SUGAR BUZZ!

AN INTERACTIVE SCIENTIFIC DISCOVERY COMIC WITH EXPERIMENTS AND GAMES YOU CAN DO AT HOME!
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In loving memory of
Cupcake and Sprinkles

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This material is based upon work supported in part by the National Science Foundation, Award Number: 1941822. The opinions, findings, and conclusions, or recommendations expressed are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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CUPCAKE! SPRINKLES!

WHAT HAVE YOU DONE?!!

CHOOSE YOUR ADVENTURE!

LET'S IGNORE THIS MESS. I'VE GOT A SWEETER ADVENTURE IN MIND!

BUZZ ON OVER TO PAGE 4 TO FOLLOW ME, THE SPY FLY, AS WE GET A TASTE OF WHAT DR. MONICA HAS BEEN UP TO IN HER SCIENCE LAB AT THE UNIVERSITY OF MICHIGAN!

EXPERIMENTS WITH SPY FLY (P.4)

THIS ISN'T WHAT IT LOOKS LIKE. OK... MAYBE IT IS. BUT IT WAS ALL SPRINKLES' IDEA!

WANT TO LEARN HOW WE INSPIRED OUR MOM, SCIENTIST DR. MONICA DUS, TO STUDY WHY WE OVEREAT? TURN TO PAGE 14 TO FOLLOW OUR STORY.

THE MISADVENTURES OF CUPCAKE AND SPRINKLES (P.14)

HOW COULD YOU HAVE EATEN SO MUCH THAT YOU MADE YOURSELVES SICK?! WHAT WAS GOING ON IN YOUR BRAINS?

WHAT REALLY HAPPENED HERE? TURN TO PAGE 18 TO LEARN MORE.

MEET DR. MONICA DUS AND PLAY THE SUGAR SHOCK GAME (P.18)
EXPERIMENTS WITH SPY FLY

SHOO!

HEY, YOU!
YES, YOU THERE!

ARE YOU HUNGRY FOR AN ADVENTURE? I HAVE A VERY IMPORTANT MISSION TO COMPLETE AND I COULD USE YOUR HELP.

ARE YOU READY?

LET'S GO!

BIOLOGICAL SCIENCES BUILDING
UNIVERSITY OF MICHIGAN
ANN ARBOR CAMPUS
**Spy Fly’s Experiment #1: How sweet it is!**

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.

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**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

<table>
<thead>
<tr>
<th></th>
<th>PURPLE DRINK</th>
<th>GREEN DRINK</th>
<th>COLORLESS DRINK</th>
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</thead>
<tbody>
<tr>
<td><strong>Flavor Prediction:</strong></td>
<td>I think this flavor will taste...</td>
<td>I think this flavor will taste...</td>
<td>I think this flavor will taste...</td>
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<tr>
<td><strong>Sweetness Prediction:</strong></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
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<tr>
<td>(circle one)</td>
<td>Not sweet</td>
<td>Not sweet</td>
<td>Not sweet</td>
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<tr>
<td>1 = not sweet at all</td>
<td>Too sweet</td>
<td>Too sweet</td>
<td>Too sweet</td>
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<td>5 = kind of sweet</td>
<td></td>
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<tr>
<td>10 = way too sweet</td>
<td></td>
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</tr>
<tr>
<td><strong>Flavor Observation:</strong></td>
<td>The flavor tasted...</td>
<td>The flavor tasted...</td>
<td>The flavor tasted...</td>
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<tr>
<td><strong>Sweetness Ranking:</strong></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
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</table>
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!
Spy Fly’s
Experiment #2: Can smell help us taste?

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.
Spy Fly’s Experiment #3: Sugar detective: can you spot the fake?

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 ½ teaspoon of sucralose (or other sweetener) onto a dish. Label with “Mystery Sample A.”
- Mystery Sample B: Measure ½ teaspoon of sugar onto a dish. Label with “Mystery Sample B.”

Follow the directions above to complete the experiment.
**Taste Observation:**
Describe how the sample tastes
- **Mystery Sample A:** I think this flavor tastes...
- **Mystery Sample B:** I think this flavor tastes...

