

MedLab: DIABETES

AT A GLANCE

Students will participate in a classroom enactment of glucose homeostasis in the body and learn the effects of diabetes on glucose regulation.

OBJECTIVES

Students will:

- Understand the regulation of glucose homeostasis between the bloodstream and cells
- Identify the effects of diabetes on standard glucose regulation
- Compare and contrast Type I and Type II diabetes

KEY VOCABULARY

diabetes, glucose, hyperglycemia, insulin, glycogen, hypoglycemia, glucagon, glucose homeostasis, insulin deficient, insulin resistant, Type 1 diabetes, Type 2 diabetes

SUGGESTED GRADE

LEVELS: 8—12

IL LEARNING GOALS

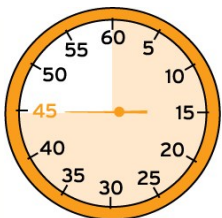
11.B; 12.A; 22.A, B, C; 23.A, B; 24.B

NGSS

MS-LS1, HS-LS1

PACE YOURSELF

TWO 45 MINUTES PERIODS



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ADVANCE PREPARATION

1. Watch [All About You: Diabetes](#) video clip to review the play in completion.
2. Use Room Diagram sheet to prepare classroom for activity.
3. Print and attach yarn to role-play cards. It is recommended to print them on card stock or laminate them for re-use (Use regular paper for the “Food” labels— these labels will be torn into pieces).
4. Print out a script for the narrator.
5. Assign roles to students.
6. Write out the Cast List in a large area for your class to reference throughout the play.

MATERIALS



Technology: Diabetes PowerPoint

Per Class:

- 2 Aluminum pans
- 1 Bottle of red food coloring
- 1 Sponge
- 1 Piece of sandpaper or printer paper
- 2 Bowls

Activity

Per Class:

- Photocopies of role-play cards
- Yarn

Per Student:

- Script

WHAT YOU NEED TO KNOW

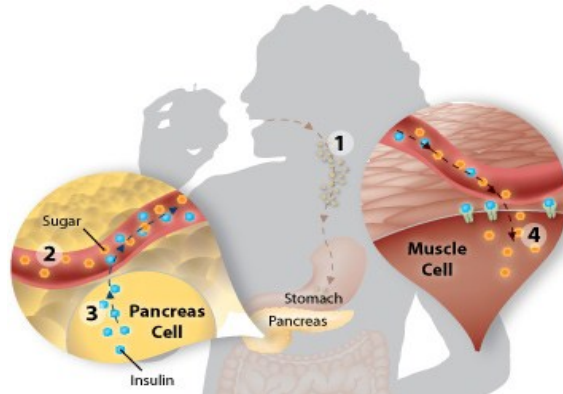


Diabetes is a condition where the body has trouble balancing the amount of glucose that is in the bloodstream. **Glucose** is a simple sugar that provides energy to all the cells in our bodies. It is absorbed directly into the bloodstream during digestion. After a meal, glucose is absorbed by the intestines and the levels of glucose in the bloodstream rise. When there are high levels of glucose in the blood, the body experiences **hyperglycemia** and sends signals to

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the pancreas to secrete insulin. **Insulin** is a hormone produced by the pancreas to stabilize glucose concentration in the body. Insulin is needed to help move glucose into the various cells throughout the body where it is used for energy. Figure 1 shows the body's pathway during standard glucose regulation.

