



**AN INTERACTIVE SCIENTIFIC  
DISCOVERY COMIC WITH EXPERIMENTS  
AND GAMES YOU CAN DO AT HOME!**



**MUSEUM OF NATURAL HISTORY**  
UNIVERSITY OF MICHIGAN



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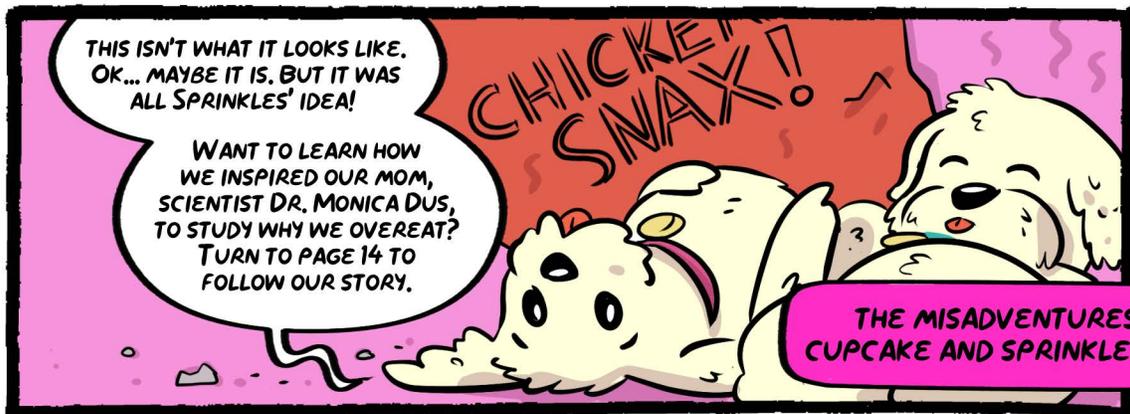
**SHARE YOUR THOUGHTS  
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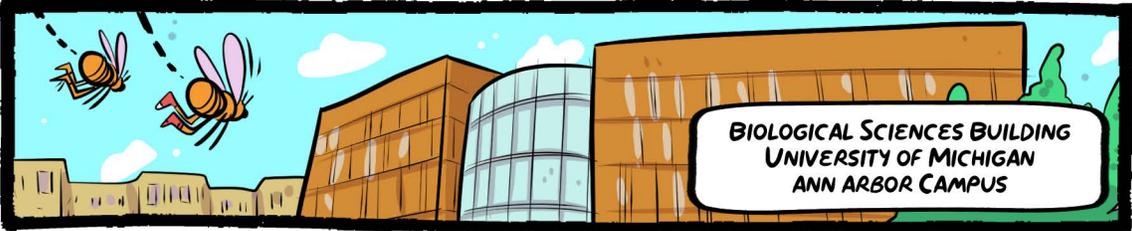
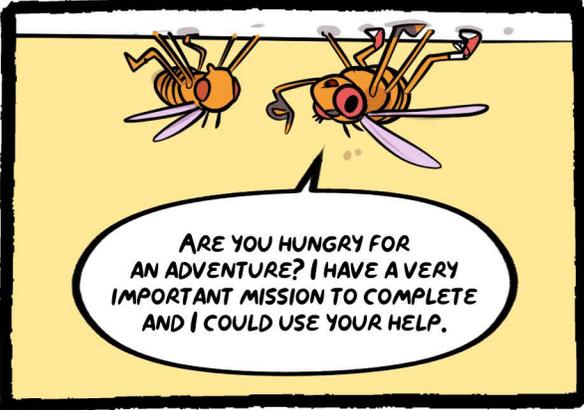
**M** | MUSEUM OF NATURAL HISTORY  
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# EXPERIMENTS WITH SPY FLY





1. Start with one sample each of 3 prepared drinks: purple, green, and colorless.
2. Predict the flavor and sweetness of each and record your answers in the Flavor Prediction and Sweetness Prediction rows on the chart on page 6.
3. Taste each sample. Record the flavor you tasted on the Flavor Observation row. On a scale from 1-10, rank how sweet each drink seems to you and circle that number in the Sweetness Ranking row on the chart.
4. Compare your sweetness rankings to those of friends or family. Did your answers differ? (See the explanation in Experiment #3 to learn more about why they might!)

Finish reading the comic and read the explanation on page 7.

### Do-it-at-home instructions

**Materials:** Water, food coloring, corn syrup, teaspoon, 3 small drinking cups, stirring spoon

**Important:** To keep the flavor answers secret from the taster(s), there should be one "scientist" and one or more "tasters." Only the scientist should create the drinks following the instructions below.

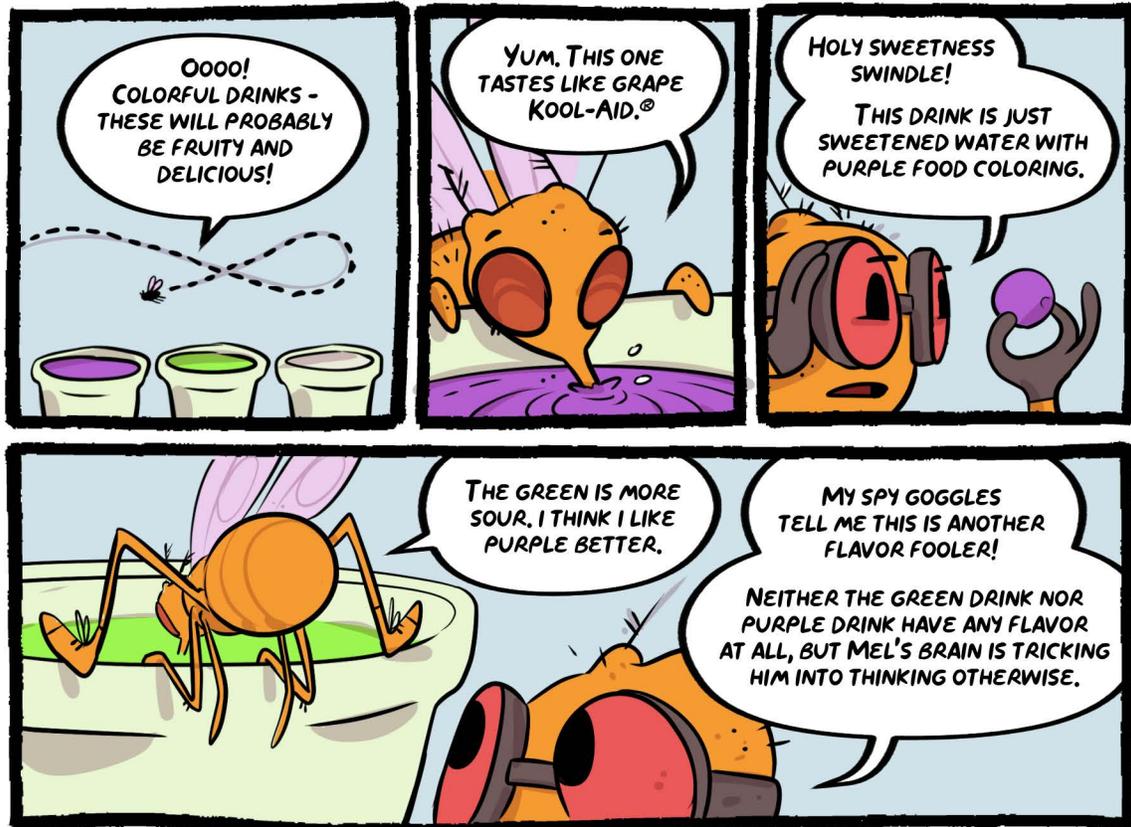
#### Steps to create the samples:

- Colorless Drink: Mix 2 teaspoons corn syrup into 6 teaspoons water. Stir until dissolved.
- Green Drink: Mix 2 teaspoons corn syrup into 6 teaspoons water. Add 1 drop of green food coloring. Stir until dissolved.
- Purple Drink: Mix 2 teaspoons corn syrup into 6 teaspoons water. Add 1 drop of purple (or red) food coloring. Stir until dissolved.

Follow the directions above to finish the experiment!

**RECORD YOUR OBSERVATIONS HERE**

	PURPLE DRINK	GREEN DRINK	COLORLESS DRINK
<b>Flavor Prediction:</b> Will it be fruity? Sour? What do you think?	I think this flavor will taste...	I think this flavor will taste...	I think this flavor will taste...
<b>Sweetness Prediction:</b> (circle one) 1 = not sweet at all 5 = kind of sweet 10 = way too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet Too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet Too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet Too sweet
<b>Flavor Observation:</b> What flavor did you taste?	The flavor tasted...	The flavor tasted...	The flavor tasted...
<b>Sweetness Rankings:</b> (circle one) 1 = not sweet at all 5 = kind of sweet 10 = way too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet Too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet Too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet Too sweet