**Sweetness Rating:**
(circle one)
1 = not sweet at all
5 = kind of sweet
10 = way too sweet
- **Mystery Sample A:** 1 2 3 4 5 6 7 8 9 10
  - Not sweet
  - Too sweet
- **Mystery Sample B:** 1 2 3 4 5 6 7 8 9 10
  - Not sweet
  - Too sweet

**Prediction:**
Circle whether you think the sample is the real or fake sugar
- **Mystery Sample A:** I think this sample is...
  - Real sugar
  - Fake sugar
- **Mystery Sample B:** I think this sample is...
  - Real sugar
  - Fake sugar

**Wow! This stuff is super sweet. It must be real sugar.**

**It tastes sweet alright, but it doesn't leave me wanting more the way those jelly beans did.**

**This isn't as sweet, but it tastes familiar.**

**I'm going to take a closer look.**
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.

Time for us to buzz off!

But you can check in on the misadventures of Cupcake and Sprinkles on page 14.

Or, to hear Dr. Monica’s side of the story, turn to page 18.
THE MISADVENTURES OF CUPCAKE AND SPRINKLES

LISTEN, SPRINKLES! SHE'S TALKING TO THE V-E-T AGAIN.

Remember that day when we ate all the chicken jerky? That was the best. I totally ate more than you did.

DID YOU HEAR THAT? APPARENTLY WE ATE 10% OF OUR BODY WEIGHT IN CHICKEN JERKY THAT DAY.

BEST DAY OF MY LIFE. ZERO REGRETS. PERSONALLY I THINK THE V-E-T OVERREACTIONED.

ACK!

Yeah, Mom's keeping us on a tight leash now.

THEY SEEMED PRETTY WORKED UP ABOUT IT!
BACK AT HOME . . .

Are you eating Monica's research notes again?

What?! No!

Hey, look. Monica left her computer on.

Maybe she's ordering us more treats.

Fat chance. This is showing findings from some of her research!

Listen to this: Food choices come down to how good something smells and tastes and how hungry we are.

But our brains can also tell how much energy is in food and that also influences what we eat.
So you're saying our brains can tell whether the food we eat has nutrients in it or if it just tastes good?

Yes! Do you think the chicken jerky changed our brains?

Chicken jerky?! Where?

Fruit flies?! Why would Monica use those pesky little fruit flies to study brains? Do they even have brains?

Of course they do! It says here that fruit flies can teach us a lot about human diseases.

75% of genes that cause disease in humans are in fruit flies too.

They have taste cells and brains just like people and dogs do.

Wild! What do they like to eat?
Well, if they have the choice between real sugar and that fake sugar used in diet drinks, they like the real sugar best when they’re hungry!

Yummmm, me too!

But Monica’s research says that when we eat a lot of sugar...

...it physically changes our brains so that we crave more sugar!

You lose some ability to taste ‘sweet’ and maybe even enjoy it, so you just want more.

Wait... just who are you talking about?!

Turn the page to hear Monica’s side of the story!

Or follow Spy Fly on Page 4.
Meet Dr. Monica: A Research Journey that Led to a Fascinating Scientific Discovery

Hi, my name is Dr. Monica Dus, and I am a scientist who studies the neuroscience of nutrition.

In other words, I look at what we eat and how that affects our brains and behavior.

One day, my dogs ate so much of their favorite treat that they actually made themselves sick.

What caused them to overeat so much? This interest led me to study how the kinds of food we eat affect our eating behaviors.
In my lab we use fruit flies in our experiments.

Believe it or not, fruit flies actually share many genes with humans.

So we use them as a model to study similar functions in us, like how taste works.

Through other scientists' experiments with the flies, we learned that when a fruit fly eats sugar...

...the sugar activates special chemical-sensing cells in the fly's taste buds called chemoreceptors...

[Diagram of chemoreceptors and proboscis]

...which then send a message to its brain.
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.

Eating a high sugar diet can actually change our brains and affect our eating habits, tricking us into eating more sugar than is healthy.

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

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

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

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.
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
**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

- *2 slices Sara Lee® Honey Wheat Bread with 2T Jif® Creamy Peanut Butter and 2T Smucker’s® Strawberry Jelly

- **Added sugar: 15g**
- **Total calories: 390**

CHICKEN TENDERS WITH BBQ DIPPING SAUCE

- *Two Tyson® Crispy Chicken Strips with 1.25 fl. oz. Sweet Baby Rays® Original Barbeque Sauce

- **Added sugar: 15g**
- **Total calories: 280**

TWO SLICES OF TOAST WITH BUTTER

- *2 slices Sara Lee® Honey Wheat Bread with 2T Land O’Lakes butter

- **Added sugar: 4g**
- **Total calories: 350**

CHOCOLATE CHIP COOKIES

- *Nabisco® Chips Ahoy! Original Chocolate Chip Cookies (3 cookies)

- **Added sugar: 11g**
- **Total calories: 160**
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: 

Added sugar: 
Total calories: