree species: red maples turn scarlet, sugar maples are orangey red, oaks are brown, red, or a mix of those two colors, and aspens turn golden.
- The most brilliant Fall colors emerge after a series of warm late summer days followed by a cold snap (above freezing).

Anne Casey was a CSU Extension 4-H STEM Peaks and Plains Regional Specialist. She is now with the Pueblo Zoo. She is the guest author, sharing her paper beads directions.

Anne originally developed these directions as one of our 4-H STEM Connections.

How to Make a Paper Bead

- Find a colorful piece of paper about 8" x 10" or so, such as pages from a catalog, magazine or old comic book. If the page has plain borders, cut them off. The edges of the paper determine the final color of the bead.



- You are going to roll the paper up onto the thinner **dowel**, starting with the lower corner. The easiest way to begin is to lay the **dowel** down at a slight angle to the bottom (the longer side) of the paper, catch the corner under the **dowel** and begin rolling.



- Before you roll up the top edge of the paper, apply a thin line of glue.



- Finish rolling up the tube and hold to set glue.



- Pull the tube off the **dowel** and lay it on the table in front of you. Now take the bigger **dowel** and flatten the first inch of tube by rolling the



POWER WORDS

- **dowel:** a peg of wood, metal, or plastic without a distinct head, used for holding together components of a structure



- **dowel** over it. You will form the bead by rolling the tube tightly up onto the bigger **dowel**, applying glue as you roll. *Be careful not to glue the paper to the **dowel** accidentally!
- Carefully pull the bead off the **dowel** after the glue sets.
- These are beautiful!

MATERIALS

- Recycled colorful piece of paper (i.e. magazine, comic book, catalog, etc.)
- thin **dowel** or bamboo skewer
- glue (white school glue, glue stick)

Why Recycle?

The pie chart at the right shows the percentages of **MSW** (municipal solid waste) we either send to the landfill, recycle/compost or burn.

As a nation, we create 262 million tons of garbage per year, or about 4¹/₂ pounds per person per day, and we recycle or compost 91 million tons of that, or about 1¹/₂ pounds per person per day.

Let's look at the materials that end up in the waste stream:

- food
- yard trimmings
- wood
- rubber, leather, textiles
- plastics
- metals
- glass
- paper
- other (everything else)

Notice that the biggest slice of the garbage pie is *paper!*

Wood pulp used to create paper accounts for about 25% of the timber cut annually or almost 4000 sq. miles of forest. That's a lot, considering all that forests do for us, including absorb carbon dioxide during photosynthesis.

The Northern Institute of Applied Climate Science estimates that US forests absorb about 750 million metric tons of CO₂ each year; that is 10% of our country's CO₂ emissions! Reusing and recycling paper helps to save those forests.

How can you reduce, reuse, recycle?

Figure 3. Management of MSW in the United States, 2017

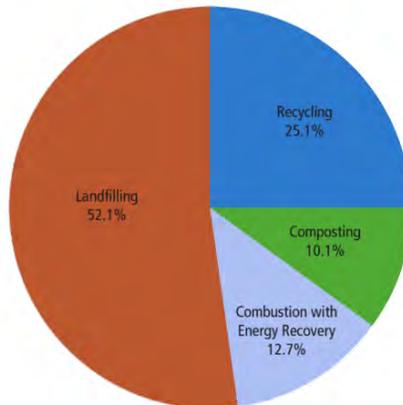
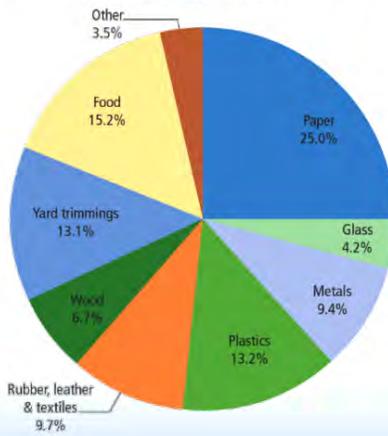


Figure 4. Total MSW Generation (by material), 2017
267.8 Million Tons



https://www.epa.gov/sites/production/files/201911/documents/2017_facts_and_figures_fact_sheet_final.pdf

POWER WORDS

- **MSW:** municipal solid waste; garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities

FASCINATING FACTS

- According to a recent Yale University/EPA study, the U.S. recycles less than 22% of its discarded materials.

Answers:

1. cross roads
2. forgive and forget
3. once in a blue moon
4. head over heels
5. history repeats itself
6. double vision
7. shrinking violets
8. misunderstood
9. slow down
10. stand in a corner
11. Jack in the box
12. back rub

FASCINATING FACTS

- U.S. recycling levels are currently 21.4% (recent EPA funded Yale University Study).
- When U.S. recycling levels reach 75% it will be the environmental and CO₂ equivalent of removing 55 million cars from U.S. roads each year.
- When U.S. recycling levels reach 75% it will generate 1.5 million new jobs in the U.S. (net).

This powerful spell produces a black snake to protect against the Dark Arts. As with all spells, you must take great care in casting this.

FIRE SAFETY



- **ADULT SUPERVISION:** ask an adult to supervise this activity
- **BUCKET OF WATER:** be sure to keep a bucket of water handy
- **ATTEND THE FIRE:** remain at the fire until it is completely extinguished
- **ROLL UP SLEEVES:** be sure your clothing is tightfitting or your sleeves are rolled up
- **HAIR TIED BACK:** if your hair is long enough to pull into a rubber band, tie it back
- **WEAR NATURAL FIBERS:** wear clothes that are cotton, linen, wool, silk or other natural fibers; synthetic fibers, if they catch on fire, melt and cause horrid burns
- **PROTECT YOUR EYES:** Wear safety goggles

In combination with the “Patronus” spell, it provides powerful protection!

Directions:

- Read the fire safety rules. Memorize them.
- Ask an adult to supervise this spell.
- Do this activity outside. Either find a clear patch of

ground by clearing the leaves and **debris**, or you can also do this on cement or blacktop area. Be sure that the area above this “spell” is **unobstructed**. You can use a **trivet** to stabilize the aluminum pie tin.

- Fill your pie tin about 2/3 full with sand.



- Measure 4 Tablespoons sugar and 1 Tablespoon baking soda in your small bowl. Mix thoroughly.
- Put on your goggles. If your hair is long enough, put it into a pony tail with a rubber band. Roll up your sleeves.
- **Saturate** the sand with the lighter fluid or isopropyl alcohol.
- Make a mound of the sugar/baking soda mixture on the center of the sand.
- With a long lighter (also called grill lighter), light the sugar/baking soda mixture on fire.

POWER WORDS

- **debris:** scattered pieces of waste or remains
- **saturate:** become thoroughly soaked with liquid so that no more can be absorbed
- **trivet:** a small metal or wood plate with short legs, especially one put under a hot platter or dish to protect a table
- **unobstructed:** not blocked; not in the way

- Wait and watch. It may take a bit to start.



MATERIALS

- baking soda
- sugar (granular, brown, or powder sugar)
- lighter fluid (for charcoal grilling) or 90%+ isopropyl alcohol
- **60 minutes for spell**

EQUIPMENT

- bucket of water
- safety goggles
- rubber band (long hair)
- aluminum pie tin
- sand
- measuring Tablespoon
- long lighter
- small bowl



- **Do not touch** the snake or sand until the entire spell has cooled.
- Above is a table of combinations for making carbon snakes. Try each one to evaluate which snake works best. Try each combination for a total of 6 trials.
 - Which sugar did you like the best: granular sugar, powdered sugar, or brown sugar?
 - Which fuel worked the best: lighter fluid or isopropyl alcohol?

chemical formula of $C_{12}H_{22}O_{11}$. Each molecule of sucrose (the chemical name for sugar) has 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms. Sugar reacts with oxygen to form other products. When you expose sugar to an open flame, it burns reacting with oxygen in the air. This is called a **combustion reaction**. The end products are carbon dioxide (CO_2) gas and water (H_2O) vapor gas. A different reaction happens if there is not enough oxygen present during the combustion to form CO_2 . The sugar **decomposes**, resulting in elemental black carbon (C), or charcoal.

The baking soda (sodium bicarbonate, $NaHCO_3$) **decomposes** at high temperatures and releases lots of carbon dioxide (CO_2). The CO_2 block oxygen from the reaction. That means the sugar forms solid black carbon snake-like structure instead of just gas CO_2 . The gases that are formed, push up the carbon

POWER WORDS

- **chemical formula:** a way that chemists describe a molecule; a **formula** says which and how many atoms are in the molecule
- **combustion reaction:** a substance reacts with oxygen from the air
- **decompose:** break down or be broken down into simpler parts
- **element:** cannot be broken down into simpler substances; **chemical elements** are the building blocks for all matter—that is, everything that takes up space in the universe

snake.

The Science:

Granulated sugar has a

	Lighter Fluid	Results	Isopropyl Alcohol	Results
Granular Sugar				
Powder Sugar				
Brown Sugar				



FUN FACTS

- Carbon is one of the most abundant elements in the Universe.
- Carbon can form four bonds. Carbon can bond with four other atoms.
- Carbon has four different forms: graphite (pencil lead, which isn't lead), diamonds, fullerenes (which form spheres), and graphene, a single layer of graphite that is really strong.

Bertie Bott's Every Flavor Beans has just hired you to come up with a brand new flavor of jelly bean! Your task is to add one more flavor to their candy for a total 21 flavors. The current flavors are:

- Banana
- Black Pepper
- Blueberry
- Booger
- Candy Floss (Cotton Candy)
- Cherry
- Cinnamon
- Dirt
- Earthworm
- Earwax
- Grass
- Green Apple
- Marshmallow
- Rotten Egg
- Sausage
- Lemon
- Soap
- Tutti-Frutti
- Vomit
- Watermelon.

Directions:

- Will you settle on a delicious and delicate confection or a nasty flavor like the infamous ear wax jelly bean? That is up to you!
- There are 5 steps to complete:
 - Make the jelly bean **mold**
 - Create your flavor
 - Make the soft inside
 - Make the hard outer shell
 - Taste and approve

Make your mold:

- Wash your ruler with dish soap and dry completely.
- Heat your glue gun.
- Place the ruler number side-up. Squeeze a small drop of glue at the 1½". **Impress** the lima bean onto the glue.
- Repeat at 3", 4½", 6", 7½",

9", and 10½" on the ruler. You will have seven lima beans secured on the ruler.



- Add cornstarch in your cookie sheet. Use the edge of the ruler to level the cornstarch to the rim. Make it level and smooth to keep the jelly bean liquid in each well not spreading out.



- **Imprint** the lima beans into the cornstarch to make a depression mold. Continue pressing rows down the cookie sheet. Leave about 1" space between rows.
- The molds work best using a rectangle, low edge cookie

POWER WORDS

- **e.g.:** Latin exempli gratia—for example
- **impress:** make a mark or design on (an object) using a stamp or seal; imprint
- **imprint:** a mark made by pressing something onto a softer substance so that its outline is reproduced
- **mold:** a hollow container used to give shape to molten or hot liquid material (such as wax or metal) when it cools and hardens
- **shall:** in this use, shall means that it must be
- **staple:** a main or important element of something, especially of a diet

sheet. If you only have a large cookie sheet, that will work also.



MOLD MATERIALS

- 10 large dried lima beans
- about 4 cups of cornstarch
- small cookie sheet with rim
- wood ruler
- hot glue gun
- dish soap
- wax paper

Make your flavor:

- Jelly beans can have two distinct flavors. The first flavor is in the soft inside.
 - You need ½ cup of liquid flavor.
 - If you use a flavor with pulp, strain the liquid before using it.
 - Remember, your flavor needs to be in liquid form.
 - Strain your flavor to remove pulp or other solid bits.
 - For the soft inside flavor, broths and juices work best.
 - this layer does not have to be flavored.
- The second flavor is on the hard shell, (the last step in jelly beans).
 - Extracts (like vanilla extract) is concentrated flavors work really nicely for adding a second layer of flavor.
 - This layer does not have to be flavored.
- Examples:
 - Peach Melba: the main flavors in this dessert are peach, vanilla, and lemon for the peach part, and raspberry and lemon for the sauce. For the soft inside, add ½ cup peach juice with a teaspoon vanilla and a Tablespoon lemon juice. For the hard shell, add raspberry extract and lemon extract.
 - Key Lime Pie: the main flavors in this dessert are key limes (more aromatic than Persian limes), sweetened condensed milk, and graham crackers. the soft inside would be lime juice with pureed graham crackers,

strain, making ½ cup of liquid. The hard shell would be sweetened condensed milk.

- How would you make recreate the flavors for baked apple? What would be your ½ cup flavor for the soft inside? What would be your flavor for the hard shell? It depends on how you make baked apples. Do you normally use peanut butter? Do you use brown sugar or honey and cinnamon?
- What is your favorite dessert? Can you recreate that?

Make the soft inside:



- In a large saucepan, mix 1¼ cup sugar and ¼ ounce unflavored gelatin.
- Add ¾ cup water. Stir until combined.
- Heat on medium heat, stirring with the wooden

*** CASTOR SUGAR**

Ingredients:

- Granulated white sugar
- Food processor

Directions:

- Add regular sugar to a food processor.
- Process it until fine (not powder).

Tips:

- Add a little extra sugar to account for the amount that may stay in the processor or be processed into dust.
- Keep a kitchen towel over the lid of the processor to trap the dust inside a little better.
- Keep an eye on your sugar as it processes: we recommend about 1-2 minutes.

spoon.

- Slowly bring to a boil, stirring constantly to



**SOFT INSIDES
INGREDIENTS**

- ¾ cup water
- 1¼ cup castor sugar *
- ¼ oz. unflavored gelatin
- ice in water
- ¼ tsp. salt
- ½ cup flavor in liquid form

* You can make your own caster sugar if you can't find it. See green box above.

EQUIPMENT

- large saucepan
- measuring cup
- measuring spoons
- stove top
- wood spoon
- teaspoon
- candy thermometer
- sieve
- wax paper

ensure that no clumps form. CAREFUL—VERY HOT! It will burn your skin.



- Check the temperature frequently. When it reaches 245°F, take the pot off the burner. This should not take more than 25 minutes. If your syrup gets any hotter than 245°F, it will make your jelly beans too hard.
- Stir in your ½ cup flavor and ¼ tsp. salt. Stir until the salt is dissolved in the syrup.



- Set the pot in a bowl of ice to stop the heat rising.



- Work quickly. With the teaspoon, fill each of your

wells on your mold with the jelly bean solution.



- Let the jelly beans sit for six to twelve hours, or until the gelatin has hardened. It will still be gummy and sticky.



- Scoop out the jelly beans from the cornstarch into a



sieve, and shake over the cookie sheet. You can

JELLY BEAN IDEAS

- What about a jelly bean with one flavor in the inside, and another on the outside? For example, if you wanted to make a Peach Melba jelly bean, your inside flavor would be peach juice, lemon juice, and a dash of vanilla. The coat would be vanilla and raspberry extract.
- You can use a rock tumbler for making a smooth outer coat. Add the grated cocoa butter into the tumbler, then add the beans. Rotate for at least two hours.
- How can you make one of the disgusting flavors? A nasty tasting jelly bean is a huge challenge. Are you up to it?

HARD SHELL INGREDIENTS

- 2 Tbsp. light corn syrup
- food coloring (any color)
- flavor extract
- ¼ cup castor sugar for each repeat while coating*
- cocoa butter (coconut oil can be substituted)

EQUIPMENT

- 3 small bowls
- teaspoon
- measuring spoons
- measuring cup
- mason jar with lid
- grater

* You can make your own caster sugar if you can't find it. See page 25.

reuse the cornstarch for additional jelly bean molds.

- Place the jelly beans on wax paper and let them sit for another few hours to set.



Make the hard outer shell:

- To make a color shell, add 2 Tbsp. light corn syrup to a small bowl. Add food coloring to the corn syrup. The more you add, the more vivid the shell color will be. Add flavor extract (e.g. lemon) if you want your shell to also have a flavor. Mix until thoroughly combined.



- In the second bowl, add the jelly beans. With the teaspoon, add 2 spoons of the color corn syrup to the jelly beans, and stir to coat each bean completely. They will be sticky. Do not add too much corn syrup. Just add a bit at a time until your jelly beans are completely coated.
- In the third bowl, add ¼ cup

castor sugar. Add the coated beans to the sugar. Stir to coat each bean. Be sure to separate the beans so that the sugar gets on the entire surface of each bean.



- Repeat adding more color, coating with sugar steps (the above two steps) until your hard outer coat is the thickness you desire.
- Add your beans to the sieve, and shake off excess sugar.
- To make the jelly bean coat smooth, grate 1 teaspoon of cocoa butter into your mason jar. You can use coconut oil, but the cocoa butter is the absolute best. This keeps



POWER WORDS

- **igneous:** formed by solidification of melted magma or lava rock
- **solute:** A substance dissolved in another substance, usually the component of a solution present in the lesser amount (in our project, the solute is sugar)
- **solution:** a liquid in which something has been dissolved (in our project, the solution is the sugar water)
- **solvent:** liquid substance in which other substances can be dissolved or dispersed (in our project, the solvent is the water)

NOTE: My example jelly beans were a bit soft. They were yummy!

- the beans from sticking.
- Add the jelly beans. Seal the jar tightly. Tilt the jar at an angle and turn it in your hand (as you would turn a doorknob), preserving the angle that allows the sugar to up and evenly coat the jelly beans. This step is extremely important. If the candy is not well-

FUN FACTS

- Candy is delightful, but it also is very hard on your teeth. Bacteria in your mouth feed on sugar. Bacteria produce plaque, which builds up on teeth. The longer the sugar stays in your mouth, the longer the bacteria have to eat it. Chewy candies that remain in your mouth are worst. Dentists recommend flossing and brushing after snacking on candy.

coated, it will not have a hard outer shell. Tumble for at least 15 minutes. The longer you tumble, the smoother the outer shell.



Taste and approve

- Taste one jelly bean. Is the flavor strong enough? Is it a good jelly bean texture?
- Did you create a delicious or nasty flavor?
- Ask your family to test. What do they think?
- Is it a keeper, or are you back to the drawing board to design a new flavor?

The Science:

The Many Transformations Of Sugar Syrup

We can use the temperature of the sugar **solution** to determine the concentration of the sugar **solute** in the water **solvent**.

If you cool sugar solution slowly, you can form large crystals. If you cool it quickly, you can form sugar glass. Totally cool! This is the same that happens when **igneous** rocks and minerals cool.

Each row of jelly beans were poured at a different sugar stage to determine which works best at our Colorado altitude. The best is the soft-ball stage at 240°F—245°F.



1. **Thread Stage**—the solution is heated between 230° F and 235° F. The sugar concentration is 80%. When placed in water, this syrup forms a liquid thread.
2. **Soft-ball Stage**—the solution is heated to between 235°F and 245°F and corresponds to a sugar concentration of 85%. When dropped in water, the solution forms a soft ball.
3. **Hard-ball Stage**—the solution is heated to between 250°F and 265°F, with a sugar concentration of 92%.



When dropped in water, this stage forms a hard ball that's still a little bit yielding if you really squish it.

4. **Soft-Crack Stage**—the solution is heated to between 270°F and 290° F with a sugar concentration of 95%. When dropped in water, this stage forms threads that are flexible.
5. **Hard-Crack Stage**—the solution is heated to between 300°F and 310° F, with a sugar concentration of 99%. When dropped in water, this stage makes hard, brittle threads.
6. **Caramelization**—If you heat your solution beyond these stages, sugar caramelizes. The water in the solution has been boiled off, and now there is a complicated series of reactions happening in the sugar molecules themselves. In the process, volatile chemicals are released that give caramelized sugar its luscious flavor.

The sugar stage for jelly beans works best at almost at the hard-ball stage. Yum!

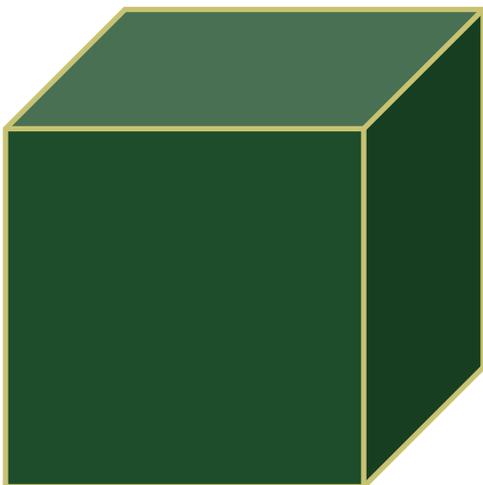
Human intelligence can be defined as a mental ability for reasoning, problem solving, and learning. We learn using our senses, our thoughts, and our experiences.

In our cogitation expedition each month, you can explore how you think. There is an entire field of study devoted to the philosophy of thought. MIND BLOWING!

Directions:

- Examine each image. They are clues to common sayings. For example:

Thinking



Solution: Thinking outside the box

PUZZLES:

1.

R
O
ROADS
D
S

2.

GIVE GET GIVE GET GIVE GET GIVE GET

3.

MOONCEON

4.

HEAD
HEELS

5.

HISTORY
HISTORY
HISTORY
HISTORY
HISTORY

6.

VISION
VISION

7.

VIOLETS

8.

STOOD
MIS

9.



10.



ANSWERS

- Don't peek until you solve these twelve puzzles. The solutions are on page 21.
- This type of puzzle is called rebus brain teasers.

11.



12.

BUR

CITATION

- Colom, R., Karama, S., Jung, R. E., & Haier, R. J. (2010). Human intelligence and brain networks. *Dialogues in clinical neuroscience*, 12(4), 489–501.

AUTHORS

- Dr. Barbara J. Shaw, Colorado State University Extension Western Region Youth Development 4-H STEM K/12 Specialist
- Tera Shults, Colorado State University Extension Rio Blanco County 4-H Youth Program Coordinator
- Anne Casey, Pueblo Zoo Education Coordinator
- Tom Lindsay, retired Portland State University instructor (geology and paleontology); HS science teacher (AP and IB Chemistry, Physics, Biology, and Calculus)

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CITATIONS

Information:

- Wands: <https://www.youtube.com/watch?v=T99JP973Rxo>; <https://www.instructables.com/id/Make-an-awesome-Harry-Potter-wand-from-a-sheet-of/>
- Brooms: https://www.exploratorium.edu/science_explorer/hoopster.html
- Astronomy: Barbara Shaw Ph.D. (2001) Astronomy, Science A 2 Z.
- Potions: <https://www.youtube.com/watch?v=rqQSIEViNpk>; <https://www.acs.org/content/acs/en/education/whatischemistry/adventures-in-chemistry/experiments/colors-move.html>
- Ancient Runes: <https://d114mzi0q5mijx.cloudfront.net/img/A/N/Anglo-Saxon-Runes-RegularA.png>
- Charms: https://harrypotter.fandom.com/wiki/Dancing_Feet_Spell; <https://frugalfun4boys.com/make-magnetic-slime/>; <https://www.nationalgeographic.org/encyclopedia/magnetism/#:~:text=All%20magnets%20have%20north%20and,atoms%20creates%20a%20magnetic%20field.>
- Herbology: <https://food52.com/blog/14782-how-to-preserve-and-press-leaves-ideas-for-using-them>; <https://tinkerlab.com/fall-crafts-glycerin-leaves/>; <https://www.thesprucecrafts.com/how-to-make-paper-beads-4045300>; [https://www.esf.edu/pubprog/brochure/leaves/leaves.htm#:~:text=Chlorophyll%20Breaks%20Down,part%20of%20their%20fall%20splendor](https://www.esf.edu/pubprog/brochure/leaves/leaves.htm#:~:text=Chlorophyll%20Breaks%20Down,part%20of%20their%20fall%20splendor;); <https://www.recycleacrossamerica.org/recycling-facts>
- Defense Against the Dark Arts: <https://www.sciencebuddies.org/stem-activities/make-a-fire-snake#instructions>; <https://io9.gizmodo.com/how-to-make-a-fiery-black-snake-rise-from-the-sand-509974972>
- Jelly Beans: <https://www.leaf.tv/articles/how-to-make-jelly-beans-step-by-step/>; https://www.howtocookthat.net/public_html/make-jelly-beans-recipe/; <https://www.bobsredmill.com/blog/recipes/what-is-caster-sugar/>; <https://www.wikihow.com/Make-Jelly-Beans>; <https://www.scienceofcooking.com/caramelization.htm>; <https://www.worldsciencefestival.com/2014/10/sugary-secrets-candy-making-chemistry/>; <https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/archive-2014-2015/candymaking.html>; [https://www.deltadentalins.com/oral_health/plaque.html#:~:text=Plaque%20is%20a%20soft%2C%20sticky,regularly%20through%20brushing%20and%20flossing](https://www.deltadentalins.com/oral_health/plaque.html#:~:text=Plaque%20is%20a%20soft%2C%20sticky,regularly%20through%20brushing%20and%20flossing;); <https://www.factinate.com/things/45-delicious-facts-sweet-sweet-candy/>
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Images:

- Wands: <https://www.youtube.com/watch?v=T99JP973Rxo>; <https://www.instructables.com/id/Make-an-awesome-Harry-Potter-wand-from-a-sheet-of-/>; <https://www.scholastic.com/parents/school-success/learning-toolkit-blog/super-bowl-science-explore-physics-paper-footballs.html>
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- Potions: <https://www.cinemablend.com/news/2475569/severus-snape-the-major-clues-he-wasnt-a-villain>; Potions: <https://www.youtube.com/watch?v=rqQSIEViNpk>
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- Ancient Runes: <https://d114mzi0q5mijx.cloudfront.net/img/A/N/Anglo-Saxon-Runes-RegularA.png>
- Charms: <https://www.youtube.com/watch?v=eCBR9MVufO8>; https://harrypotter.fandom.com/wiki/Dancing_Feet_Spell
- Herbology: <https://www.tor.com/2013/11/19/neville-longbottom-is-the-most-important-person-in-harry-potter/>; <https://food52.com/blog/14782-how-to-preserve-and-press-leaves-ideas-for-using-them>; <http://sparkandchemistry.com/blog/leaf-mason-jar-candle-holder/>
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- Jelly Beans: https://www.howtocookthat.net/public_html/make-jelly-beans-recipe/; Jelly Beans: <https://www.leaf.tv/articles/how-to-make-jelly-beans-step-by-step/>; <https://www.yourfamily.co.za/tutorial/sugar-stages>; <https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/archive-2014-2015/candymaking.html>