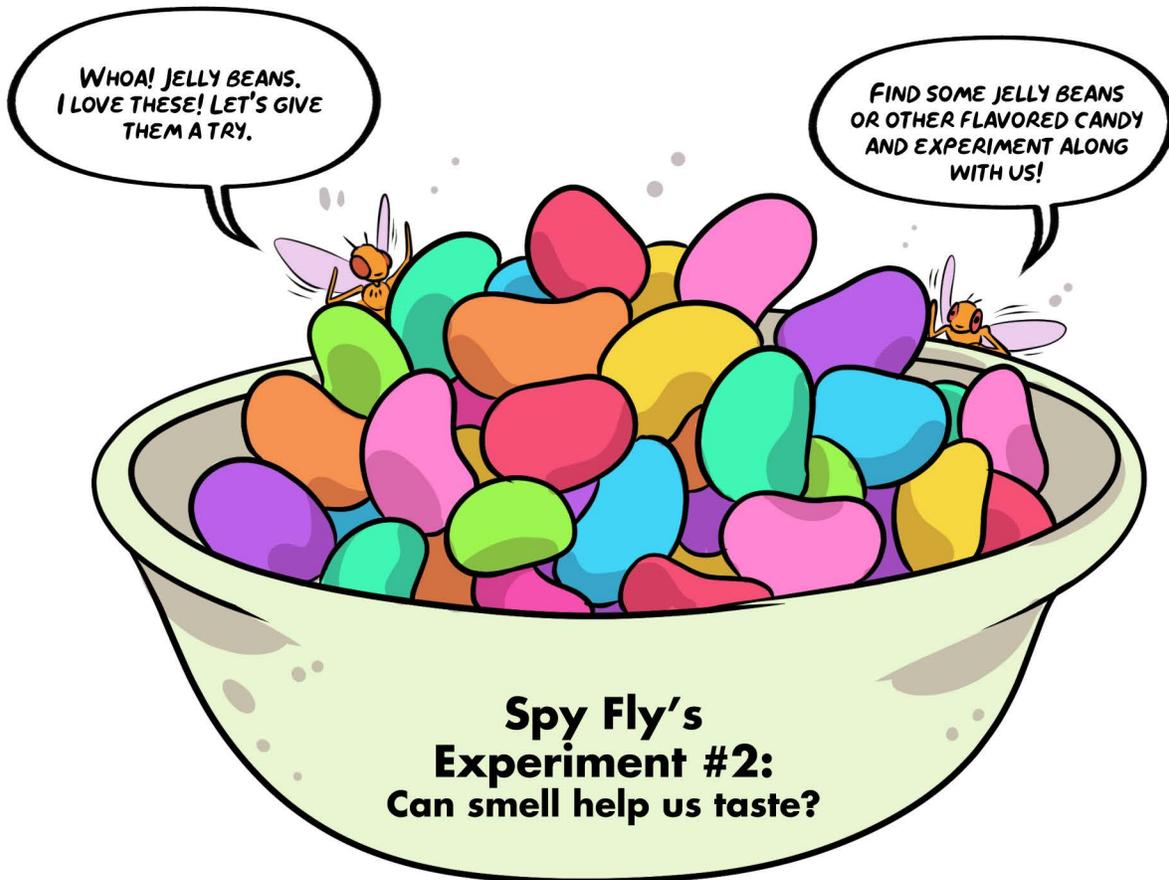
### What's going on?



We may think we mostly rely on our tongues when it comes to determining what something tastes like, but it turns out that other senses play a big role too. This experiment shows how critical vision is to flavor perception. You may have predicted that the purple would taste fruity and sweet, the green less sweet or a little sour, and the colorless sample to have no flavor at all. After tasting the samples, some people will still believe the green is more sour than the purple, even though all three samples have the same level of sweetness and none had a flavor added! Did *your* eyes trick you?

Don't worry if they did. It just means that your senses are working together to help you make decisions about the choices in front of you. You've probably experienced green as a sour flavor or purple as a sweet, fruity flavor before. Your brain made a memory of it so that the next time your eyes see a purple drink your brain recalls the memory and predicts that the purple drink will be fruity and sweet. Far back in human history, these learned memories would help us better survive in our environments. We could quickly choose the sweetest (often reddest, orangest, or purplest) fruits from the tree – those that had the most energy to provide. That would save us time and energy and ultimately help with our survival.

Today, when we make decisions about what to eat and how much to eat, we still use these predictions or memories. That's great if they are accurate, but often food companies will add coloring to foods to make them appear more tantalizing – even when they're not good options!

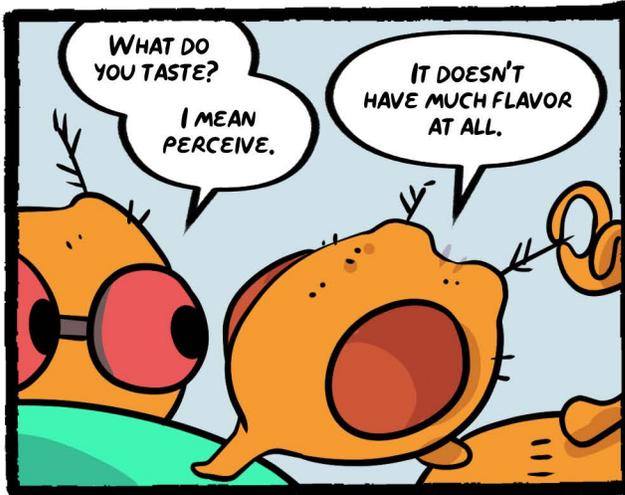
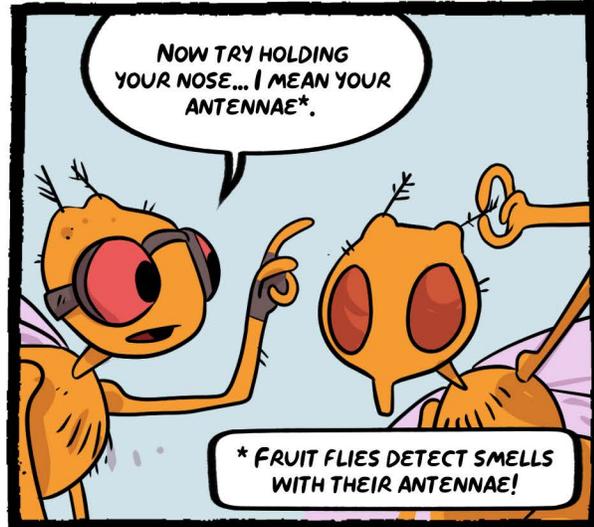
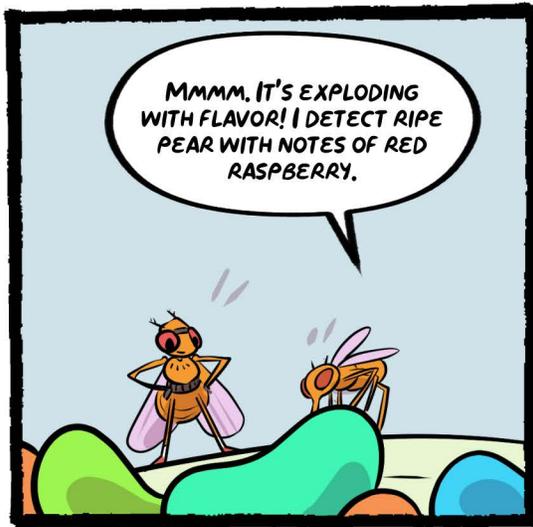


1. Choose two different jelly beans. Eat one and describe its flavor.
2. Hold your nose then eat the second jellybean. Is it more or less difficult to describe the flavor?
3. If you're a sugar-addicted fruit fly, repeat steps 1 - 2. (Human children should ask their grown-ups first!)

For an extra challenge, try holding your nose and closing your eyes!  
Can you correctly identify the flavors of ANY of the jellybeans?  
How do your other senses contribute to your ability to detect flavor?

#### Do-it-at-home instructions

Find assorted jelly beans or other flavored candy then follow the directions above to complete the experiment!



### What's going on?

Have you ever heard someone say, "This candy tastes like lemon"? It turns out that most of us use the word taste incorrectly, including Spy Fly! As you probably discovered in this experiment, plugging your nose has a big impact on your ability to perceive the complexity of jelly bean flavors. That's because flavor is more than just taste!

Flavor is a combination of taste, smell, and other characteristics such as the spiciness and texture of foods. Taste, on the other hand, refers to only 5 main characteristics – sweet, bitter, sour, salty, and savory (also called umami).

Sweetness, saltiness, etc. are sensed by specialized taste cells in your tongue that transmit signals to your brain. These signals are used to make predictions about food and our experiences with it (like what you observed in Experiment #1). The sense of smell, just like vision, influences how you identify the complexities of flavors.

Together, the combination of all the senses is important for both our love for food and our ability to make predictions about its flavor and taste.



1. Start with Mystery Sample A, Mystery Sample B, a small cup of water, and a "tasting" toothpick.
2. Wet the tasting toothpick in the water and dip it into Mystery Sample A. Taste Mystery Sample A. Record your observations in the Taste Observation section on the chart on page 11. Do not share your sample or toothpick.
3. Wet the tasting toothpick in the water and dip it into Mystery Sample B. Taste Mystery Sample B. Record your observations in the Taste Observation section on the chart. Do not share your sample or toothpick.
4. Taste each sample again and consider its sweetness. On a scale from 1-10, rank how sweet each sample seems to you and circle that number in the Sweetness Ranking row on the chart.
5. Now make a prediction: Which sample is the real sugar and which is the fake sugar? Circle your answer in the Prediction row on the chart.
6. Finish reading the comic and read the explanation on page 12 to find out whether your taste buds are tops or whether you've been sweetness swindled!

#### Do-it-at-home instructions

**Materials:** Sugar, artificial sweetener (like sucralose, saccharin, aspartame, or stevia), flat toothpicks, small dishes, small cup of water

**Important:** To keep the answers secret from the taster(s), there should be one "scientist" and one or more "tasters." Only the scientist should create the samples following the instructions below.

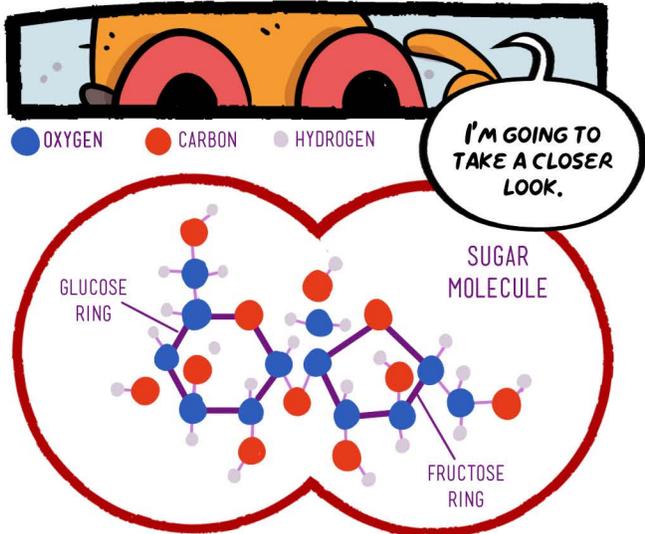
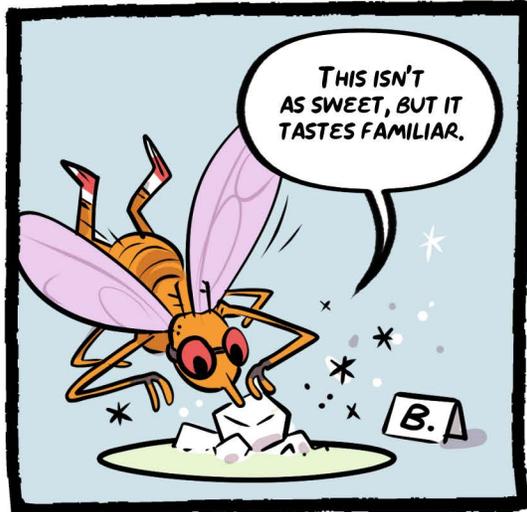
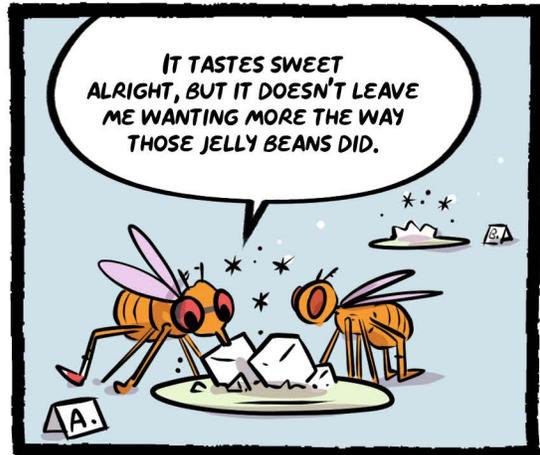
#### Steps to create the Mystery Samples:

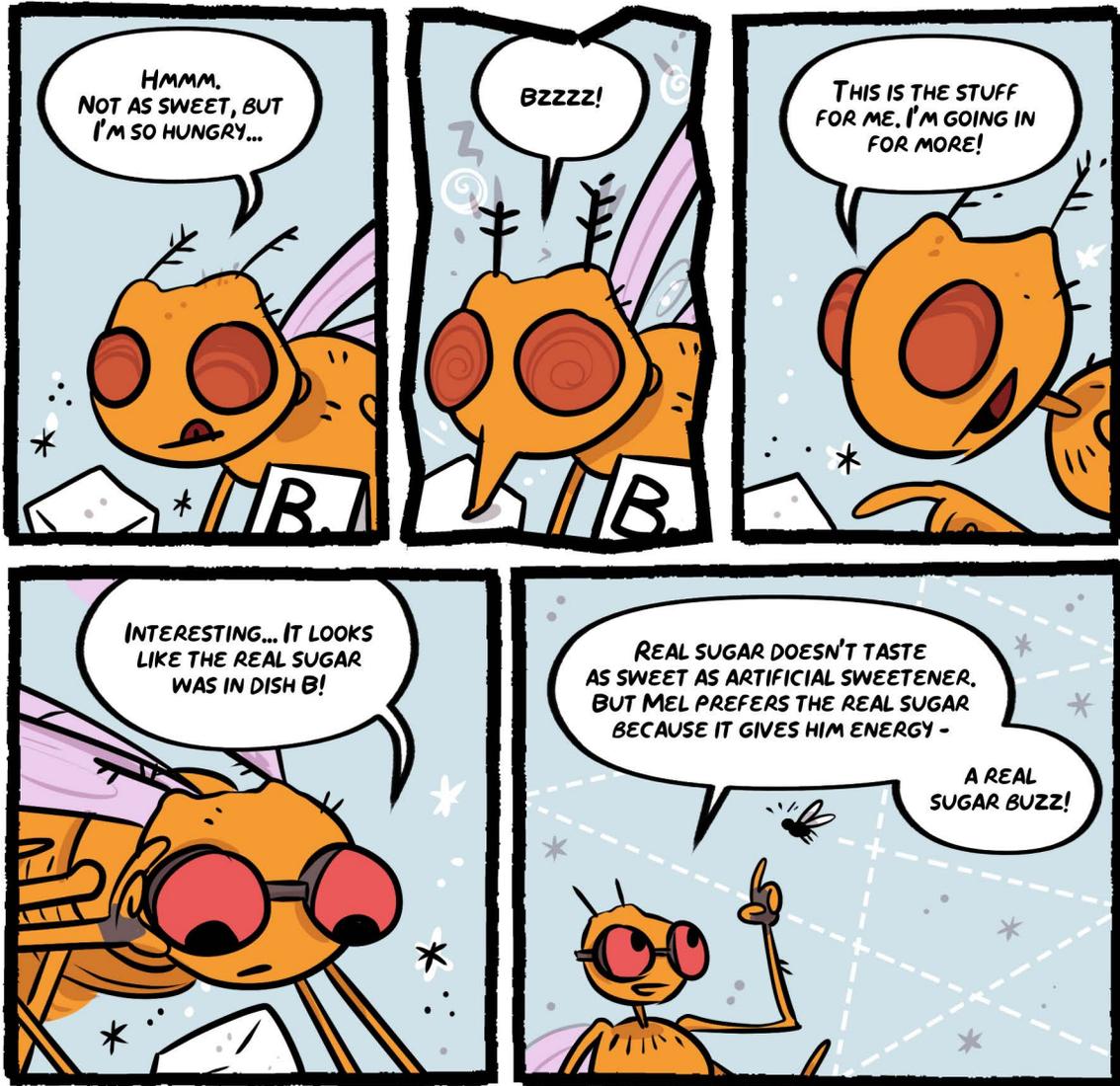
- Mystery Sample A: Measure  $\frac{1}{2}$  teaspoon of sucralose (or other sweetener) onto a dish. Label with "Mystery Sample A".
- Mystery Sample B: Measure  $\frac{1}{2}$  teaspoon of sugar onto a dish. Label with "Mystery Sample B".

Follow the directions above to complete the experiment.

RECORD YOUR OBSERVATIONS HERE

	MYSTERY SAMPLE A	MYSTERY SAMPLE B
<b>Taste Observation:</b> Describe how the sample tastes	I think this flavor tastes...	I think this flavor tastes...
<b>Sweetness Rating:</b> (circle one) 1 = not sweet at all 5 = kind of sweet 10 = way too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet                      Too sweet	1 2 3 4 5 6 7 8 9 10 Not sweet                      Too sweet
<b>Prediction:</b> Circle whether you think the sample is the real or fake sugar	I think this sample is...  Real sugar                      Fake sugar	I think this sample is...  Real sugar                      Fake sugar





### What's going on?

In nature, most things that taste sweet contain real sugar, but in the grocery store, that is not always the case. "Sugar-free" foods are sweetened with artificial sweeteners: substances that activate the taste cells in the tongue but don't contain energy (calories). Even if your taste buds are tricked into thinking something is sugary, your brain is not. Specialized brain cells – known as **interoceptive neurons** – can actually measure how much energy sugars contain and are not fooled by sweetness. Your body can tell the difference between real, energy-providing sugars and fake sugars, even if your taste buds cannot.

What does this mean about those "sugar-free" foods and drinks? They may not satisfy your brain's craving for energy. In fact, recent studies have suggested that diets high in artificial sweeteners may trick people into overeating!

