GEEK & CO. SCIENCE!

PROJECT KIT

Ages 8+

CHoCoLaTE SCIENCE LAB

THAMES & KOSMOS

WARNING. Only for use by children 8 years of age or older with continuous adult supervision and assistance. Components in this kit may be sharp, breakable, or have sharp edges. Some experiments require the use of a stove and high temperatures.

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Advice for parents and supervising adults

This experiment kit is not suitable for children under 8 years. It must be used with an adult at all times. The kit provides a fun introduction to physical science topics through chocolate making activities.

The work of a chocolate maker is fun and exciting, but it is not always easy. This is why we would like to thoroughly inform you of safety precautions, so that you can guide your child with advice and help. You must supervise and assist him or her with all of the activities in this kit, but especially when using the stove and working with hot ingredients. This also applies to the use of sharp knives and other kitchen utensils (e.g. breakable mugs).

Take a look through this instruction manual and pay particular attention to the

→ Safety information and rules (inside front cover),
→ Safety notes that accompany each experiment (marked with an exclamation point symbol (!)), and
→ First aid in case of accidents (inside back cover).

Discuss the experiments and the individual work steps with your child before beginning. Use only the recommended ingredients.

Chocolate molding requires several different talents and skills. It can be affected by the weather, temperature, and the specific equipment used. Don't get discouraged if a particular step does not work out as expected. Having some experiments "fail" is an important part of science.

Select the working steps that appear suitable for your child and supervise him or her during the melting, pouring, packaging, and storage of the chocolates. Your own chocolates will not keep as long as commercially available chocolates that often contain preservatives. You should always use fresh ingredients and write the production date on the gift box to make sure that the gift recipient eats the sweets soon.

Tell your child to read these instructions, safety rules, and first aid information, to follow them, to keep them for reference, and to perform only those experiments that are described in the manual.

Pick an area in the kitchen that can tolerate spills and stains. When working with hot pots, have a trivet and pot holders available, and make your child aware of the danger of burns.

To keep the tools in this kit in good condition, they should always be washed by hand and not in the dishwasher. The high temperatures used in a dishwasher might deform the plastic forms.

If your child has to stay away from certain sweets or avoid some ingredients (for example because of an allergy), you will have to alter the recipe or not use it. Always check the contents of purchased ingredients.

We hope you and your young chocolatier have lots of fun with this kit!

NOTE! *The additionally required items are highlighted in italic script in the individual experiments. Before starting the experiments, carefully read through everything that will be required and make sure to have all the materials ready.*

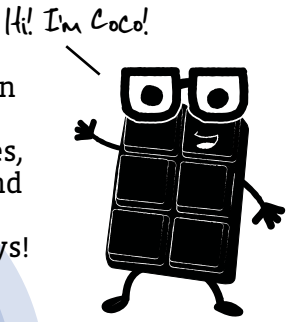
KIT CONTENTS

1	Valentine's box die-cut sheets
2	Tree box die-cut sheet
3	Flower box die-cut sheet
4	Clear wrapping foils (12)
5	Aluminum foil sheets (12)
6	Chocolate shapes mold
7	Chocolate egg mold
8	Baking cups (30)
9	Pick tool
10	Dipping fork tool
11	Lollipop sticks (15)

YOU WILL ALSO NEED: *Ceramic mug, chocolate chips, kettle, spoons, desk lamp, napkin, metal cooking pot, metal bowl, kitchen thermometer, measuring spoons, spatula, water, couverture chocolate (recommended) or coating/molding chocolate, baking rack, chocolate filling ingredients, glue stick, tape, scissors, yarn or string*

KITCHEN EQUIPMENT: *You will need a stove, sink, and a regularly well-equipped kitchen. Read through each experiment to make sure you have everything you need for the experiment.*

Hey Choco-Scientists!



Want to make some sweet chocolate treats and learn some physical science while you're at it? Then let's get started! After you've made your chocolate shapes, you can wrap them in foils and plastic wrappers, and make some cool gift boxes for them. Then you can give them to your family and friends for the holidays! Coco the Geeker will be your guide!

PART 1

PHASES OF MATTER IN CHOCOLATE

Transferring heat

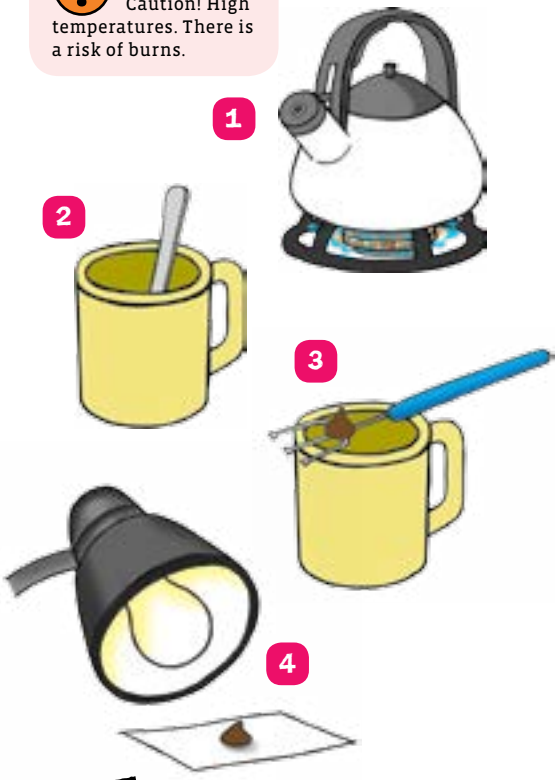
You will need:

