

# INVESTIGATING BLOOD SUGAR

**PROMISE**

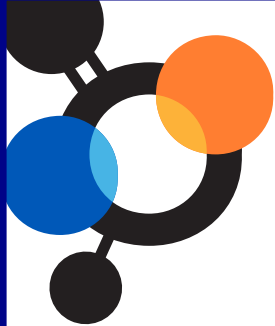
SANFORD<sup>®</sup>  
RESEARCH



# PICTURE THIS

Katie Ruiz has come into your clinic with a laundry list of symptoms. Using what you learn during this lesson, see if you can give her a diagnosis and treatment plan.

# Start by reviewing Katie's info and filling in her Patient Chart.

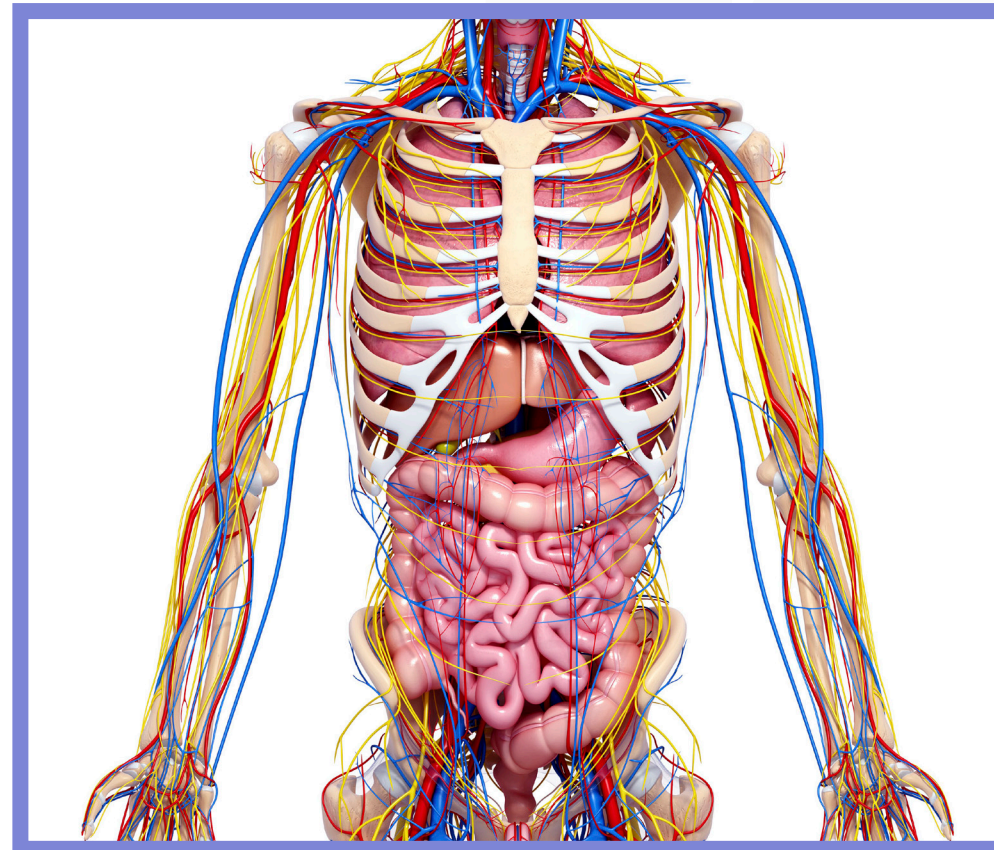


## PATIENT CHART

PATIENT NAME: <i>Katie Ruiz</i>		AGE: <i>13</i>	SEX AT BIRTH: <input type="checkbox"/> Male <input checked="" type="checkbox"/> Female <input type="checkbox"/> Unassigned
WEIGHT: <i>120</i>	BLOOD PRESSURE: <i>187/100</i>	HEART RATE: <i>115 bpm</i>	
KEY SYMPTOMS: <ul style="list-style-type: none"><li>- Dizzy</li><li>- Headache</li><li>- Extremely thirsty &amp; hungry</li><li>- Had to go the bathroom 5 times in the middle of the night</li><li>- Has lost 10 pounds in the last month even though she eats about 2,000 calories a day</li></ul>			
INITIAL DIAGNOSIS: <i>Unknown</i>			

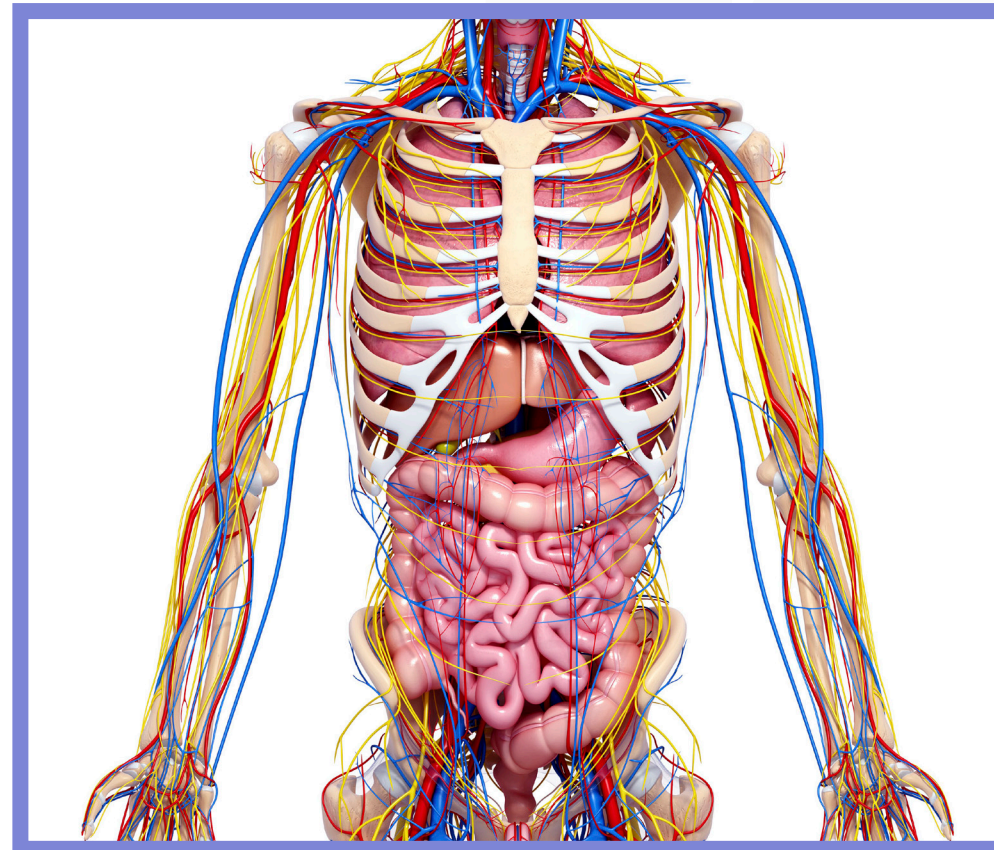


# Before moving on, take a look at the images. What do you notice? What do you wonder?





# THEY'RE ALL SYSTEMS!



# WHAT IS A SYSTEM?

Systems have boundaries that keep them contained. They have inputs and outputs to the system as well as components in the system that perform one or more functions.

Discuss how your school is a system.  
How is your body a system?

# SYSTEMS ORGANIZATION

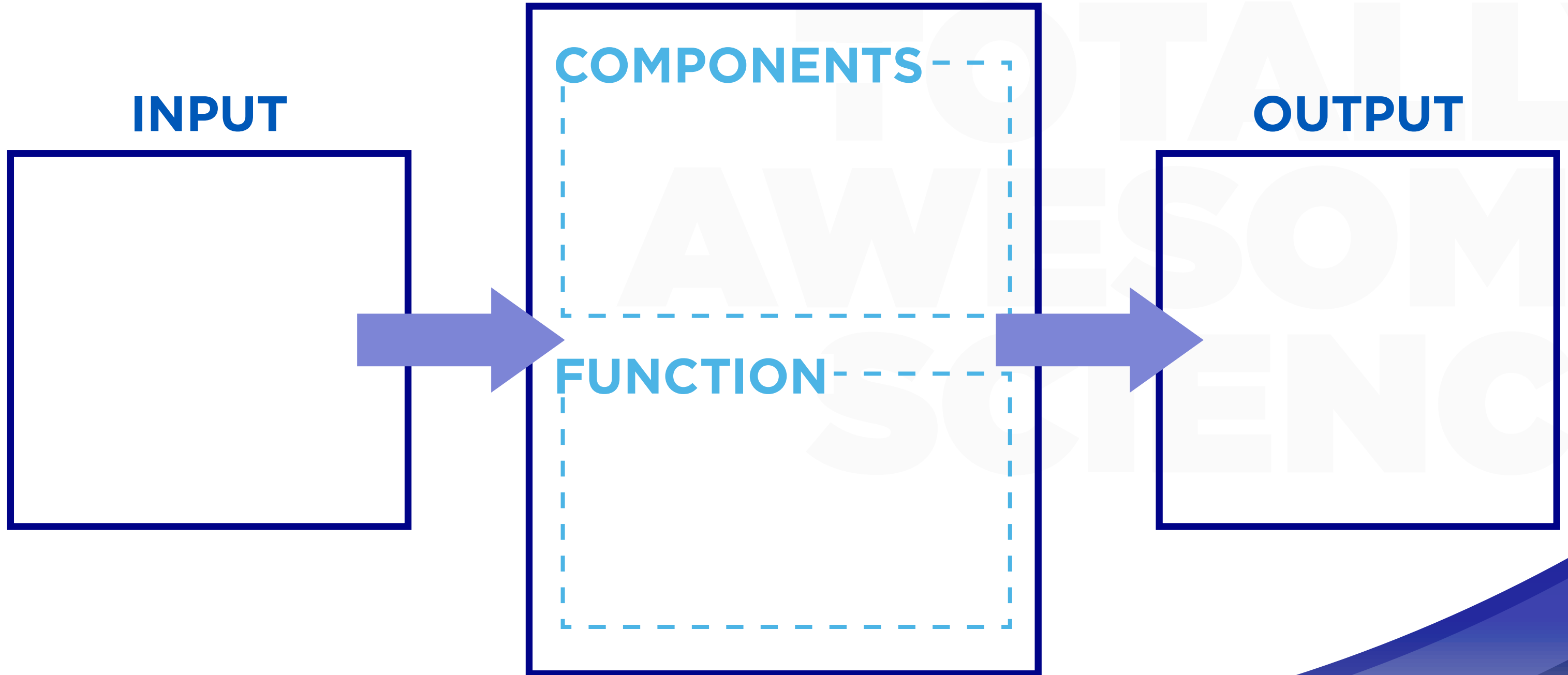
BOUNDARY

INPUT

OUTPUT

COMPONENTS

FUNCTION



Name: \_\_\_\_\_



## INVESTIGATING BLOOD SUGAR

Answer the questions below as you progress through the Investigating Blood Sugar lesson and slideshow.

### PART 1: SYSTEMS

1. Look at the pictures on the slideshow. Fill in the KWL chart below.

WHAT I KNOW	WHAT I WANT TO KNOW	WHAT I LEARNED

2. How is your school a system? Label the parts of a school system.

3. How is a computer a system? Label the parts of a computer system.

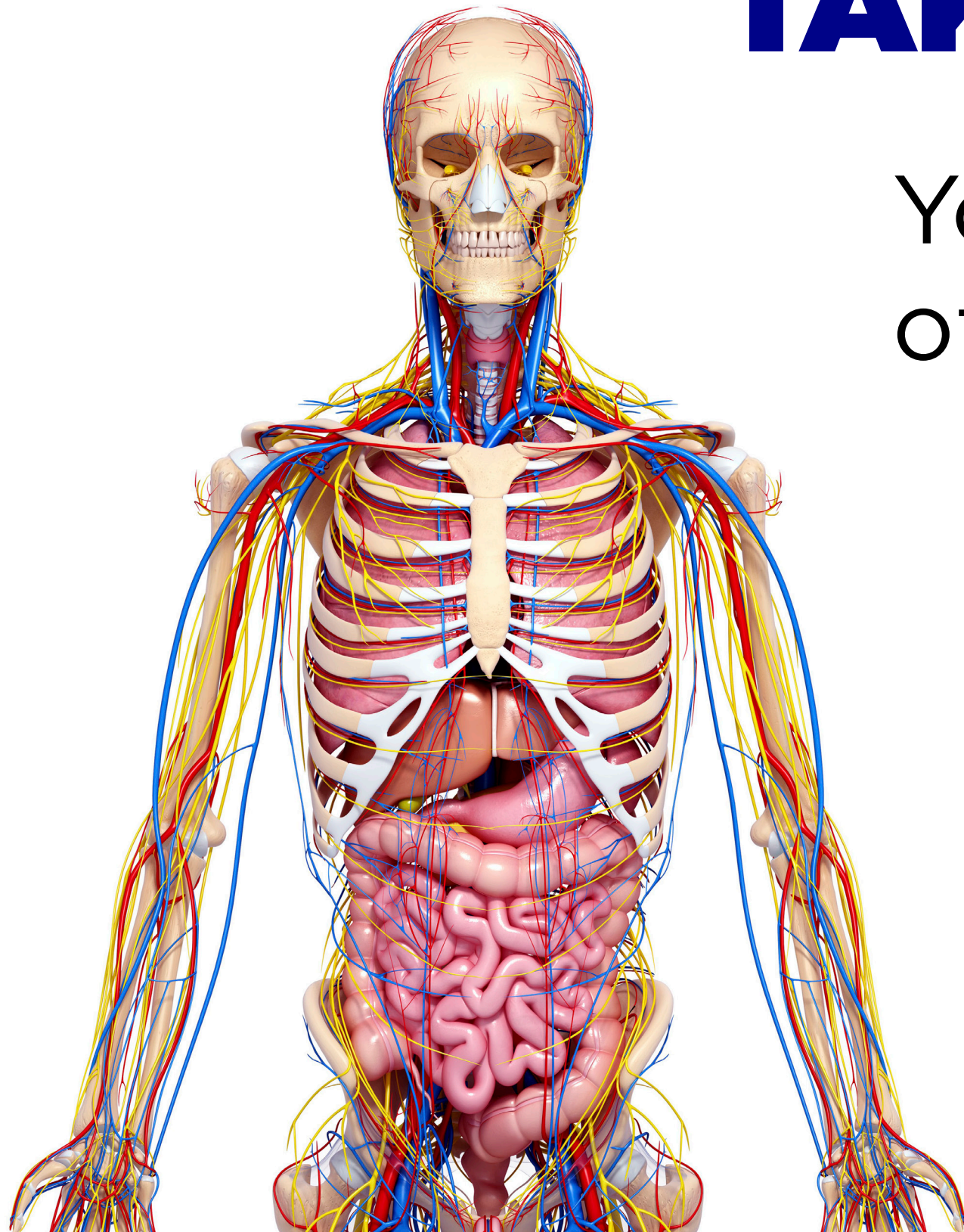
**Label the  
different parts of  
the school system  
and the body  
system in your  
lab notebook.**



# TAKE A CLOSER LOOK

Your body system is comprised of many other systems.

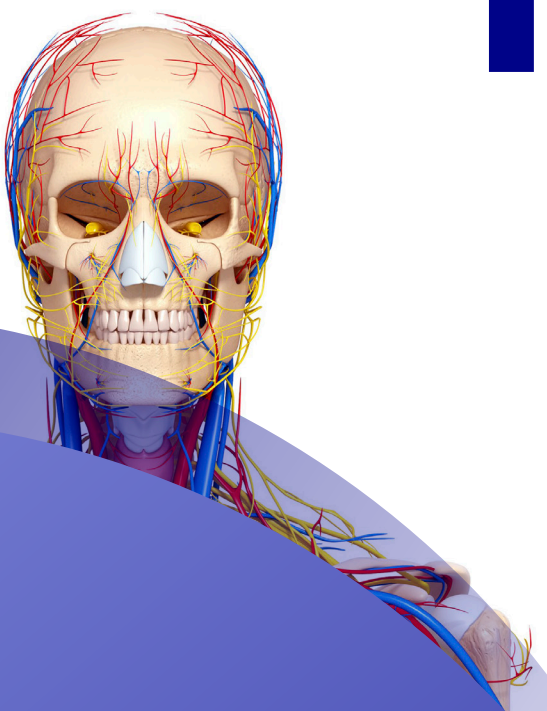
- Digestive system
- Excretory system
- Nervous system
- Circulatory system
- Endocrine system



# TAKE A CLOSER LOOK

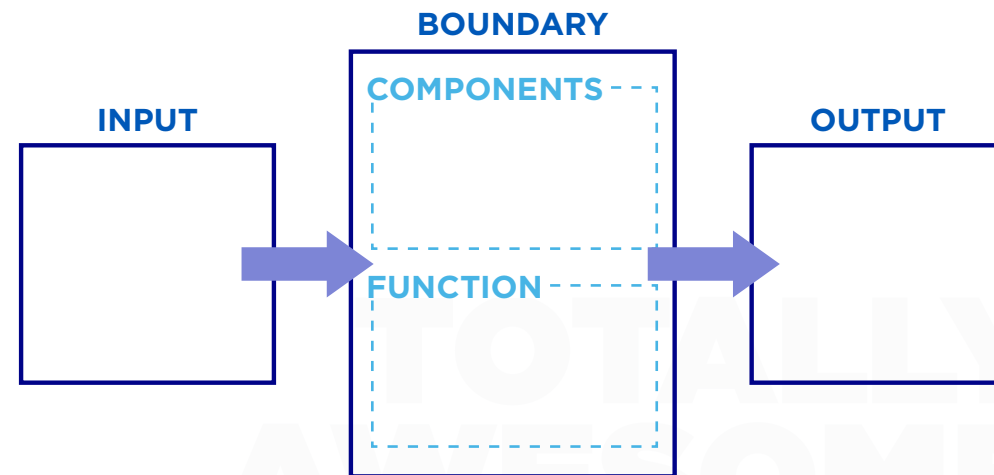
Your body system is comprised of many other systems.

- Digestive system
- Excretory system
- Nervous system
- **Circulatory system**
- Endocrine system

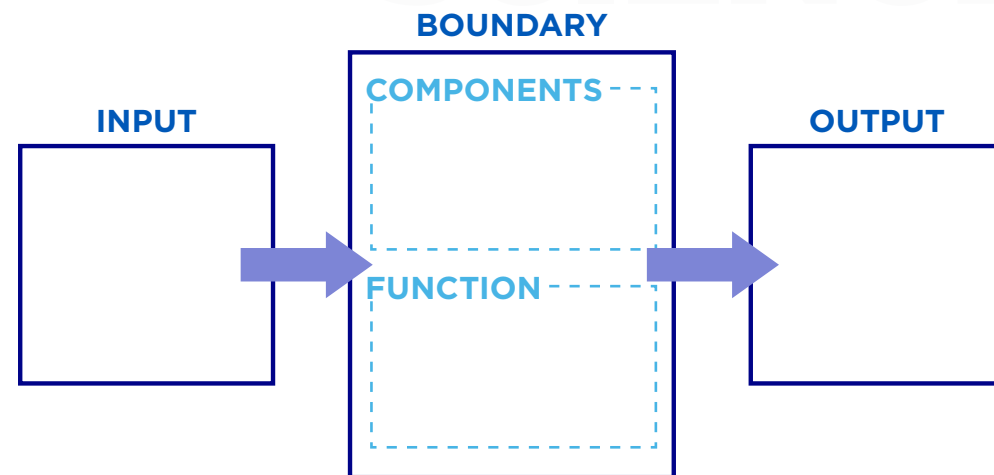


**To help Katie,  
we are going  
to examine  
one of these.**

4. How is your body a system? Fill in the systems organizer below.



5. There are many systems in your body that work together. Fill in the systems organizer below with details about the circulatory system.



**In your lab notebook, fill in the boundaries, inputs, outputs, components, and function of the circulatory system.**



# WHAT IS A SOLUTION?

In order to understand what is happening in Katie's body, we need to understand solutions.

- What do you know about solutions?
- What are some examples of solutions?
- What was the last solution you made?
- Can you define solute, solvent, and solution?

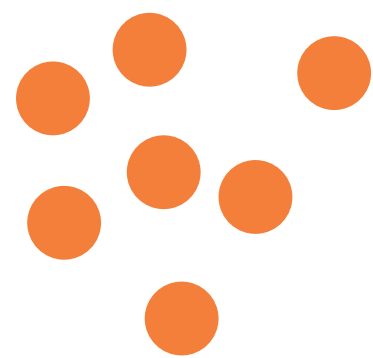
Record this in your lab notebook.

# WHAT IS A SOLUTION?

**Solute:** Example is sugar

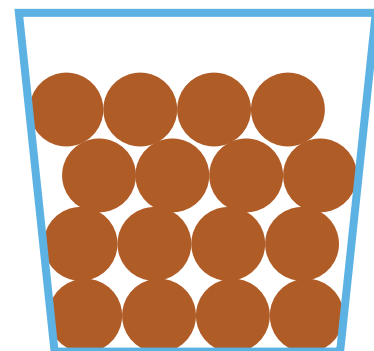
**Solvent:** Example is water

**Solution:** Liquid mixture in which the minor component (the solute) is uniformly distributed within the major component (the solvent)



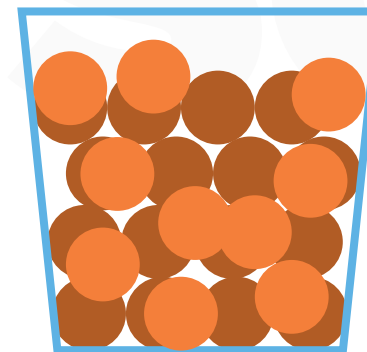
**SOLUTE**

+



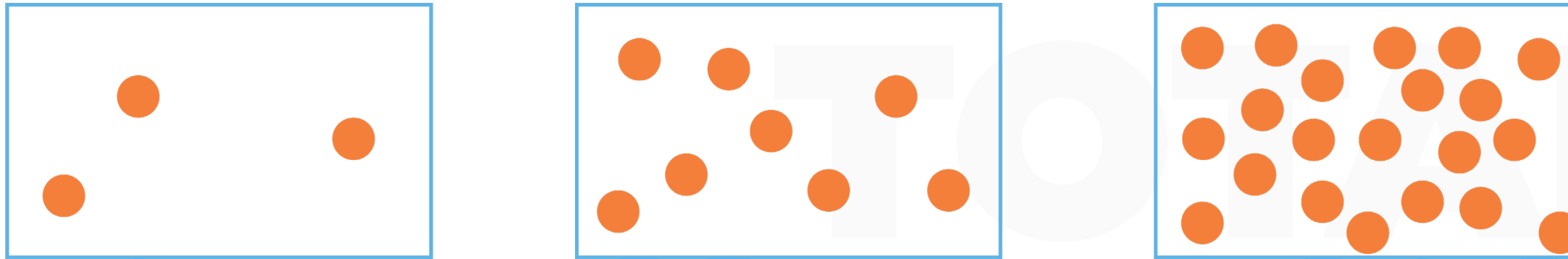
**SOLVENT**

=



**SOLUTION**

# DESCRIBING SOLUTIONS

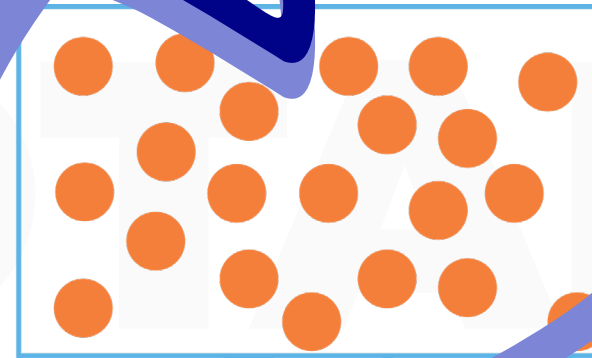
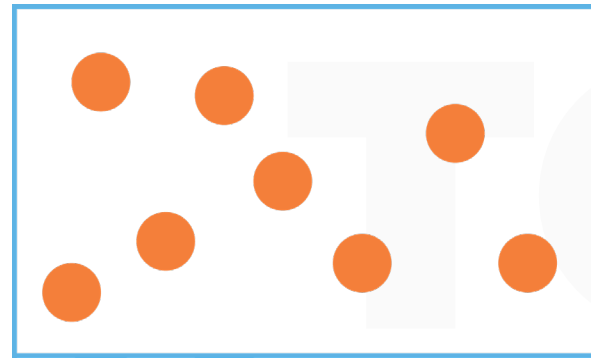
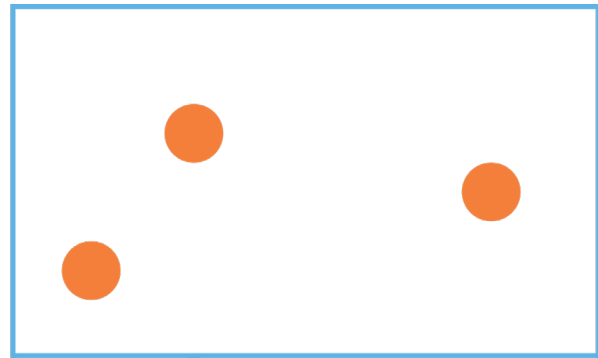


Solutions can be described by the concentration of solute in the solvent.

Which of the solutions to above has the highest concentration of molecules?



# DESCRIBING SOLUTIONS



Solutions can be described by the concentration of solute in the solvent.

Which of the solutions to above has the highest concentration of molecules?

# DESCRIBING SOLUTIONS

Another term used to describe solutions is viscosity. A solution that has high viscosity would be thick and sticky. An example of a viscous solution is honey.

**Viscosity:** State of being thick, sticky, and semifluid in consistency due to internal friction

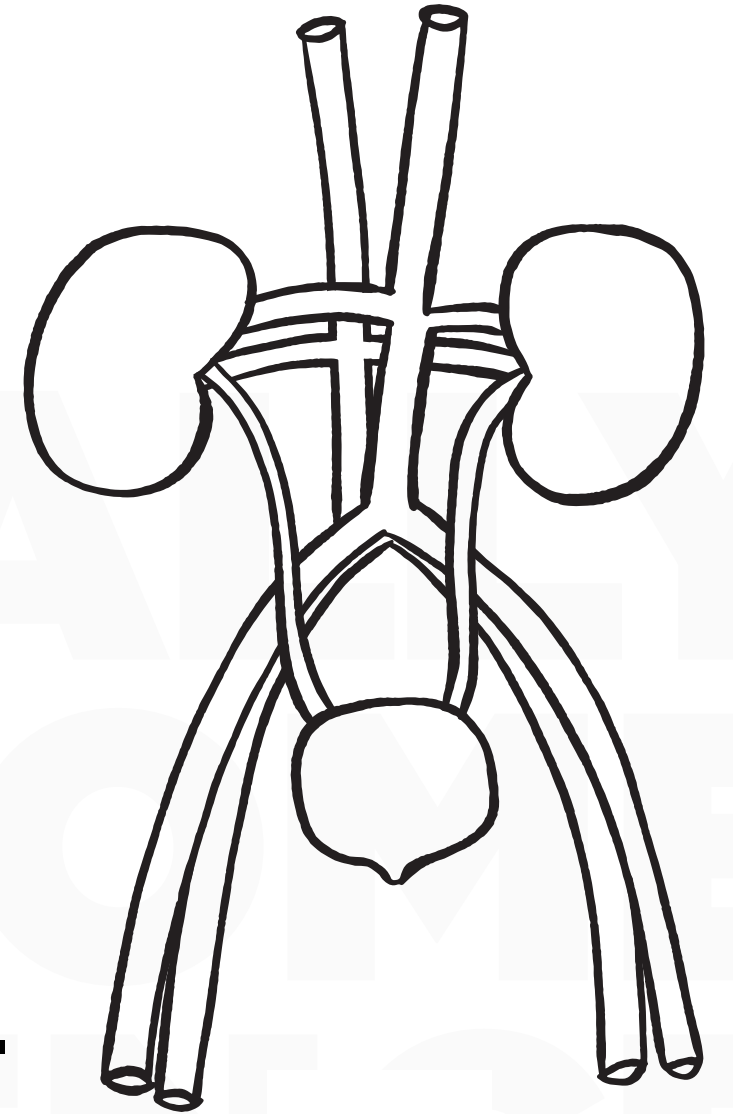
# EXPERIMENT TIME!

- You will be given 4 solutions labeled A-D.
- Objective: Determine which solution is the most concentrated using only a straw.
- Label the solutions 1 through 4 with the most concentrated as #1.
- After you have finished, answer the analysis questions in your lab notebook.



# BLOOD SUGAR

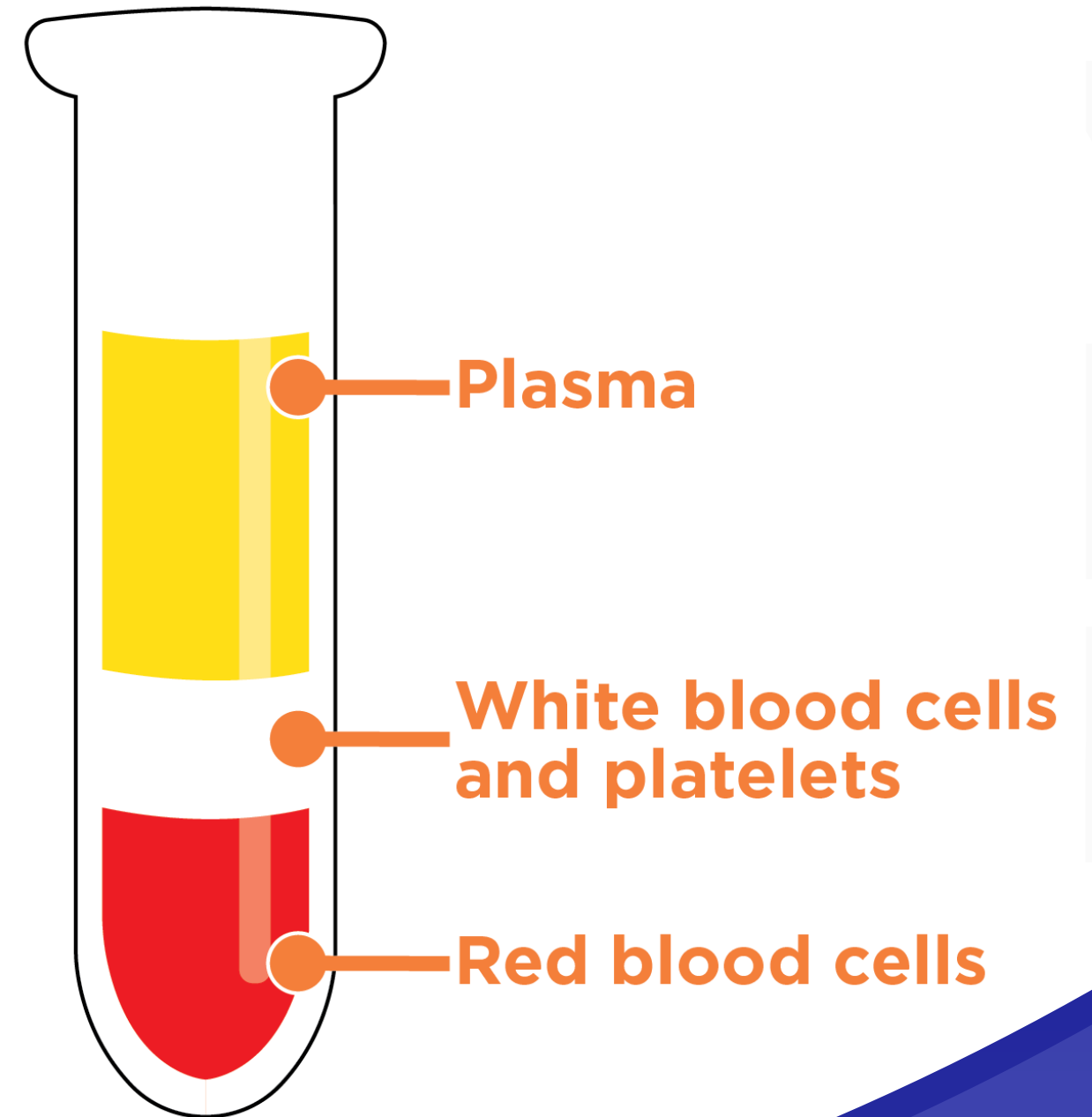
- Blood is filtered by the kidney.
- The kidney produces urine, which is all the waste removed from the blood.
- When there is too much sugar in the blood, the kidney removes extra sugar.
- To remove extra sugar, it needs to remove water from the blood too.
- This creates a lot of urine and makes the blood more concentrated.



# BLOOD SUGAR

When doctors look at your blood sugar, they are concerned with the sugar dissolved in your plasma.

Plasma is water with dissolved molecules in it. Plasma is a solution.



### PART 3: BLOOD SUGAR

1. What percentage of your body is made of water?
2. Out of all the water in your body, how much is found in plasma?
3. Where else is water found in the body?
4. Using the table below, calculate how much sugar is in your body.

ACTION & CALCULATION	VALUE
1 Record weight.	lb
2 Convert pounds to kilograms. <i>Multiply by 0.45</i>	kg
3 Find serum body weight. <i>Multiply by 6% (0.06)</i>	kg
4 Convert kilograms to liter. <i>Multiply by 1</i>	l
5 Convert liter to deciliter. <i>Multiply by 10</i>	dl
6 Find blood sugar miligram per deciliter. <i>Multiply by blood sugar content (use 95 as base)</i>	mg
7 Convert miligrams to grams. <i>Multiply by 0.001</i>	g

# Discuss these questions with a neighbor and record your answers in your lab notebook:

- What percentage of your body is water?
- Out of all the water in your body, how much is found in plasma?
- Where else is water found in the body?

# WATCH THIS!



ILLY  
MILK  
ICE



## ACTION & CALCULATION

## VALUE

<b>1</b> Record weight.	<b>lb</b>
<b>2</b> Convert pounds to kilograms. <i>Multiply by 0.45</i>	<b>kg</b>
<b>3</b> Find serum body weight. <i>Multiply by 6% (0.06)</i>	<b>kg</b>
<b>4</b> Convert kilograms to liter. <i>Multiply by 1</i>	<b>l</b>
<b>5</b> Convert liter to deciliter. <i>Multiply by 10</i>	<b>dl</b>
<b>6</b> Find blood sugar miligram per deciliter. <i>Multiply by blood sugar content (use 95 as base)</i>	<b>mg</b>
<b>7</b> Convert miligrams to grams. <i>Multiply by 0.001</i>	<b>g</b>

**How much sugar is in your blood? Use your body weight to complete the calculations in your lab notebook.**

# BLOOD SUGAR

- Your cells need glucose.
- Cells use glucose to make ATP, the energy needed to do work in your body.
- You need about 2,000 calories a day to function. Each gram of glucose gives you 4 calories.

How much glucose do you need each day?

# BLOOD SUGAR

- Your cells need glucose.
- Cells use glucose to make ATP, the energy needed to do work in your body.

about 2,000 calories a day

**2000** calories

---

**4** calories per gram

**= 500** grams per day

Each gram of glucose gives you

do you need each day?

# BLOOD SUGAR

- How many grams of sugar do you have in your blood?
- Is that enough sugar for the day?
- What would happen if all 500 grams were in the blood at one time?
- What are the best ways to get glucose into your body? *Hint: A diet of sugar sticks will not give you what you need to survive.*



# BLOOD SUGAR

- Cells need a way for glucose to enter.
- A hormone called insulin unlocks the cell so glucose can enter.
- Insulin is produced by the pancreas and allows for glucose to be turned into ATP at a steady rate.
- Without insulin, what would happen?



# ORDER TESTS

Now that you know about bodily solutions, it's time to order blood and urine tests for Katie and record them in her chart.

# TEST RESULTS

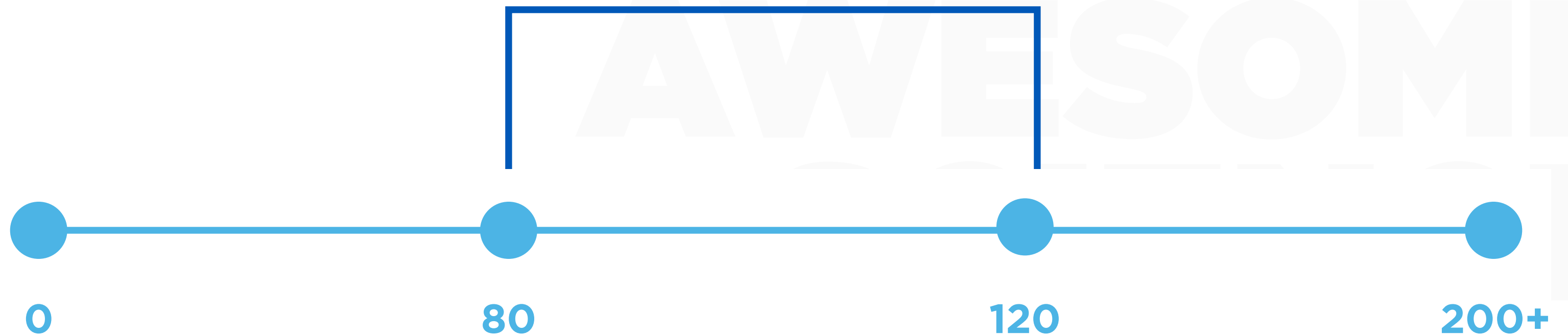
**Blood Test:** Katie's blood sugar is 300 mg/dl.

**Urine Test:** Katie's urine contains no blood or excess hormones, but glucose was detected.

Are these results regular or irregular?

# BLOOD SUGAR IMBALANCE

80 mg/dl to 120 mg/dl is considered **NORMAL**.





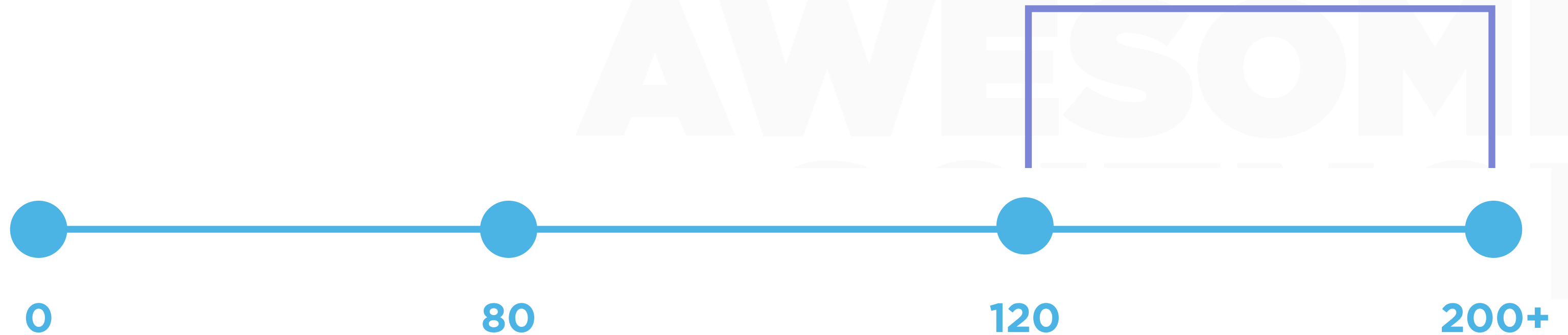
# BLOOD SUGAR IMBALANCE

Below 80 mg/dl is called **HYPOGLYCEMIA**.



# BLOOD SUGAR IMBALANCE

Above 120 mg/dl is called **HYPERGLYCEMIA**.



# BLOOD SUGAR IMBALANCE

## HYPOGLYCEMIA

### Symptoms:

- Feeling dizzy
- Sweating/chills
- Fast heartbeat
- Confusion

### What to do:

- Eat a snack
- Drink juice
- See a doctor if it continues

## HYPERGLYCEMIA

### Symptoms:

- Frequent urination
- Extreme thirst/hunger
- Headache
- Sugar in urine

### What to do:

- Drink plenty of water
- See a doctor



# DIAGNOSIS

Can you explain what is happening to Katie's system? Explain your thought process using evidence. Do you have a suggestion for an input into Katie's system?





**FILL OUT THE  
REMAINING  
SECTIONS OF  
KATIE'S CHART!**

# DIAGNOSIS

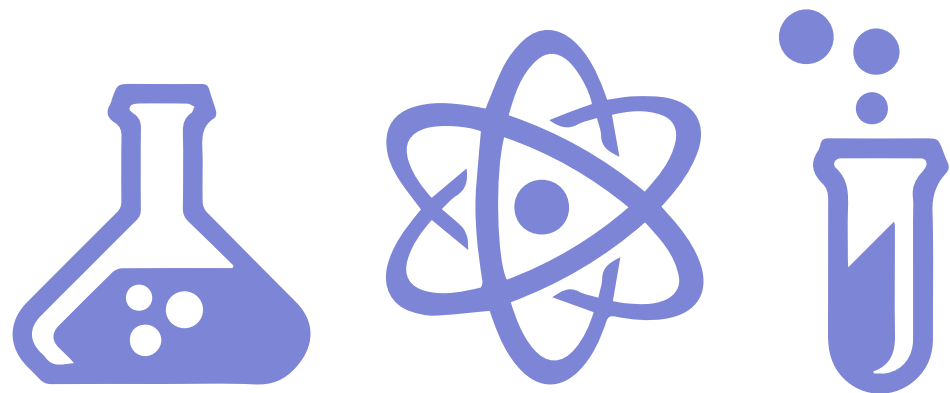
Can you explain what is happening to Katie's system? Explain your thought process using evidence. Do you have a suggestion for an input into Katie's system?

# DIAGNOSIS & TREATMENT

Katie's symptoms and tests indicate that she has diabetes. Diabetes (specifically Type 1 Diabetes) occurs when the pancreas does not produce insulin.

Her body is unable to use the glucose that is entering, so it is being removed through urine. When glucose is removed through urine, water is also removed causing high blood pressure, frequent urination, and thirst. Katie will need an input of insulin to regulate her system.

# ANSWER ANY REMAINING QUESTIONS IN YOUR LAB NOTEBOOK!



6. Fill in the sugar range chart with the appropriate blood sugar concentrations. Then decide where Katie's blood sugar readings place her.

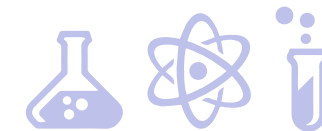
HYPOTONIC

NORMAL

HYPERTONIC

--	--	--

7. Based on what you learned about Katie, provide a treatment plan. What input would you recommend? Provide evidence for your reason.



## Here's what I did today!

Today I visited the virtual PROMISE Lab at Sanford Research. I learned about systems, solutions, and blood sugar. I was able to review a mock patient's symptoms, run virtual tests, and diagnosis her illness while learning about diabetes.