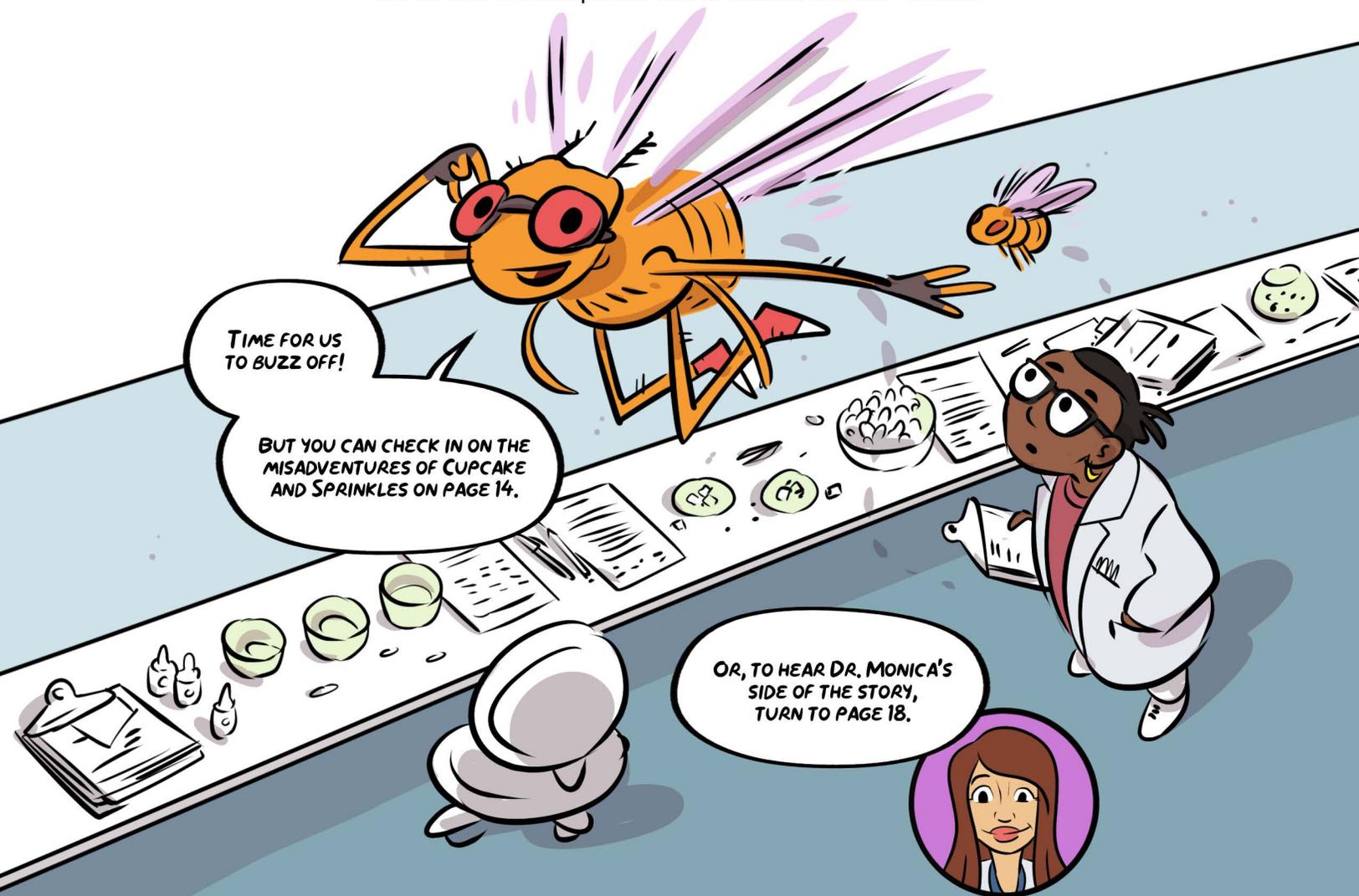
You may have made another interesting observation from this experiment and Experiment #1. Compare your sweetness rating with others around you including parents, grandparents, teachers, or friends.

Do you notice any differences between older and younger people?

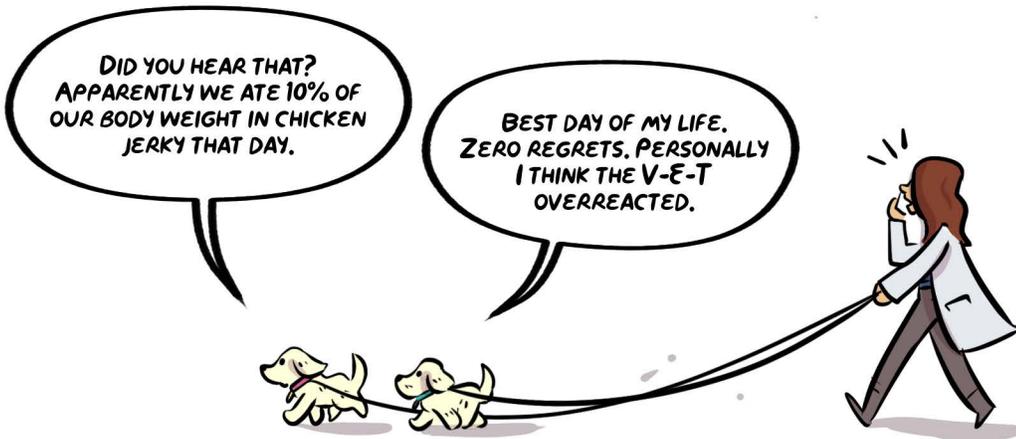
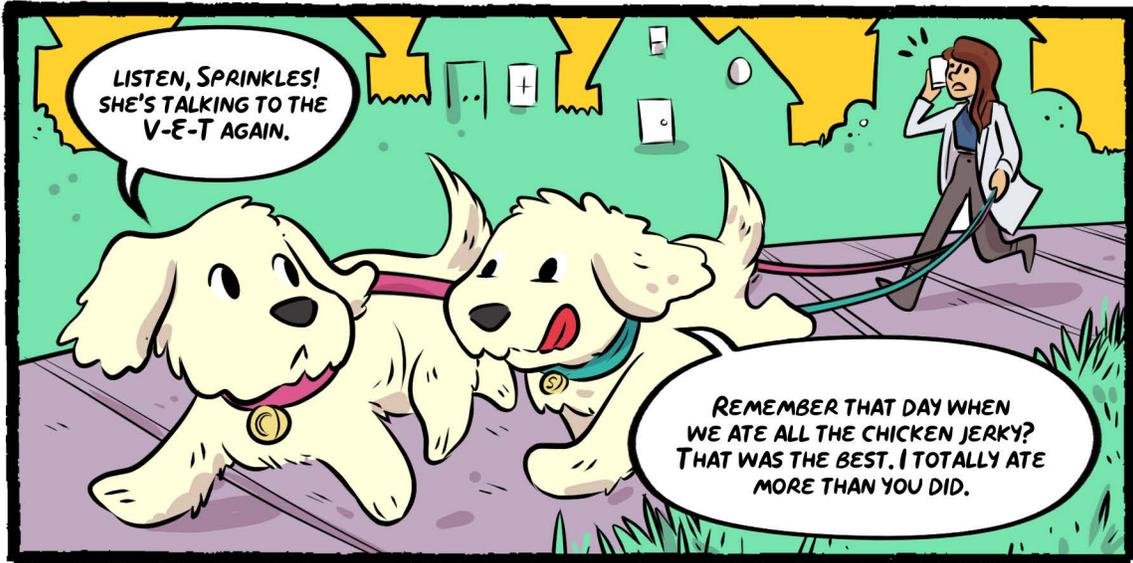
An adult may have rated both the fake and real sugar as too sweet, while children may rate them as less sweet. So who's right?

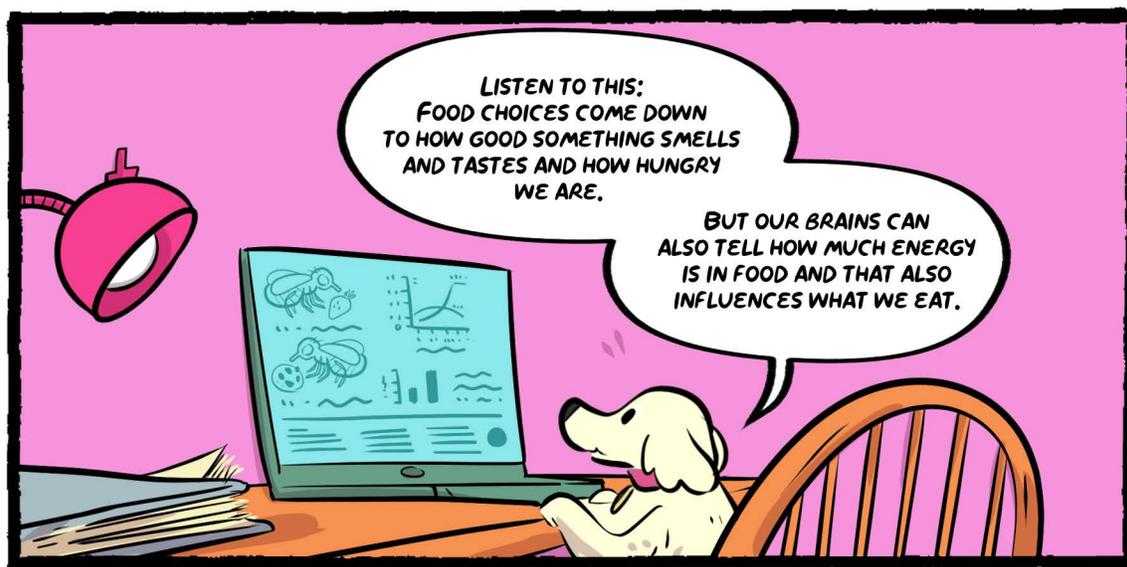
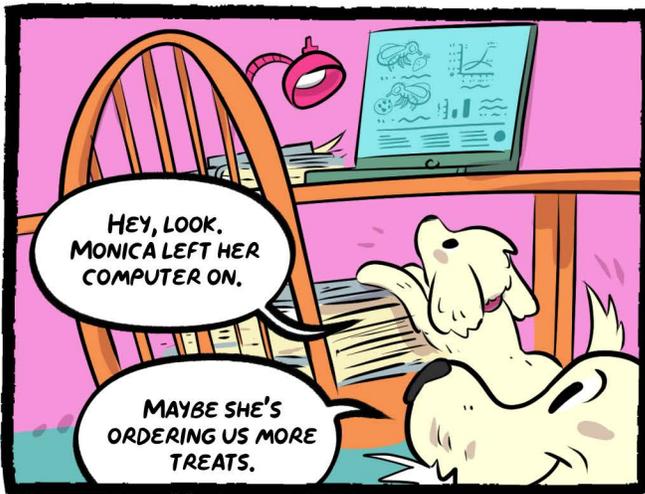
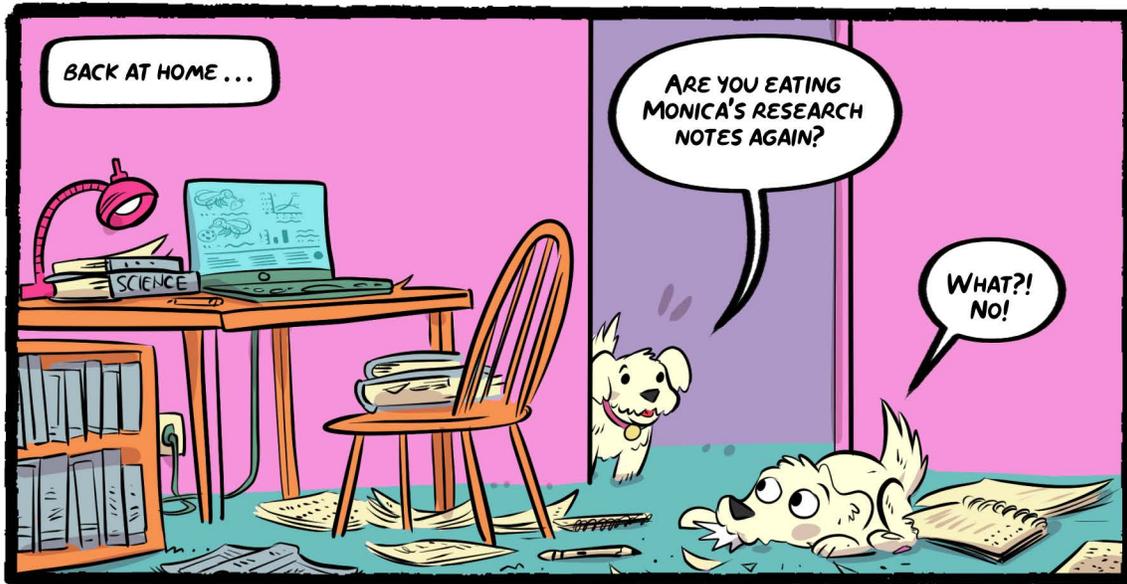
It turns out that our perception of sweetness changes during our lifetimes. Kids prefer things to be sweeter and usually rate sugars as less sweet than adults.