Dipping fork, *2 chocolate chips, boiling hot water (electric kettle, or kettle and stove), ceramic mug, metal spoon, desk lamp, napkin*

Here's how:

1. Boil water in an electric kettle or in a kettle on the stove.
2. Fill the mug with the hot water. Place the metal spoon in the mug. Wait three minutes. Touch the spoon's handle. Is it hot to the touch?
3. Replace the water in the mug with fresh hot water from the kettle. Balance the dipping fork on the rim of the mug, as shown. Place a single chocolate chip on the dipping fork. Wait a few minutes. What happens to the chocolate chip?
4. Place a chocolate chip on a napkin, and put it on a table. Position a desk lamp so its light shines on the chip from only an inch away. Wait a few minutes, then touch the chip. What happens to the chocolate chip?

Safety Note: Caution! High temperatures. There is a risk of burns.



GEEK OUT!

WHAT'S HAPPENING?

Heat was transferred in each step of this experiment. In step 2, you saw conduction; step 3, convection; and step 4, radiation. See page 8 for more information.

Chocolate shapes

You will need:

Chocolate mold, aluminum foils, *metal cooking pot, metal bowl (that fits in the pot as shown), kitchen thermometer, spoons, measuring spoons, spatula, water*

1 cup of chocolate: couverture chocolate is recommended. This is high-quality, real chocolate.

Safety Note: Caution! High temperatures. There is a risk of burns.

Here's how:

1. Set up the pot and bowl as shown. Put a few inches of water in the pot. This setup is called a double boiler.
2. Put 2/3 cup of chocolate into the bowl. Melt it on low heat. The water in the double boiler should be just simmering. Don't let any water get in the bowl.
3. Allow all the chocolate to melt and reach a temperature of 110 °F, and no higher!
4. Turn off the heat and add the remaining 1/3 cup of chocolate, finely chopped.
5. Stir the chocolate until it has all melted. Once the chocolate has cooled to 80 °F, turn the stove on again and bring it back up to 90 °F, and no higher!
6. Carefully spoon the melted chocolate into the cavities in the mold.

TIP!

You can use **chocolate coating** instead of couverture chocolate. In chocolate coating, some or all of the cocoa butter has been replaced by vegetable fats. It is usually easier to work with, melts faster, does not require tempering, and solidifies better. You can find it at craft stores, some baking shops, and some supermarkets.

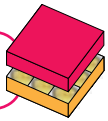
Here's how it continues:

7 When the mold is filled with chocolate, tap it a few times on the side and shake it gently on the table to get the chocolate to settle into the shapes.

8 Let the chocolate cool and harden for a number of hours. To speed up this process, you can put the mold in the freezer.

9 Once the chocolate is hard, you can carefully push it out of the mold with your fingers, or you can pry it loose with the pick tool.

10 Wrap your chocolate shapes in foil and put them in the gift boxes.



Valentine's box on pg. 13 suggested.

GEEK OUT!

WHAT'S HAPPENING?

The double boiler allows for the slow, controlled heating of the chocolate. You had to bring the chocolate from 110 °F, to 80 °F, and then to 90 °F, so that it would harden into smooth, hard, shiny chocolate when it finally cooled. This process is called tempering. Tempering allows the cocoa butter crystals in the chocolate to form uniformly, which makes the chocolate smooth instead of sticky, hard instead of crumbly, and shiny instead of dull.

GEEK OUT!

What is temperature?

Temperature is the measure of the average kinetic energy of the particles in a sample of matter. The temperature of a cup of hot cocoa is higher than the temperature of a scoop of ice cream. This means that the particles in the hot cocoa have a higher average kinetic energy than those in the ice cream. Kinetic energy is simply motion energy. So the particles in the hot cocoa are moving faster than those in the ice cream.

Chocolate bunny

You will need:

Everything from the "Chocolate Shapes" experiment, lollipop sticks, plastic wrappers or aluminum foils

Here's how:

1. Melt and temper the chocolate as you did in the "Chocolate Shapes" experiment.
2. Fill the bunny cavity halfway with the spoon.
3. Carefully place the lollipop stick in its spot in the bunny cavity.
4. Fill the bunny cavity the rest of the way.
5. Wait for the chocolate to harden, and then carefully remove the bunny from the mold. Wrap in a plastic wrapper or aluminum foil.

Tie on a tag to make a nice gift.

Chocolate Santa

You will need:

Everything from the "Chocolate Shapes" experiment, aluminum foils

Here's how:

1. Melt and temper the chocolate as you did in the "Chocolate Shapes" experiment.
2. Fill the two halves of the santa cavity with the spoon.
3. Wait for the chocolate to harden. Carefully remove the two halves from the mold.
4. With a little bit of melted chocolate, "glue" the two halves of the santa together. Wrap in aluminum foil.

Tree gift box on pg. 14 suggested.

Chocolate egg

You will need:

Everything from the "Chocolate Shapes" experiment, egg mold, aluminum foils

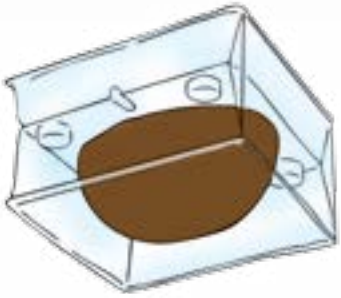
Here's how:

1. Melt and temper 1/4 cup of chocolate in the double boiler.
2. Pour about 4 teaspoons or 1 and 1/2 tablespoons of melted chocolate into the egg mold, up to the fill line marked in the plastic.
3. Close the mold. Let the chocolate cool completely. Again, you can put it in the freezer to speed the hardening.
4. Carefully remove the egg half from the mold.
5. Repeat to mold a second egg half.
6. "Glue" the two egg halves together using a little melted chocolate placed along their edges.
7. Wrap your egg in foil.

Safety Note: Caution! High temperatures. There is a risk of burns.

2

3



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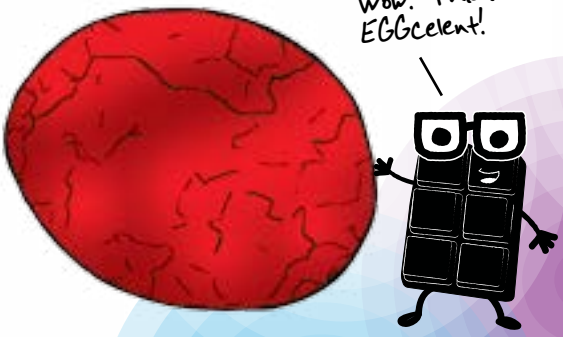


GEEK OUT!

WHAT IS HEAT?

Temperature and heat are not the same thing. While temperature is a measure of the average kinetic energy of a sample of matter, heat is the total kinetic energy of all particles in the sample. Imagine filling up a bucket of water from a pond and immediately measuring the temperature of the water in the bucket and the water in the pond. The temperature would be the same for both. But, because there are far fewer particles in the bucket than in the pond, the amount of heat in the bucket is far lower. Heat takes into account the total amount of matter.

HEAT TRANSFER

Conduction is the transfer of heat through solids. In your experiment, heat was conducted through the metal spoon up to the top of the handle. The heat is transferred directly from particle to particle as they bump together. Metals are examples of good conductors, and wood and plastic are examples of poor conductors.

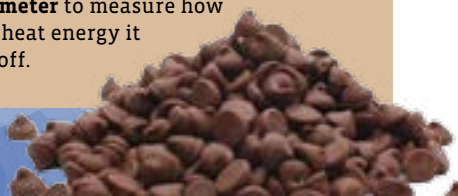
Convection is the transfer of heat through liquids and gases. When liquids and gases heat up, the particles move faster and faster. Because they are free to move around, the faster moving particles move farther apart. This makes the liquid or gas less dense, and thus it will rise above cooler liquids or gases. This is why warm air rises.

Radiation is the transfer of energy through empty space. Instead of particles moving around as in conduction and convection, radiation is transmitted by electromagnetic waves, like light. This is how the light from the light bulb was able to heat up the chocolate chip.

CALORIES MEASURE HEAT

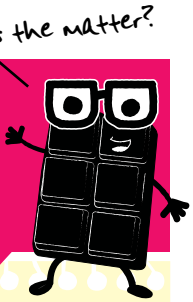
Scientists measure heat in units called **calories.** You might be thinking to yourself that this term sounds familiar and that you have heard it when people talk about food. And you are right! Food calories and the calories scientists use to measure heat are related, but not exactly equal. A food calorie (or large calorie, or kilocalorie) is equal to 1,000 times a scientific calorie (or small calorie). Often food calories are called kcals or Calories with a capital C. A scientific calorie is a measure of the heat energy needed to increase the temperature of 1 gram of water by 1 °C. Scientists also use joules to measure heat energy. One calorie equals 4.18 joules.

A single chocolate chip has about 2 to 3 calories. A cup of chocolate chips has 800 to 1200 calories. Scientists can burn a food sample in a special device called a **calorimeter** to measure how much heat energy it gives off.



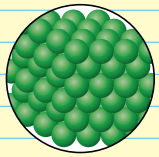
GEEK OUT!

THE PHASES OF MATTER



There are three **phases of matter:** solid, liquid, and gas. (There are actually others, like plasma and Bose-Einstein condensate, but they're much less common.) This means that pretty much all the stuff you see in the world can be characterized as being in either a solid, liquid, or gas phase.

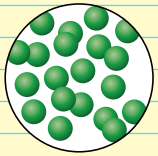
The atoms of **solids** are packed together densely and have fixed positions in space relative to each other (like bricks in a wall), which makes solids rigid.



Solid water (ice)

Liquid water

Liquids have atoms that are packed less densely than are those of solids, and while solids form a rigid shape, liquids move freely. But when liquids are poured into a container, they must conform to the shape of the container, except for possibly one surface (like the surface of water in a fish tank).



This is not the case for **gases,** which must conform to the shape of the container entirely (like water vapor in a fish tank, which would have no surface different from the walls of the tank). The atoms of gases are packed the least densely of all three phases, and are in relatively random motion. Gases have no definite shape or volume, can expand and contract greatly with changes in temperature and pressure, and spread easily to distribute themselves evenly throughout a container — hence their total conformity to the shapes of containers.

Gaseous water

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FREEZING AND MELTING

When a liquid **freezes,** it turns to a solid. The temperature at which this happens is called the **freezing point.**

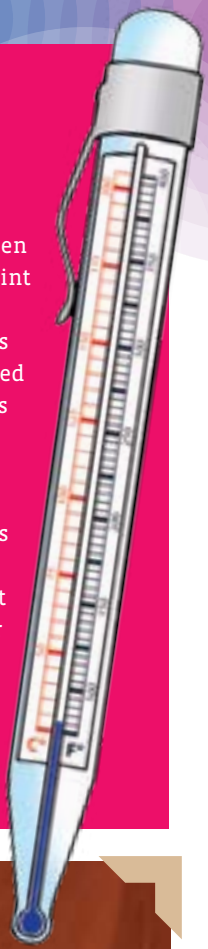
When a solid **melts,** it turns into a liquid. This is the opposite of freezing. The temperature at which this happens is the **melting point.** The melting point and freezing point of a substance are often the same.

Water freezes and ice melts at the same temperature, 0 °C or 32 °F. But in your chocolate molding experiments, you saw that chocolate behaves a little differently. Chocolate is a mixture of different ingredients, not just one compound like water. Because of this, different types of chocolate will have different melting points.

Dark chocolate that has been tempered has a melting point around 95 °F.

Tempering is a process by which chocolate is heated up to specific temperatures and then cooled in a controlled way to yield uniform crystals. Yes, chocolate contains crystals of cocoa butter!

Chocolate that has not been tempered has a lower melting point, as low as 63 °F. Tempered chocolate has a glossier sheen, a crisper bite, and molds into firmer shapes.

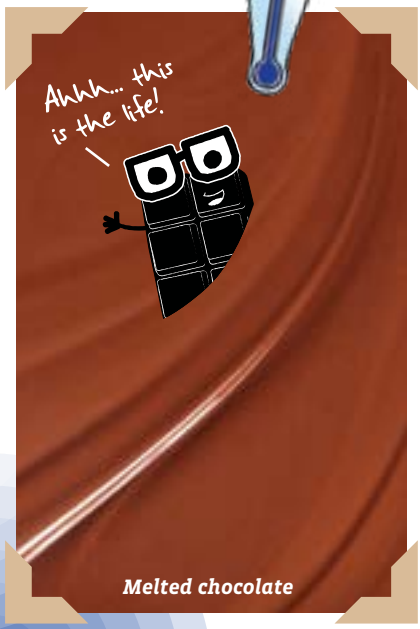


BOILING AND CONDENSATION

When a liquid **boils,** it changes to a gas. The temperature at which this happens is called the **boiling point.** Scientists also refer to boiling as **vaporization.**

When a gas changes to a liquid, it **condenses.** The temperature at which this happens is called the **condensation point.**

Water boils at 100 °C or 212 °F. Chocolate on the other hand does not have a specific boiling point: Its various ingredients will all vaporize at different temperatures, much higher than 212 °F.



Melted chocolate

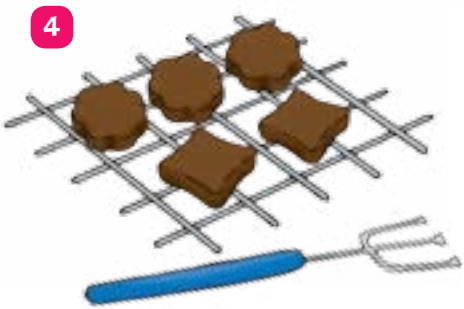
Chocolate coatings

You will need:

Everything from the "Chocolate Shapes" experiment, dipping fork, pick tool, *baking rack, fillings to coat such as caramel, nougat, nuts, marshmallows, wafers, cookies, or flavored fondants*

Here's how:

1. Melt and temper the chocolate in the double boiler. Keep it melted.
2. Take the filling you want to coat in chocolate and rest it on the dipping fork.
3. Lower the dipping fork holding the filling into the chocolate. Carefully remove the coated filling and place it on a baking rack. Use the pick tool to decorate the tops before they dry.
4. Let the coated chocolates cool and harden.
5. Place the hardened, coated chocolates into baking cups and then into gift boxes.



GEEK OUT!

What is cocoa butter?

Most fats are mixtures of many different fat molecules. **Cocoa butter** is special because it contains relatively few types of fat molecules arranged in an orderly way. Because of this, cocoa butter melts uniformly at a specific temperature, while other fats melt gradually over a range of temperatures. This unique property is what gives chocolate its wonderful texture.

GEEK OUT!

WHERE DOES CHOCOLATE COME FROM?

The Aztecs brewed a thick beverage from cocoa pods, water, vanilla, and honey, which they called **Xocoatl** (pronounced "shockolatle"). The main ingredient, fruit pods from the **cacao tree,** was valued so highly that the Aztecs even used these fruits as money. The valuable beans came to Europe via Spain, first as a beverage. To make it, cocoa powder was grated into hot water or milk, sugar or honey was added, and the brown liquid was whipped until foamy. The delicious beverage spread all over Europe and is the ancestor of today's hot cocoa.

The perennial cacao tree will grow to be about 26 feet tall in plantations. Its yellow flowers are half an inch long and sit in bundles directly on its trunk. From these will grow eight-inch long cucumber-like fruit pods, which will change color from green to yellow to red. Inside these, embedded in white, sweet-and-sour flesh, there are about 30 seeds, called **cocoa beans**, although they are not actually beans. These seeds are highly nourishing. They are almost 50% fat, or **cocoa butter.** They also contain a chemical similar to caffeine called **theobromine,** at levels that are safe for humans but dangerous for pets.

Cocoa fruits are harvested today similar to how they were in the days of the Aztecs. The fruits are cut from the tree with sharp knives and immediately split to extract the seeds, which are then fermented. During this process, they are heated by the effect of bacteria, yeast, and enzymes, to about 45 °C (113 °F) and develop the fine, recognizable cocoa aroma. Finally, the beans are dried and roasted.

To be processed into cocoa powder, the cocoa beans are ground up into cocoa mass. This is exposed to high pressure in presses heated with steam, which releases the cocoa butter fat. The remainder is ground into fine cocoa powder ready to be packaged and sold.

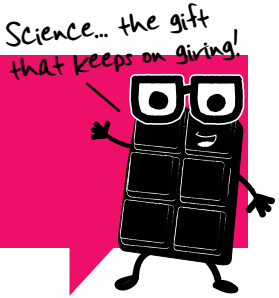
Cacao pods

Raw cocoa beans

Roasted cocoa beans

PART 2

MAKING THE GIFT BOXES



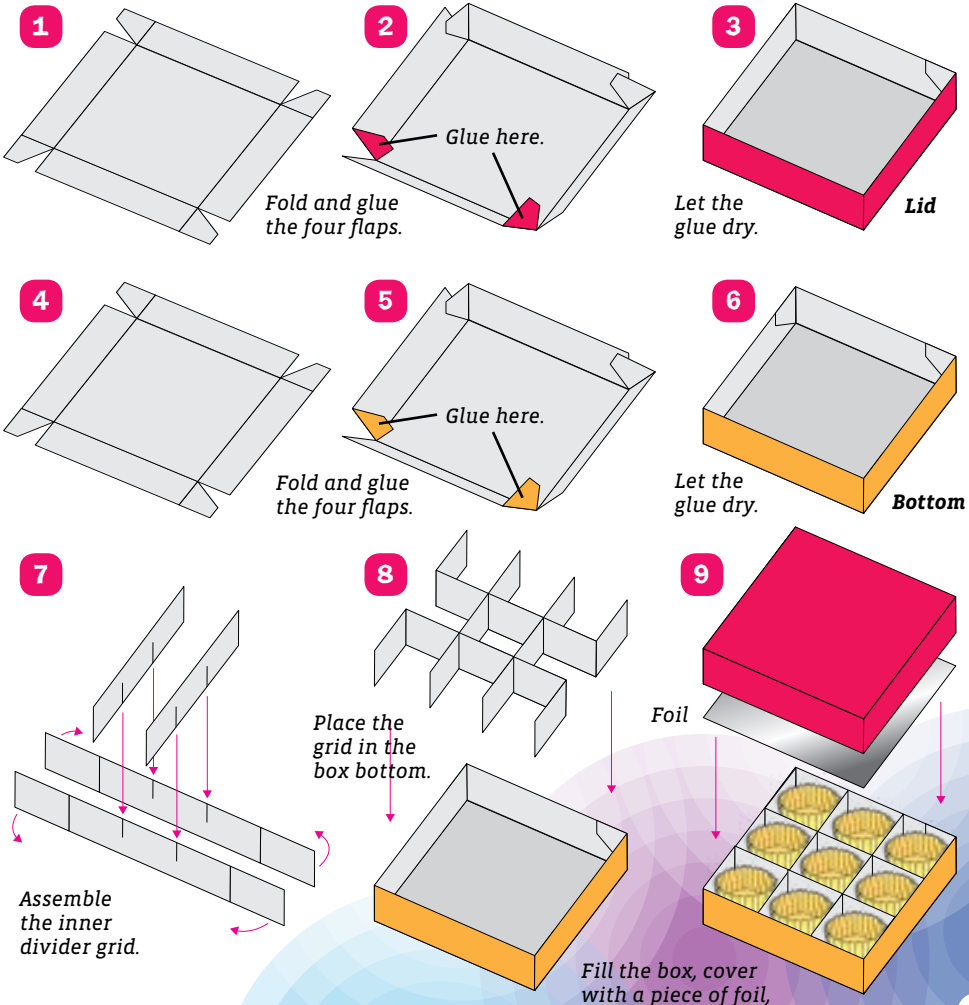
Valentine's box

You will need:

Die-cut box pieces, aluminum foil (cut to 11 x 11 cm), *glue stick, scissors*

Here's how:

Follow the steps below to fold and glue the box. Then fill it with small baking cups and your wrapped chocolates.



Flower box

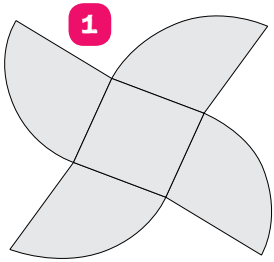
You will need:

Die-cut box piece, *tape*

Here's how:

Follow the steps below to fold the box. Then place a wrapped chocolate in it.

1



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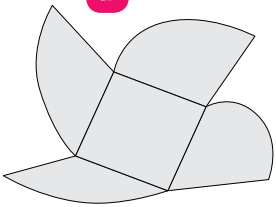
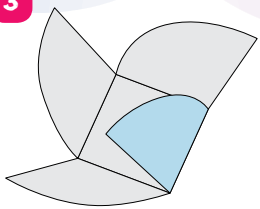


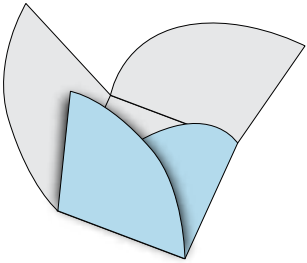
Crease all of the flaps upward.

3



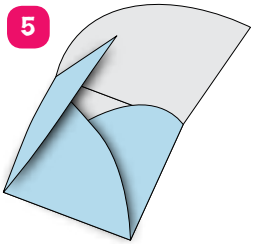
Fold the first flap up.

4



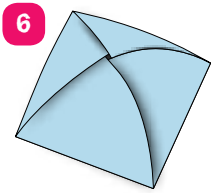
Fold the second flap up.

5



Fold the third flap up.

6



Fold the fourth flap up and tuck it under the first flap. Secure with a small piece of tape if necessary.

Tree box

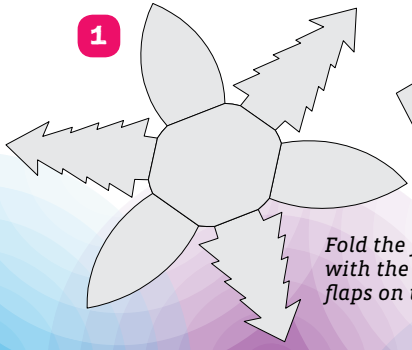
You will need:

Die-cut box piece, *yarn, scissors*

Here's how:

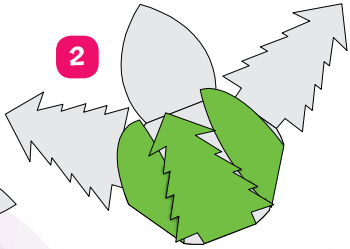
Follow the steps below to fold the box. Then fill it with your wrapped chocolates.

1



Fold the flaps upward with the three smooth flaps on the inside.

2



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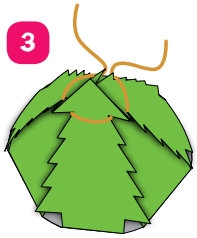
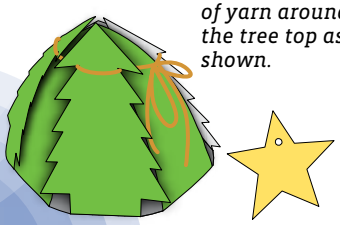


Wrap a piece of yarn around the tree top as shown.

4



Tie the yarn in a bow and add a star tag.

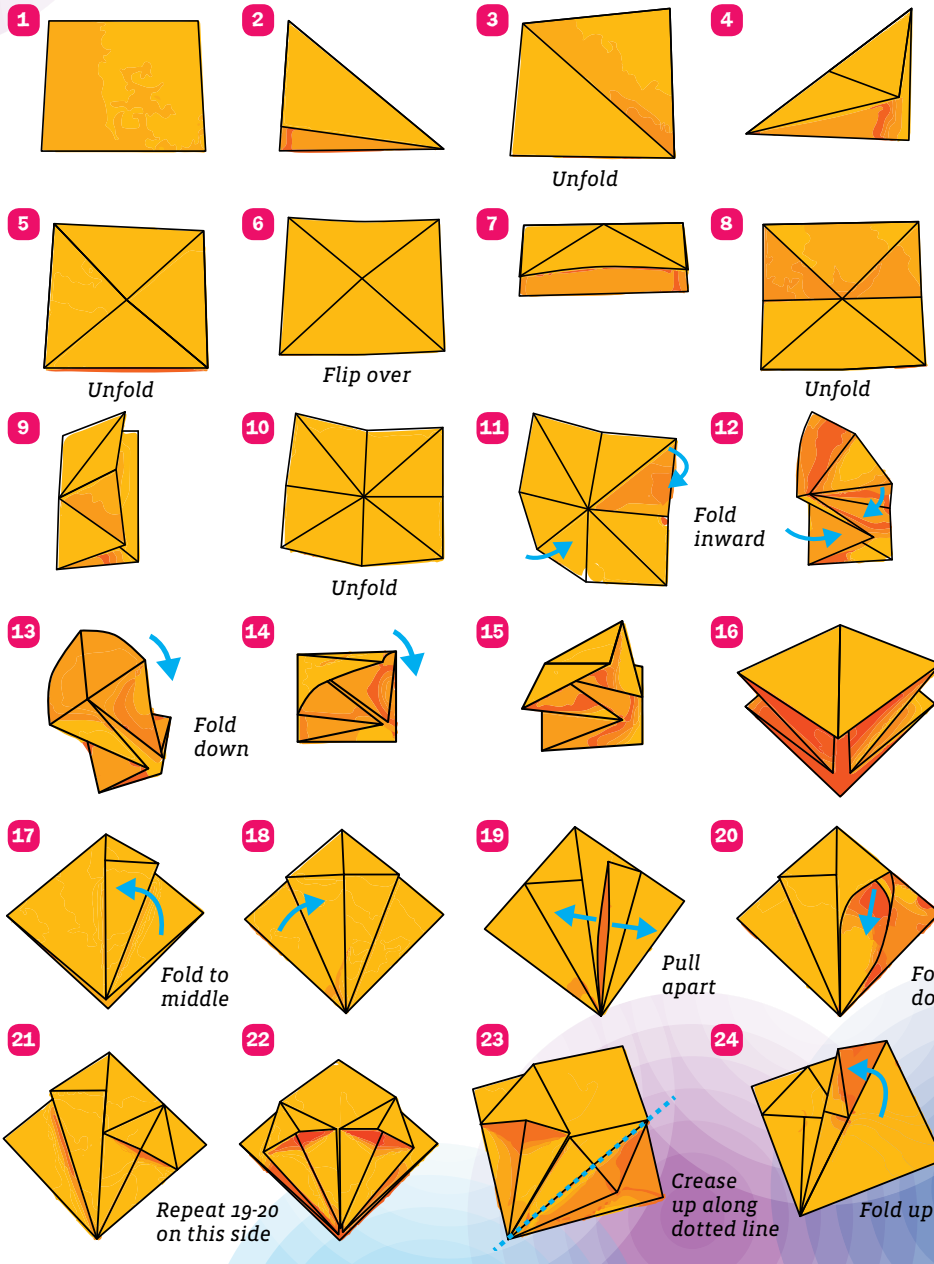
Origami star box

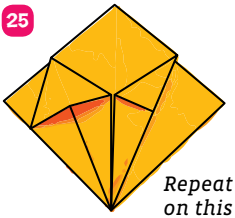
You will need:

Square piece of paper, scissors

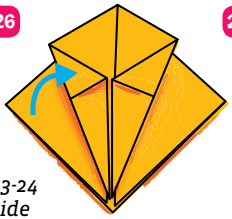
Here's how:

Follow the steps below to fold the box. Then place your wrapped chocolates in it.



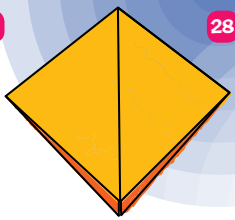


25



26

Repeat 23-24 on this side

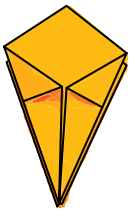


27

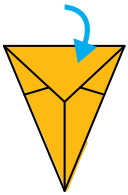
Flip over

28

Repeat 17-26 on this side

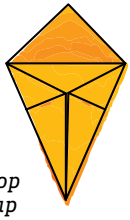


29



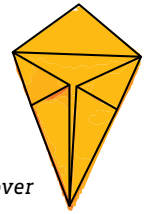
30

Fold top down



31

Fold top back up



32

Flip over

33

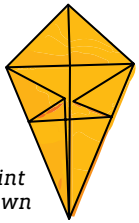
Fold top down

34

Fold top back up

35

Fold point up

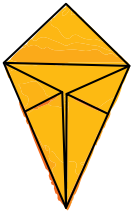


36

Fold point back down

37

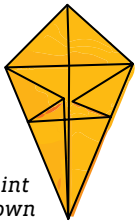
Fold leaf over



38

39

Fold point up

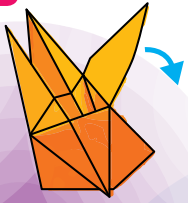


40

Fold point back down

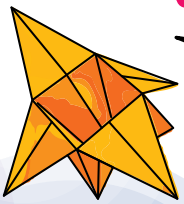
41

Repeat 37-40 for two remaining points



42

Start unfolding the points



43

Unfold all four points and push out the inside of the box

44

Flatten out the bottom of the box and it's done! Fill the box with the wrapped chocolate beetles for a fun Halloween treat!

Safety information

WARNINGS.

Not suitable for children under 8 years. For use under adult supervision. Read the instructions before use, follow them and keep them for reference.

Keep small children and animals away from experiments. Keep the experimental set out of reach of children under 8 years old.

Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.

This kit contains functional sharp points, corners, or edges. Do not injure yourself!

Keep the packaging and instructions as they contain important information.

The chocolates should be wrapped in plastic wrappers or aluminum foil before placing them in the die-cut cardboard boxes.

All of the plastic and metal parts should be cleaned by hand before use.

Safety rules

Read this before starting any experiments.

1. Read these instructions before use, follow them and keep them for reference.
2. Keep young children and animals away from the work area and stove at all times.
3. Store this kit out of reach of children under 8 years of age.
4. Clean all equipment after use. Clean all pots and utensils with hot water and soap.
5. Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
6. Never work alone. An adult should always be present. Pay attention to the information provided with each experiment.
7. Pay special attention to the quantity specifications and the sequence of the individual steps. Only perform experiments that are described in this instruction manual.
8. Maintain a safe distance from the pot so that no hot liquid can splash onto your face or hands. When boiling, water and chocolate gets very hot and can cause serious burns if it comes in contact with skin. Therefore work slowly and carefully when melting the chocolate in the double boiler and when pouring the hot chocolate into the molds.
9. The included tools and the plastic molds for chocolate figures and chocolate eggs are not dishwasher safe. They will be deformed by high temperatures, so wash them by hand.
10. Clean the work surface carefully after you are finished and always wash your hands thoroughly — before and after you work.
11. If you are allergic to certain foods (for example, nuts) you must avoid sweets that contain such ingredients. Therefore, always begin by checking the list of ingredients. If you are diabetic, you must only eat the amount of sugar allowed by your diet plan.
12. It goes without saying that there can be no smoking in a confectionery shop. Also, do not eat other types of food while working with these recipes. For everything to turn out well, you must stay very focused on your work.

Kosmos Quality and Safety

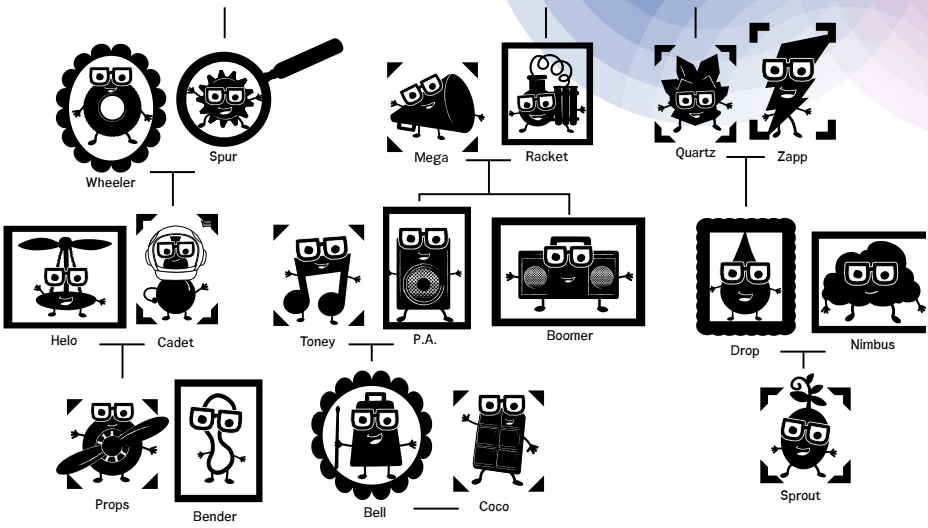
More than one hundred years of expertise in publishing science experiment kits stand behind every product that bears the Kosmos name. Kosmos experiment kits are designed by an experienced team of specialists and tested with the utmost care during development and production. With regard to product safety, these experiment kits follow US safety standards, as well as our own refined proprietary safety guidelines. By working closely with our manufacturing partners and safety testing labs, we are able to control all stages of production. While the majority of our products are made in Germany, all of our products, regardless of origin, follow the same rigid quality standards.

First aid information

Advice in case any accidents should happen during experimentation.

1. In case of burns: Wash affected area with plenty of water for at least 10 minutes.
2. In case of doubt or larger burns, seek medical advice without delay.
3. **In case of injury (e.g. cuts)** always seek medical advice.

MEET THE NEXT-GEN GEEKERS!



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