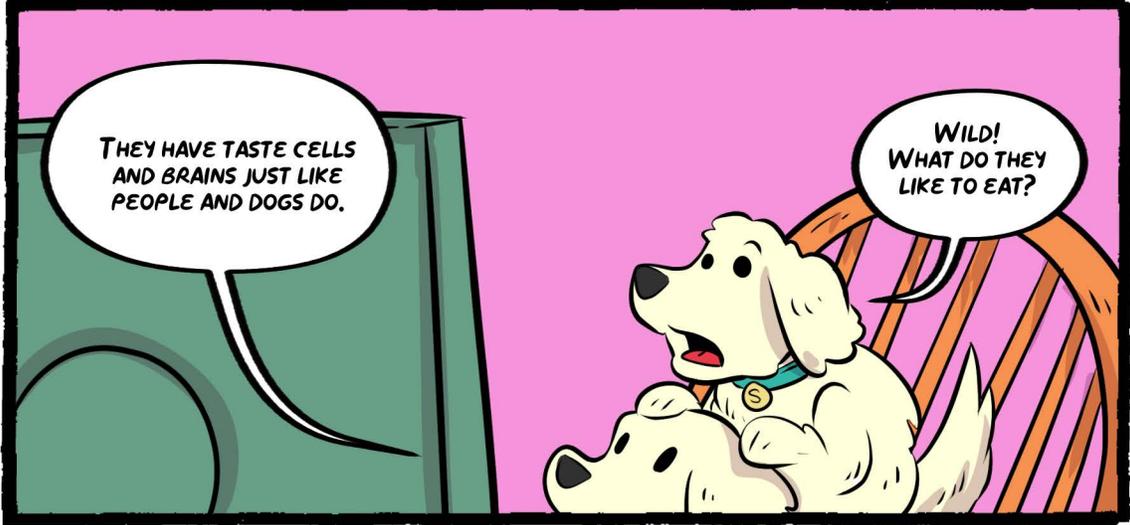
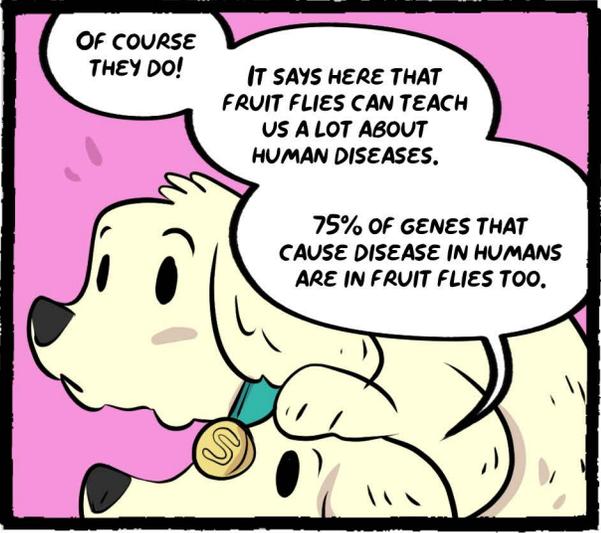
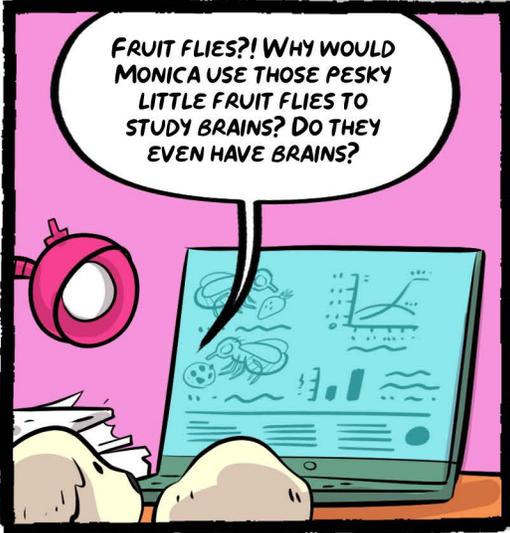
Additionally, how much sugar you regularly eat affects how well you recognize something as sweet. The less sugar in your diet, the more intensely you'll perceive sweetness, and the opposite may also be true. High levels of sugar in the diet dull the response of the taste cells to sweetness. This may affect the food choices we make, like eating more sugary foods, because we can't tell how much energy they contain. It may also confuse our brains into craving even more sugar or making incorrect predictions about how much sugar something contains (we looked into this in Experiment #1). In the long run, this can lead to consequences such as diabetes and heart disease.

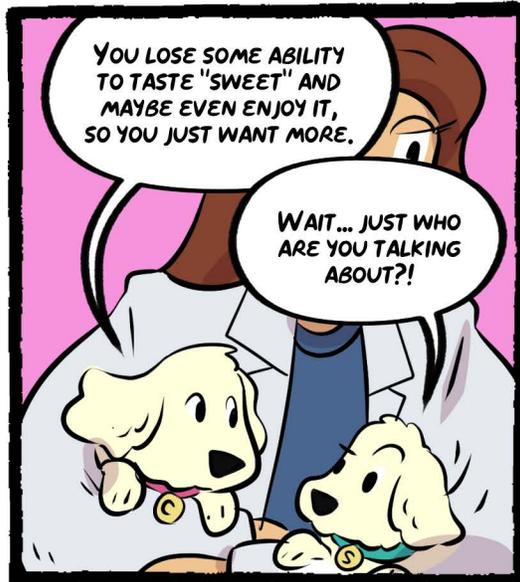
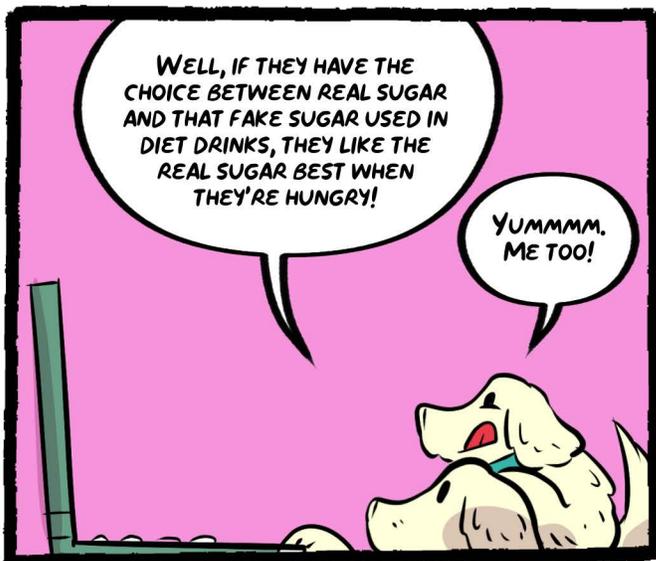


# THE MISADVENTURES OF CUPCAKE AND SPRINKLES

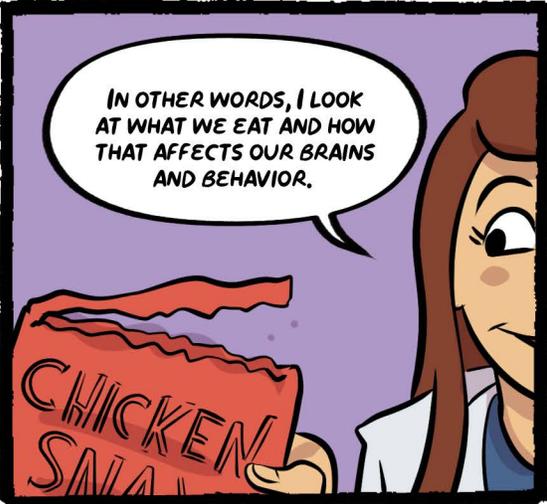
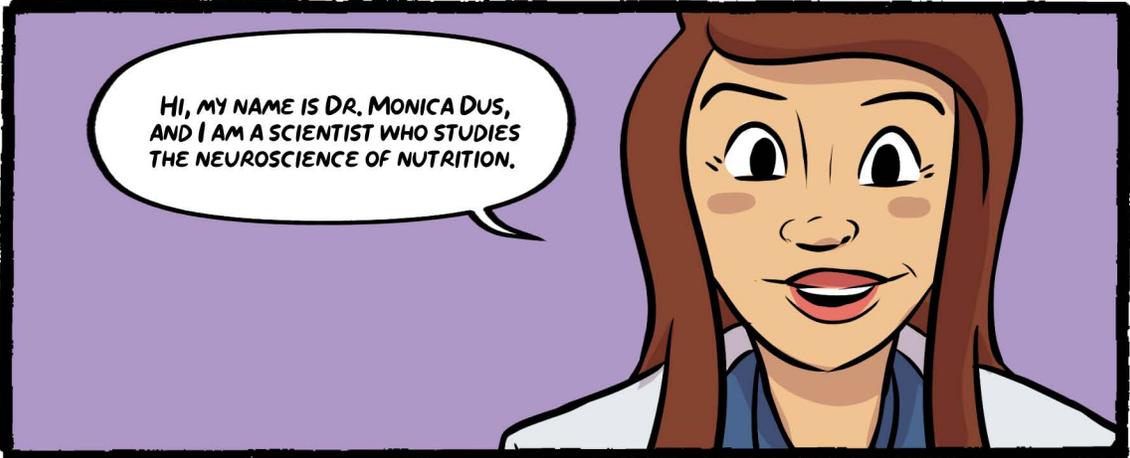


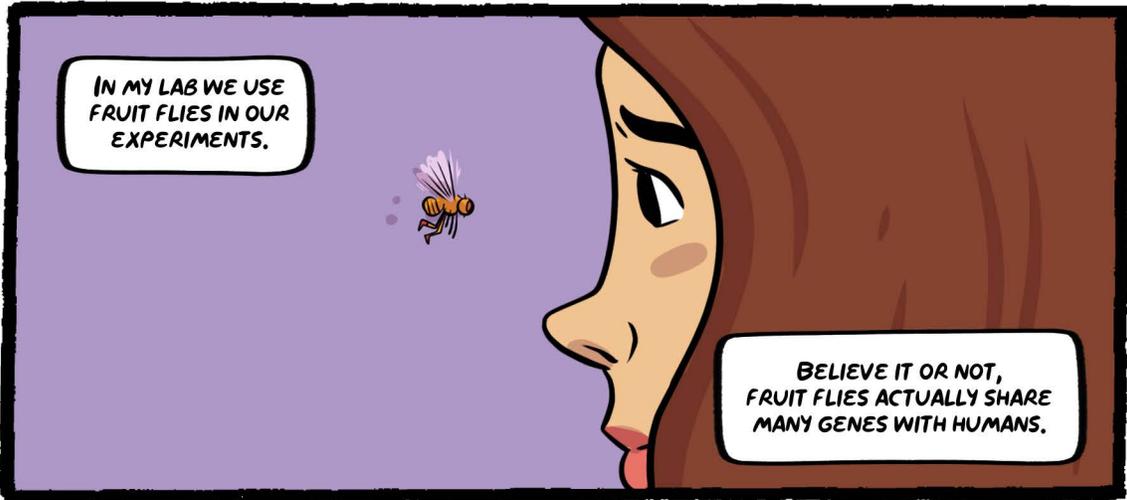




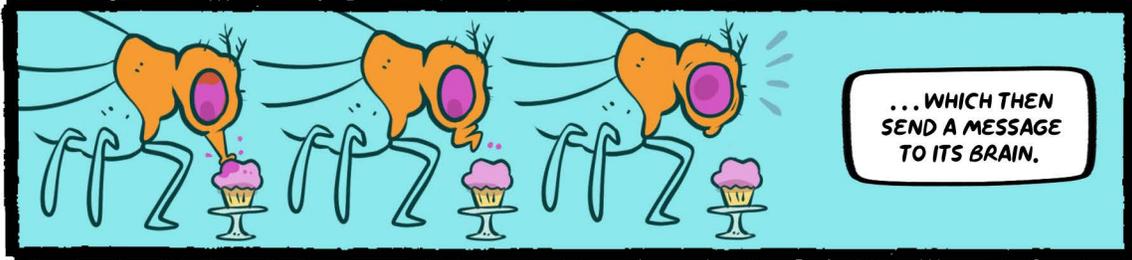
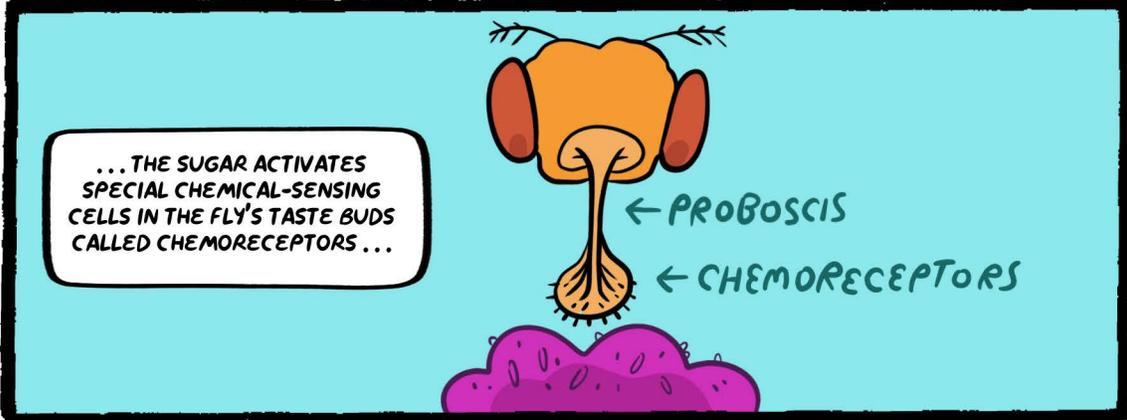


**MEET DR. MONICA: A RESEARCH JOURNEY THAT LED TO A FASCINATING SCIENTIFIC DISCOVERY**



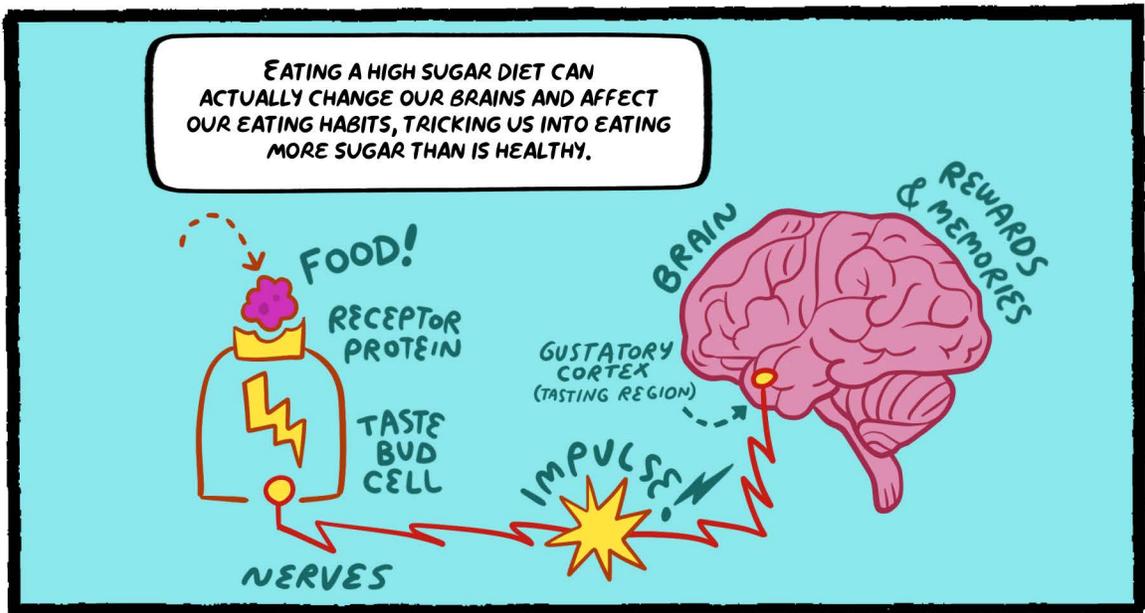


SO WE USE THEM AS A MODEL TO STUDY SIMILAR FUNCTIONS IN US, LIKE HOW TASTE WORKS.



IN OUR LAB, WE DISCOVERED THAT THE MORE SUGAR THE FLY EATS DURING ITS LIFE, THE LESS LIKELY IT WILL BE ABLE TO TASTE "SWEETNESS" ...

... AND THE MORE LIKELY IT WILL BE TO OVEREAT THE NEXT TIME IT GETS A SWEET TREAT.



IN THE PAST, THERE WEREN'T MANY SWEET FOODS AVAILABLE.

WE ATE LEAN MEATS, WHOLE GRAINS, NUTS AND SEEDS, VEGETABLES AND FRUIT.

BUT TODAY... THERE IS AN OVER-ABUNDANCE OF SUGARY TREATS AND DRINKS AVAILABLE.



TO MAKE MATTERS WORSE, FOOD MANUFACTURERS ADD SUGAR TO NON-DESSERT FOODS LIKE SOME CRACKERS, SALAD DRESSINGS, AND EVEN TOMATO SOUP.

THESE "HIDDEN SUGARS" CAN REALLY START TO ADD UP. THE AVERAGE AMERICAN ADULT EATS ABOUT 75 GRAMS OF ADDED SUGAR PER DAY. THIS IS OVER 3 TIMES MORE THAN WHAT IS RECOMMENDED BY HEALTH EXPERTS.



DO YOU THINK YOU CAN DISCOVER WHERE THESE "HIDDEN SUGARS" ARE LURKING?



TAKE A LOOK IN YOUR FRIDGE, CUPBOARDS, OR PANTRY THEN PLAY THE SUGAR SHOCK GAME ON THE NEXT PAGE.

TURN TO PAGE 22 TO PLAY THE SUGAR SHOCK GAME.

TURN TO PAGE 14 TO HEAR CUPCAKE AND SPRINKLES' SIDE OF THE STORY.

OR EXPERIMENT WITH SPY FLY ON PAGE 4.

# SUGAR SHOCK!

PLAY AT HOME GAME

**Objective:** To create a typical meal using the Sugar Shock cards.

**Secret objective:** To create a meal with the lowest amount of sugar!



TAKE A LOOK IN YOUR FRIDGE, CUPBOARDS OR PANTRY THEN PLAY THE SUGAR SHOCK GAME!

## How to play:

1. Cut out the Sugar Shock cards. You can color them in if you'd like!
2. Mix all of the cards together and place them face up so that you only see the food name.
3. Choose a player to start. That player selects cards to create a typical meal they might eat.
4. Play continues until all players have chosen cards. Fighting over the same card? Just create a duplicate on a scrap of paper!
5. Players compare cards to see who eats the most added sugar. The player with the least added sugar wins.

### Optional: Make it your own!

Choose one player to be the Spy Fly. The Spy Fly looks through the fridge, cupboard, or pantry to find typical foods and drinks that they might have as part of a meal or snack.

On the front of each blank Sugar Shock card, the Spy Fly writes the name of the food or drink and draws a picture. On the back they write the number of grams of added sugar and the total calories.

### **Another way to play:**

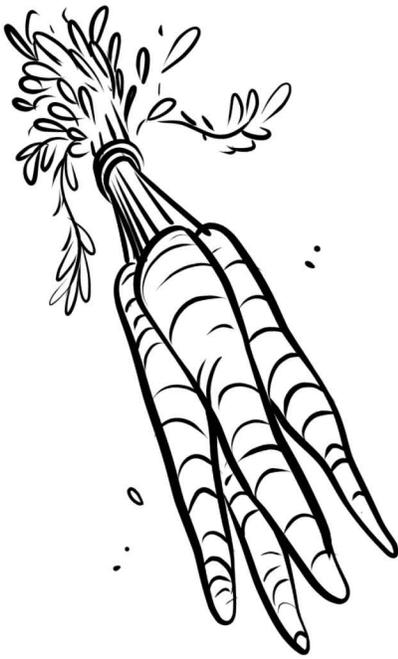
Players compete to put the Sugar Shock cards in order from most to least added sugar.

Shuffle the cards and deal them face up to each player.

Each player tries to arrange their cards in descending order from foods with the most sugar to foods with the least sugar. The player who is closest to the correct order wins!



The World Health Organization recommends that children consume no more than 25 grams (2 tablespoons) and adults no more than 50 grams (4 tablespoons) of added sugar in a day. This includes sugar from fruit juices but not whole fruits.



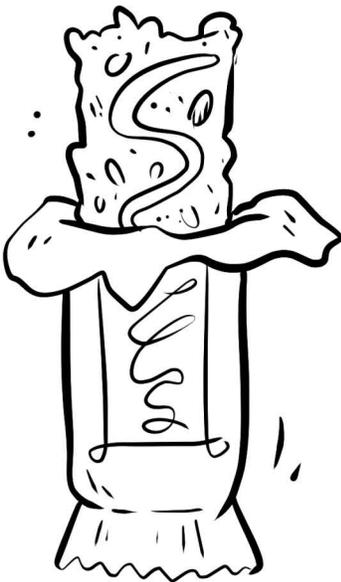
CARROTS



CHOCOLATE MILK



KELLOGG'S®  
CEREAL BAR



CHOBANI®  
FLIP YOGURT



**CHOCOLATE MILK\***

**ADDED SUGAR: 13 g**

**TOTAL CALORIES: 160**

**\*8OZ. PRAIRIE FARMS®  
1% LOWFAT**

**CARROTS\***

**ADDED SUGAR: 0 g**

**TOTAL CALORIES: 25**

**\*1 MEDIUM CARROT**

**CHOBANI® FLIP YOGURT\***

**ADDED SUGAR: 18 g**

**TOTAL CALORIES: 190**

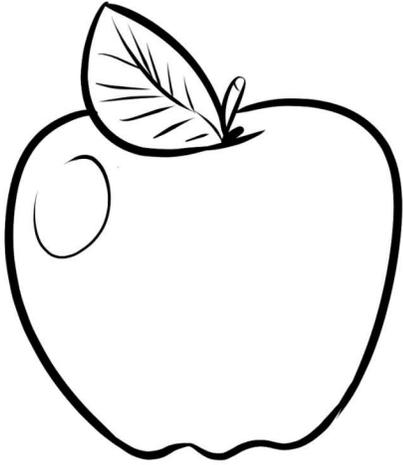
**\*COOKIES AND CREAM VARIETY**

**KELLOGG'S® CEREAL BAR\***

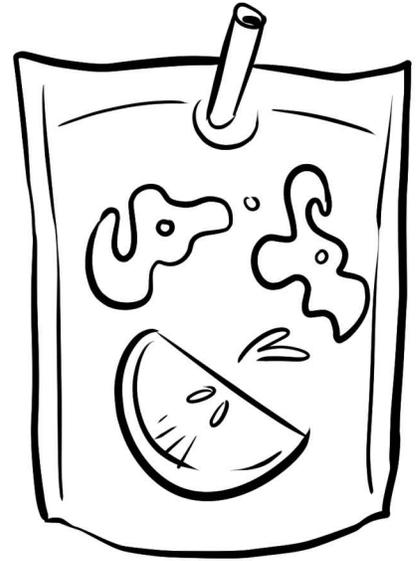
**ADDED SUGAR: 10 g**

**TOTAL CALORIES: 110**

**\*CRAN-VANILLA CRUNCH VARIETY**



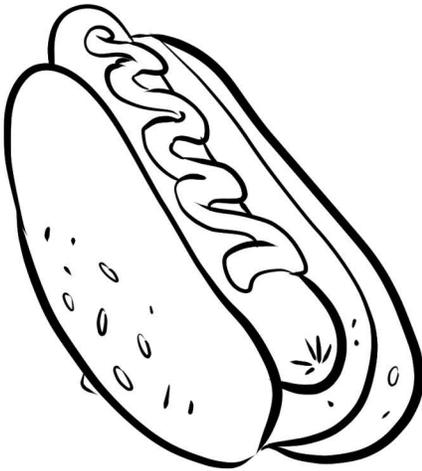
APPLE



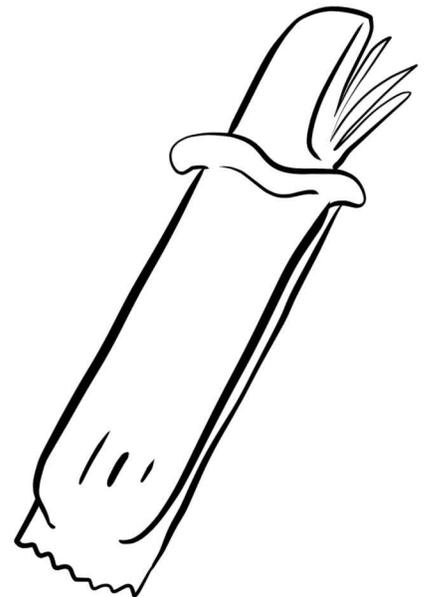
CAPRI SUN®



HOT DOG WITH BUN  
AND KETCHUP



MOZZARELLA  
CHEESE STICK



**CAPRI SUN®\***

**ADDED SUGAR: 13g**

**TOTAL CALORIES: 50**

**\*ONE POUCH,  
FRUIT PUNCH FLAVOR**

**APPLE\***

**ADDED SUGAR: 0g**

**TOTAL CALORIES: 80**

**\*MEDIUM GALA APPLE**

**MOZZARELLA CHEESE STICK\***

**ADDED SUGAR: 0g**

**TOTAL CALORIES: 80**

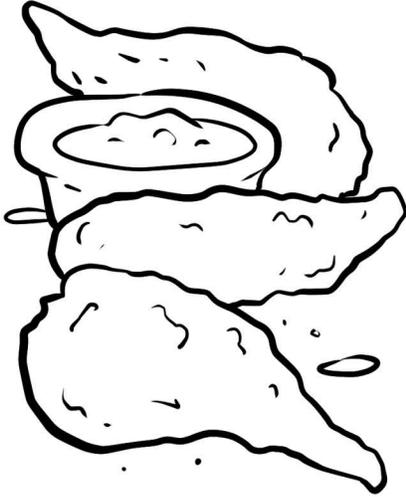
**\*ONE PIECE KRAFT® STRING CHEESE**

**HOT DOG WITH BUN  
AND KETCHUP\***

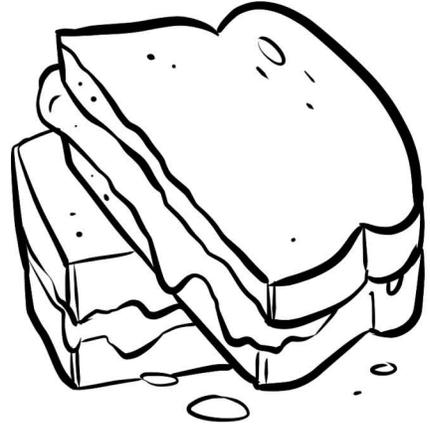
**ADDED SUGAR: 9g**

**TOTAL CALORIES: 270**

**\*OSCAR MAYER® WEINER  
WITH  
IT HEINZ® TOMATO KETCHUP  
ON A BALL PARK® BUN**



CHICKEN TENDERS WITH  
BBQ DIPPING SAUCE



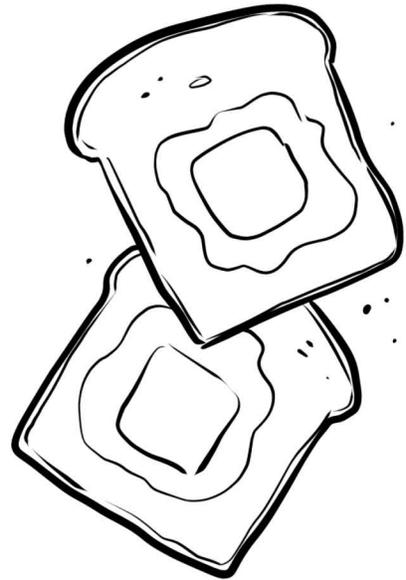
PEANUT BUTTER AND  
JELLY SANDWICH



CHOCOLATE CHIP  
COOKIES



TWO SLICES OF TOAST  
WITH BUTTER



**PEANUT BUTTER AND  
JELLY SANDWICH**

**ADDED SUGAR: 15g**

**TOTAL CALORIES: 390**

**\*2 SLICES SARA LEE®  
HONEY WHEAT BREAD  
WITH  
2T JIF® CREAMY PEANUT BUTTER  
AND  
2T SMUCKER'S® STRAWBERRY JELLY**

**CHICKEN TENDERS  
WITH BBQ DIPPING SAUCE**

**ADDED SUGAR: 15g**

**TOTAL CALORIES: 280**

**\*TWO TYSON®  
CRISPY CHICKEN STRIPS  
WITH  
1.25 FL. OZ. SWEET BABY RAYS®  
ORIGINAL BARBEQUE SAUCE**

**TWO SLICES OF TOAST WITH BUTTER**

**ADDED SUGAR: 4g**

**TOTAL CALORIES: 350**

**\*2 SLICES SARA LEE®  
HONEY WHEAT BREAD  
WITH  
2T LAND O'LAKES BUTTER**

**CHOCOLATE CHIP COOKIES**

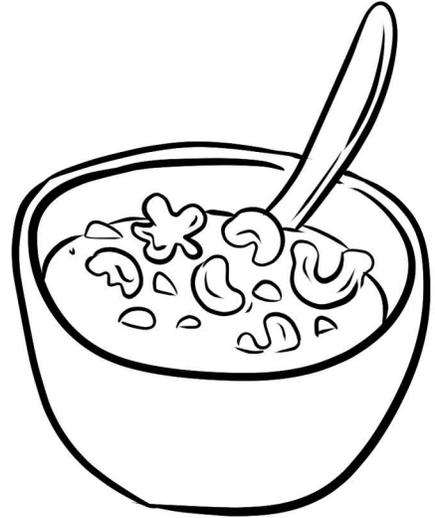
**ADDED SUGAR: 11g**

**TOTAL CALORIES: 160**

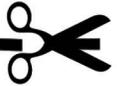
**\* NABISCO® CHIPS AHOY!  
ORIGINAL CHOCOLATE  
CHIP COOKIES  
(3 COOKIES)**



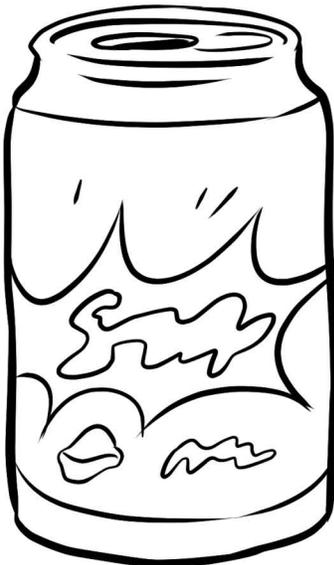
CHOCOLATE GLAZED  
DONUT



LUCKY CHARMS® CEREAL  
WITH MILK



SPRITE®



CAMPBELL'S®  
TOMATO SOUP



**LUCKY CHARMS®  
CEREAL WITH MILK\***

**ADDED SUGAR: 12 g**

**TOTAL CALORIES: 190**

**\*1 CUP GENERAL MILLS®  
LUCKY CHARMS CEREAL  
WITH  
1/2 CUP SKIM MILK**

**CHOCOLATE GLAZED DONUT\***

**ADDED SUGAR: 18 g**

**TOTAL CALORIES: 360**

**\*DUNKIN DONUTS®  
CHOCOLATE GLAZED DONUT**

**CAMPBELL'S® TOMATO SOUP\***

**ADDED SUGAR: 16 g**

**TOTAL CALORIES: 180**

**\*1 CUP**

**SPRITE®\***

**ADDED SUGAR: 38 g**

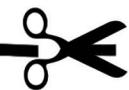
**TOTAL CALORIES: 140**

**\*1 12 OZ. CAN**

**NOW IT'S YOUR TURN!**

**LOOK FOR FOODS AND DRINKS YOU ENJOY.  
ON EACH BLANK CARD, WRITE THE NAME  
OF THE FOOD OR DRINK. YOU CAN DRAW  
A PICTURE OF IT TOO!**

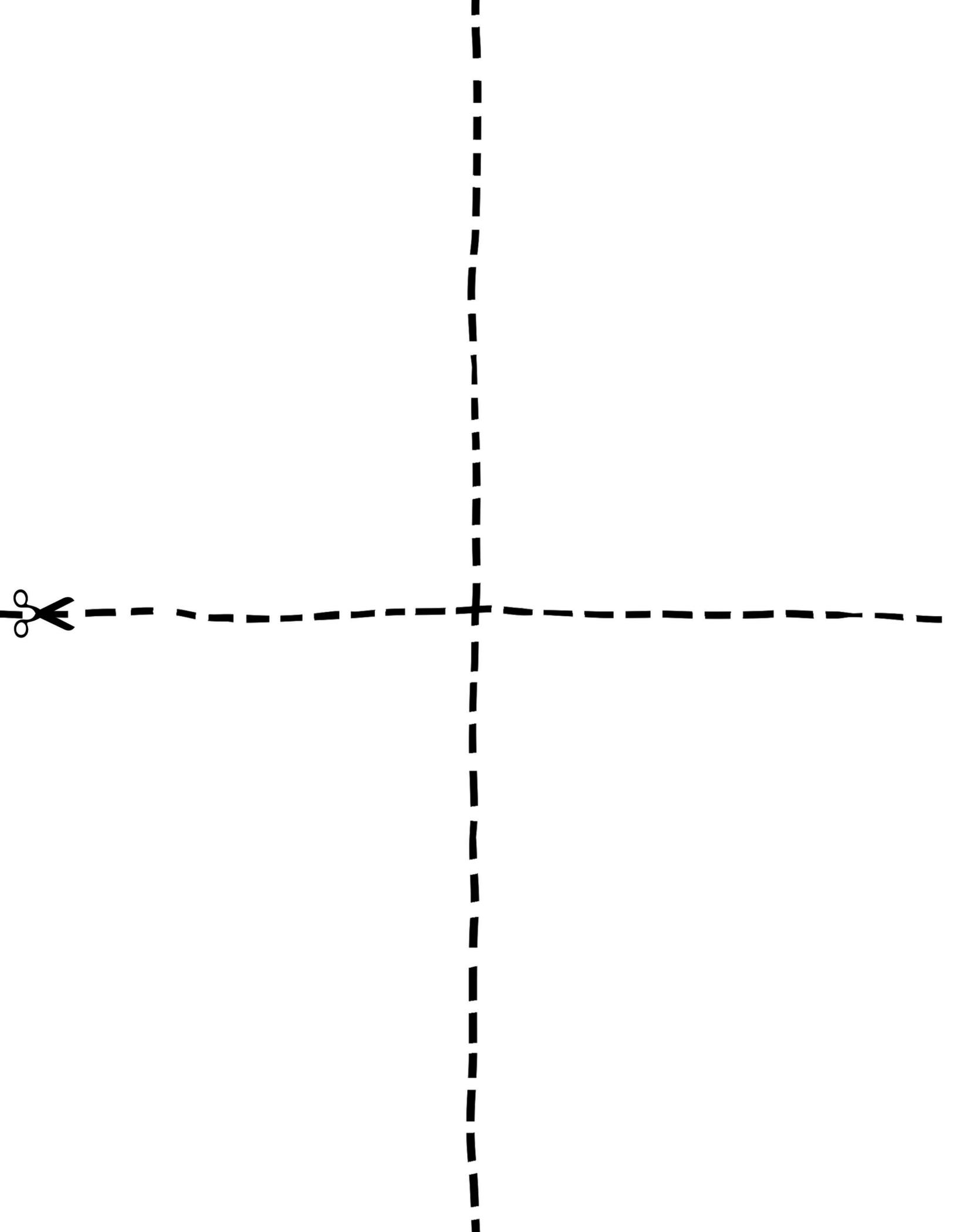
**RECORD THE TOTAL CALORIES AND  
GRAMS OF SUGAR IN EACH SERVING  
ON THE BACK OF THE CARD.**



**ADDED SUGAR:**  
**TOTAL CALORIES:**

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