Figure 1: Standard Blood Sugar Regulation

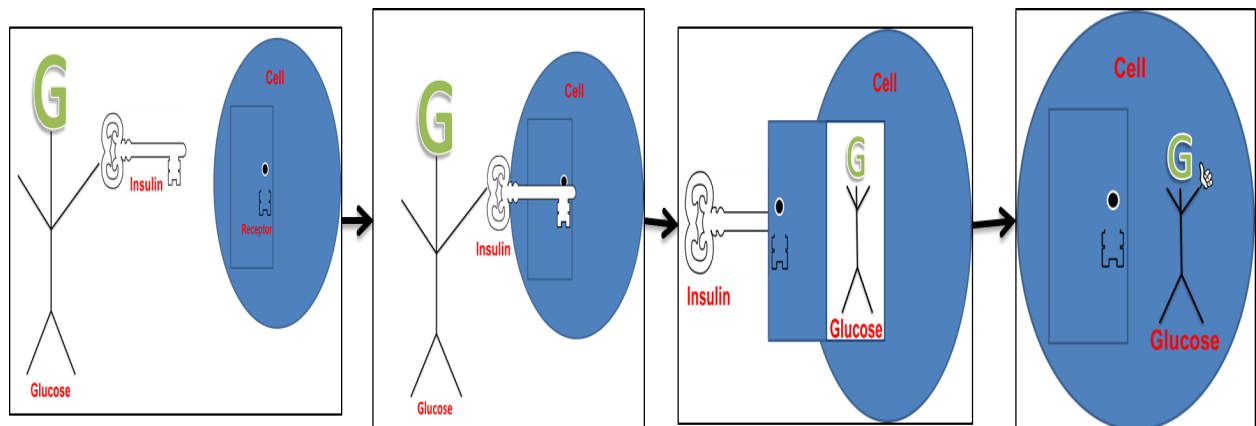


learn.genetics.utah.edu/

After food enters the body (1), it is broken down and sugar (glucose) enters the bloodstream (2). Sugar stimulates cells in the pancreas to release insulin (3). Insulin travels through the blood to other cells in the body and signals the cells allow glucose molecules in to use the sugar for energy (4).

When an insulin molecule arrives at a cell site, it attaches itself to an insulin receptor located on the outside of the cell. Once the molecule and receptor attach, the glucose channel of the cell opens and glucose can enter the cell to make energy. Think of the way a key unlocks a door- insulin interacts with cells much the same way. At rest, each cell is like a door that is closed and locked. In order to unlock the door, an insulin molecule (the key) must match up to the insulin receptor (the lock). Once this happens, glucose molecules are able to enter the cell and fuel energy production. This process reduces blood glucose levels, which causes the pancreas to stop secreting insulin. Figures 2 (basic) and 3 (detailed) show how insulin helps move glucose from the bloodstream into the cells by functioning as a key that unlocks receptors on the cell.

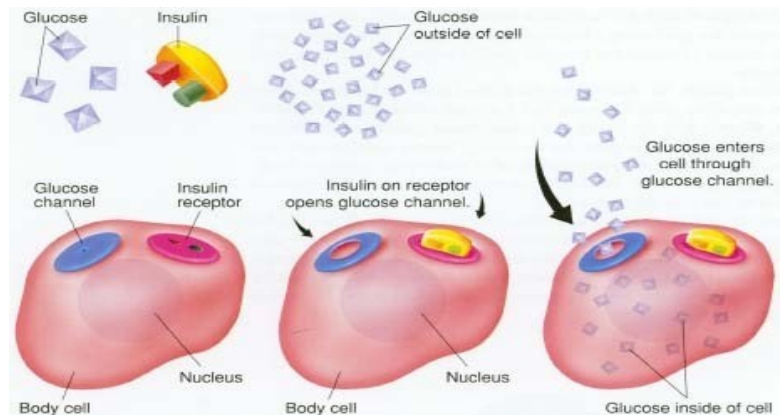
Figure 2: Insulin-regulated Glucose Transport (basic)



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Insulin-regulated glucose transport is not the only process that assists the body in decreasing blood glucose levels; the liver has a special job- like a warehouse for excess glucose. When levels of glucose in the blood are high, the liver responds by absorbing the excess glucose. It packages the glucose into bundles called glycogen. **Glycogen** molecules are long chains of glucose molecules that can be stored in the liver and then released when the glucose levels in the blood are too low.

Figure 3: Insulin-regulated Glucose Transport (detailed)



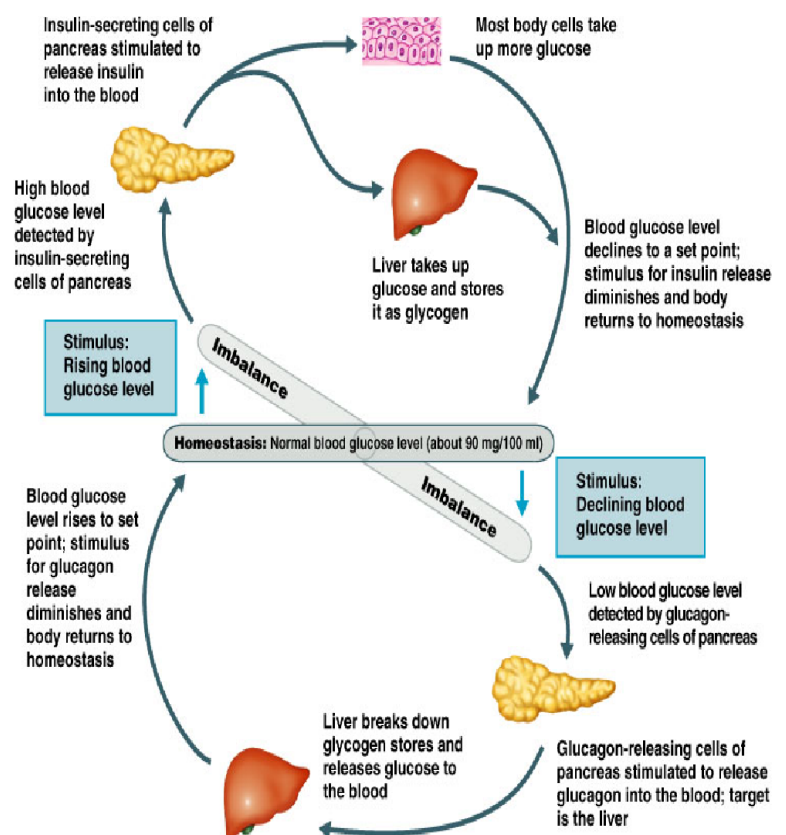
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Remember- after a meal, blood glucose rises *above* standard level (hyperglycemia) and the body sends a signal to the pancreas to secrete insulin. But, what happens when blood glucose drops *below* standard level?

When a person is between meals or sleeping, the body experiences **hypoglycemia**; the blood glucose drops below standard level and the body signals the pancreas to release glucagon. **Glucagon** is a hormone—also formed in the pancreas - that helps raise blood glucose levels by converting glycogen, which was stored in the liver, back to glucose. Glucose is then released back into the bloodstream to stabilize (increase) blood glucose levels.

Eventually, all of the newly released glucose increases blood sugar and signals the pancreas to secrete additional insulin. The newly released insulin helps move glucose into various parts of the body's cells where it is used for energy. The results of insulin-regulated glucose transport and liver absorption cause blood glucose levels to decrease. When blood glucose levels decrease below standard level, glucagon is released from the pancreas and the cycle continues. The interrelationship between the insulin and glucagon hormones maintains **glucose homeostasis** in the blood. Figure 4 shows how insulin and glucagon use a negative feedback mechanism to maintain glucose homeostasis within the body (detailed in the *Homeostasis* lesson).

Figure 4: Insulin and glucose roles in Glucose Homeostasis



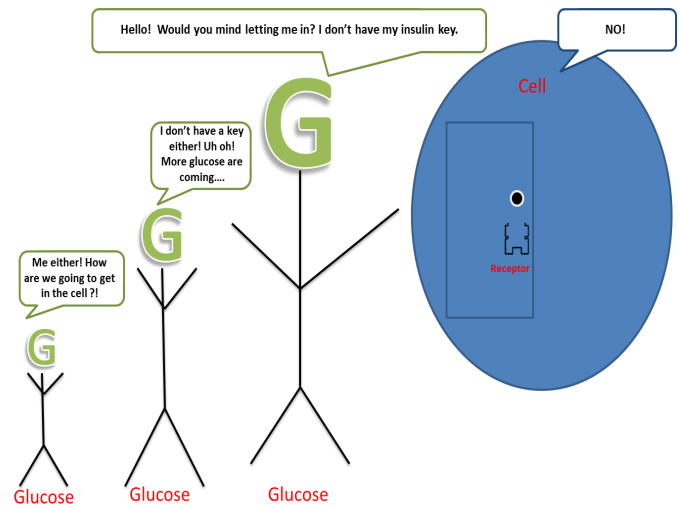
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Maintaining glucose homeostasis depends upon the accurate secretion and functioning of insulin. Diabetes is characterized by high levels of blood glucose resulting from the deficiency of or resistance to insulin. If a person does not produce enough insulin (**insulin deficient**), or the insulin is not capable of transporting the glucose into the cells (**insulin resistant**), cells will not get the energy needed to properly function. Insulin deficiency and insulin resistance are the two major classifications of diabetes: Type 1 and Type 2.

Type 1 diabetes, occasionally referenced as insulin-deficient diabetes, is a form of diabetes that results from an autoimmune destruction of the insulin-producing cells of the pancreas. In Type 1 diabetes, the pancreas makes little to no insulin. Do you remember the lock and key analogy? Without insulin present to unlock the receptors on the cells, glucose cannot enter the cells to provide energy and glucose builds in the bloodstream. Without insulin-regulated glucose transport, the body must find alternate ways to remove glucose from the blood and stabilize blood glucose levels. Figure 5 builds on the concept from Figure 2, highlighting lack of insulin production.

Figure 5: Type 1 diabetes- lack of insulin production

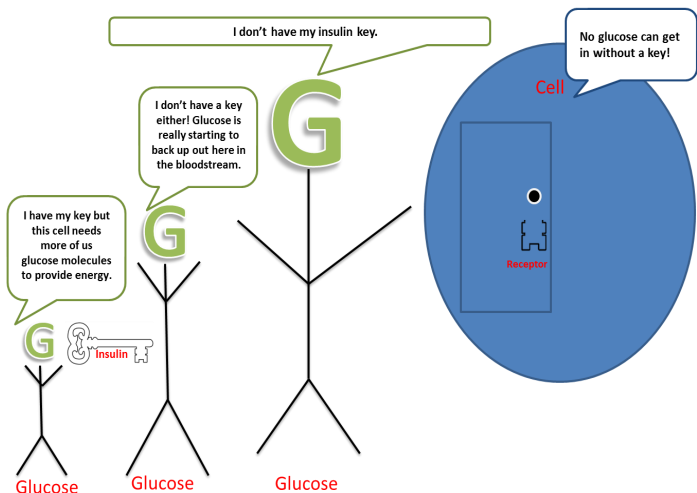


One of the essential functions of the kidneys is to remove waste from the body. Here, the kidneys strive to remove the excess glucose, which pulls water with it and leads to heavy urination and an insatiable thirst. The accumulation of glucose in the bloodstream leads to additional complications such as, blurred vision, fatigue, infections, etc. The causes of these complications are detailed in the *Diabetes Symptom Chart* located on page 6.

Type 1 diabetes is found in approximately 10% of diabetics and is usually diagnosed before a person turns 19 years old. Risk factors for Type 1 diabetes include autoimmune, genetic, or environmental factors. Because the pancreas does not produce insulin, Type 1 diabetics must use an insulin pump or perform insulin injections around meals to cope with the glucose load from digestion. A delicate balance of insulin medications, regulated carbohydrate consumption and physical activity is the best way for Type 1 diabetics to stabilize their blood glucose levels.

Type 2 diabetes, occasionally referenced as insulin-resistant diabetes, is a form of diabetes caused by a metabolic disorder in which cells fail to use insulin properly. In Type 2 diabetes, the body still produces insulin but may make less than average or there may be a decrease in the number and/or responsiveness to receptors on the cell. Let's revisit our trusty lock and key analogy! In our first example, the body makes limited insulin (key) and while the insulin molecule (key) matches the insulin receptor (lock),

Figure 6: Type 2 diabetes- decreased insulin production

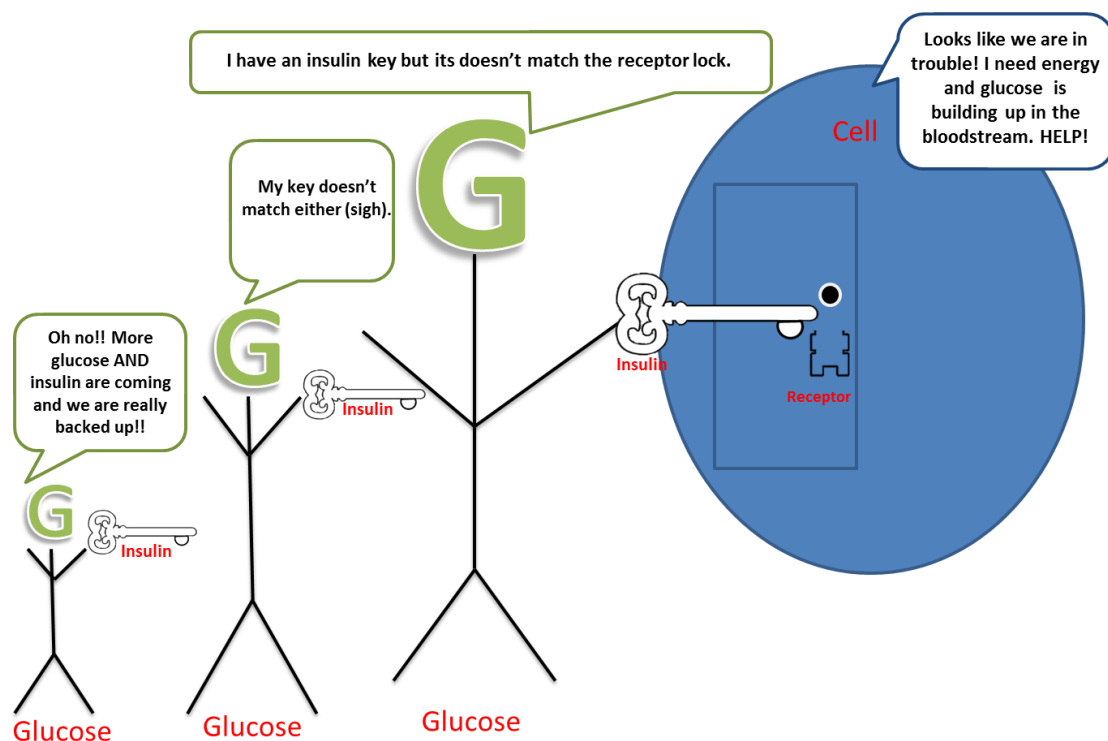


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allowing glucose transport into the cell; the insufficient amount of insulin (key) reduces the overall rate at which the glucose can enter the cell to provide energy. The glucose molecules build up in the bloodstream as they slowly wait to enter the cell. Figure 6 builds on the concept from Figure 2, highlighting decreased insulin production.

The second example is a result of insulin (key) that does not accurately match the insulin receptor (lock). Here, the insulin molecule (key) is simply not a match for the insulin receptor (lock) or the insulin receptor (lock) has accumulated fat tissues at the receptor site altering the initial shape of receptor. With the second examples, even though insulin is present, it cannot be used as effectively as it should; resulting in extremely high levels of glucose and insulin in the blood. Figure 7 builds on the concept from Figure 2, highlighting mismatched insulin and insulin receptors.

Figure 7: Type 2 diabetes- mismatched insulin and insulin receptors



Type 2 diabetes is found in approximately 90% of diabetics and typically occurs in adults over the age of 30. The Center for Disease Control (CDC) reports Type 2 diabetes, once known as 'adult onset' diabetes, is increasingly being diagnosed in youth. In the past 5 years there has been a 33% increase in youth diagnosed with Type 2 diabetes. The CDC also reports that the percentage of adolescents, who were obese, increased from 5% to 18% over the same period. Nationwide, more than half of the people with Type 2 diabetes are obese, and approximately 30% are overweight. The buildup of excess fat tissue at the insulin receptor sites contributing to insulin resistance, suggests a direct correlation between obesity and diabetes. And in 2010, more than one third of US youth were overweight or obese. These statistics are often higher in many underserved communities. It is time to educate children about this disease so they have the knowledge to live their healthiest life.

Although the physiology of Type 1 and Type 2 diabetes differ within the body, the lack of a properly functioning system results in similar symptoms which are highlighted in the *Diabetes Symptom Chart* on page 6. Additional risk factors for Type 2 diabetes may include older age, family history of diabetes, lack of

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physical activity and race/ethnicity. In addition to reducing body weight through diet and exercise, Type 2 diabetics often take oral anti-diabetic drugs and insulin injections to stimulate insulin production and increase insulin sensitivity at the cellular level to assist with managing their disease.

Figure 8: Diabetes Symptom Chart

Symptom	Why?
<ul style="list-style-type: none"> • Frequent urination • Presence of glucose in urine 	People with diabetes have excess sugar (glucose) built up in their blood due to the absence or lack of properly functioning insulin. The kidneys are forced to absorb and filter excess sugar. Glucose is excreted into the urine along with fluids drawn from cell tissues. The constant removal of glucose from the body triggers frequent urination.
<ul style="list-style-type: none"> • Excessive thirst 	Frequent urination removes essential fluids from the body contributing to excessive thirst in people with diabetes.
<ul style="list-style-type: none"> • Extreme hunger 	Frequent urination causes diabetics to lose essential calories. Since the body has trouble transporting glucose to the cells for energy, fat cells are often used as a replacement.
<ul style="list-style-type: none"> • Tiredness or fatigue 	Because the body cannot properly use glucose for energy, people with diabetes often suffer from fatigue. Increased blood glucose levels affect blood viscosity and contributes to poor circulation. Poor circulation decreases the rate that the body delivers energy to the cells.
<ul style="list-style-type: none"> • Changes in vision 	Increased blood glucose levels affect blood viscosity and contributes to poor circulation. The retinal nerve of the eyes degenerate slowly because of the inadequate supply of nutrients to the eyes. This lack of nutrient supply and degeneration leads to blurred vision and occasionally blindness in people with diabetes.
<ul style="list-style-type: none"> • Numbness or tingling in hands or feet 	When blood vessels are damaged by excess glucose in the blood; they no longer carry enough blood to the extremities to provide essential oxygen and nutrients.
<ul style="list-style-type: none"> • Abnormally high frequency of infection • Slow-healing wounds or sores 	Glucose itself is a rich medium which promotes the growth of bacteria and viruses; in fact, it is used in all laboratories as a culture medium to grow bacteria. High blood glucose levels make diabetics prone to a variety of infections throughout the body.

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WARM UP

This warm up activity is designed to help students visualize the difference in how a person with and without diabetes receives blood glucose to provide energy to our body's cells.

1. Take the two aluminum pans and fill them with at least enough water to cover the bottom of the pans. Make sure each pan has the same amount of water.
2. Place enough red food coloring in the water and swirl it around, so as to resemble blood. (Optional)
3. Tell your students that the red water in the pan represents blood glucose directly after we eat a meal.
4. Explain that both demonstrations represent how the body utilizes blood glucose to make energy but one demonstration will represent the process for a person with diabetes and the other demonstration will represent the process for a person without diabetes.
5. Now, place the pans side by side.
6. Take your sponge and swirl it around in the water of the first pan, getting it completely soaked. Then, ring out the sponge above the bowl labeled 'body cells'.
7. Now, take your sandpaper or paper and swirl it around in the second pan, just as you did the sponge.
8. Ring out the sandpaper directly above the other bowl labeled 'body cells'.
9. Have your students observe the amount of liquid transferred from the pans to the bowls.
10. Begin a class discussion by asking some of the following questions (see Check for Understanding for answers):
 - Which method was best for transferring blood glucose to the body cells?
 - Which method do you think represents a person with diabetes? Without diabetes? Why?
 - What do you think the sponge represents? The sandpaper?
11. After your discussion, let students know that you will revisit this demonstration and compare your answers after your main activity.
12. Present the Diabetes PowerPoint presentation before doing the following activity.



ACTIVITY

Note: Before you start your activity have the class fill out the students' roles on the Cast List. Also, discuss where each student should begin on "the set" of the play. This serves as a great refresher of background information. Where are insulin located? Glucagon? Etc. The script is below.

Scene 1: Standard Glucose Homeostasis

Narrator: "When people eat food, it goes to their stomach where it gets broken down into different things. One of those "things" is called glucose. Glucose is a simple sugar that provides energy to all the cells in your body. It's like gas in a car- without it, our bodies won't have power. Humans are always on the go and we need energy!"

Students (Glucose #1, Stomach): The food walks up to the stomach. The stomach removes the food label, rips it into pieces and drops the pieces into a bucket labeled "digested food". Under the food label the student will have a glucose label.

Narrator: "After glucose is broken down in the stomach, it is absorbed by the intestines and is then distributed all over the body through the bloodstream."

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Students (Glucose #1, Intestines): The glucose molecule hugs the intestines and slowly walks into the bloodstream.

Narrator: **"When our bodies detect an increase of glucose in our bloodstream, it sends a signal to the pancreas to release the hormone, insulin."**

Students (Pancreas, Insulin #1): The insulin hormone should leave the pancreas and enter the bloodstream.

Narrator: **"Insulin helps move glucose from the bloodstream into the cells by functioning as a key that unlocks receptors on the cell."**

Students (Glucose #1, Insulin #1): The insulin hormone and glucose molecule should lock arms. The insulin should escort the glucose to the body cells site. The insulin should extend their "key" as it approaches the body cells.

Narrator: **"Once the receptors are unlocked by insulin, glucose can enter the cell and provide energy to the body. Cells, insulin and glucose are really like a team! They must work together to help the body stay energized."**

Students (Glucose #1, Insulin #1, Body Cells, Pancreas): The insulin should go to the cell "door" and turn the "key". Once the cell door is opened, the glucose should enter the body cells and the insulin should return to the pancreas.

Narrator: **"Cells use the energy in the glucose molecule to carry out life processes."**

Student (Glucose #1): The glucose should begin a slow series of 10 jumping jacks to simulate the energy being used. After the jumping jacks are complete, the glucose should slowly jog in place.

Narrator: **"Cells require several glucose molecules to secure enough energy to complete various tasks."**

Students (Stomach, Intestines, Glucose #2, Glucose #3, Insulin #2, Insulin #3, Pancreas, Body Cells): One at a time, Glucose #2 and Glucose #3 should walk up to the stomach. The stomach removes the food label, rips it into pieces and drops the pieces into a bucket labeled "digested food". Then, each glucose molecule should hug the intestines and enter the bloodstream. Glucose #2 should be escorted to the body cells by Insulin #2 and Glucose #3 should be escorted to the body cells by the Insulin #3. First, the Insulin/Glucose #2 pair should go to the cell "door" and turn the key. Once the cell door opens, Glucose #2 should enter the body cells and Insulin #2 should return to the pancreas. The cell "door" should close. As soon as the Glucose #2 enters the cell, it should begin its series of 10 jumping jacks. After the jumping jacks are complete, the glucose molecule should slowly jog in place. Repeat the same steps for Glucose # 3 and Insulin #3.

[Optional: Review CHECK FOR UNDERSTANDING Questions 1-4]

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Narrator: "Once a cell has acquired enough glucose for its energy requirement, any additional glucose in the bloodstream is taken to the liver for storage."

Students (Stomach, Intestines, Body Cells, Glucose #4, Glucose #5, Glucose #6, Glucose #7, Glucose #8, Glucose #9, Insulin #1, Insulin #2, Insulin #3, Insulin #4, Insulin #5, Insulin #6, Liver): One at a time, Glucose #'s 6-9 should walk up to the stomach. The stomach removes the food label, rips it into pieces and drops the pieces into a bucket labeled "digested food". Then, each glucose molecule should hug the intestines and enter the bloodstream. The body cells should hold up a sign that reads "WE ARE AT CAPACITY." Each new molecule should be escorted by the insulin to the liver. The insulin(s) return directly to the pancreas after taking glucose to the liver. [Pairs: Glucose #4/Insulin #1, Glucose #5/Insulin #2, Glucose #6/Insulin #3, Glucose #7/Insulin #4, Glucose #8/Insulin #5, Glucose #9/Insulin #6]

Narrator: "While stored in the liver, glucose likes to form close bonds with other glucose molecules. These glucose molecules link together and form long chains called glycogen. Glycogen molecules are stored in the liver and later released when the levels of glucose in the blood are low."

Students ([Glucose #4, Glucose #5, Glucose #6]- Glycogen #1, [Glucose #7, Glucose #8, Glucose #9]- Glycogen #2, Liver): Once the six glucose molecules are in the liver, they should link arms in groups of three to simulate the bond formation of a glycogen molecule. Each group of three should hold up a glycogen label.

[Optional: Review CHECK FOR UNDERSTANDING Questions 5-7]

Narrator: "Can anyone think of a time when blood glucose levels get low in our bodies? Every night when we go to bed, our glucose levels decrease. Why??? Because if we are sleeping, we are unable to eat, right? Without new food consumption, our bodies have to find internal ways to keep our glucose levels balanced."

Students (Glucose #1, Glucose #2, Glucose #3, Body Cells): Glucose 1, 2 & 3 disappear from body cells.

Narrator: "During times like these, the body signals the pancreas to release a hormone called glucagon."

Students (Glucagon, Pancreas): The glucagon slowly travels from the pancreas to the liver.

Narrator: "Glucagon travels from the pancreas to the liver to break the bonds of glycogen. Glycogen is converted back to glucose and then released from the liver into the bloodstream to stabilize blood glucose levels. The newly released glucose molecules are then taken back to the body cells by insulin to provide energy to the cells."

Students (Glucagon, Pancreas, Liver, Glucose #4, Glucose #5, Glucose #6, Glucose #7, Insulin #1, Insulin #2, Body Cells): The glucagon travels from the pancreas to the liver where he or she should begin breaking the bonds of the glycogen molecules. First, glucagon will push Glucose #4 out of the liver. Insulin #1 is released from the pancreas and escorts Glucose #4 to the body cells. The insulin goes to the cell "door" and turns the key. Once the cell door opens, the glucose enters. The insulin returns to the pancreas and Glucose #4 begins a slow series of 10 jumping jacks, followed by jogging in place. Directly af-

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ter, Glucose #4 and Insulin #1 lock arms, glucagon will push Glucose # 5 out of the liver. Insulin #2 is released from the pancreas and escorts Glucose #5 to the body cells. The insulin goes to the cell “door” and turns the key. Once the cell door opens, the glucose enters. The insulin returns to the pancreas and Glucose #5 begins a slow series of 10 jumping jacks followed by jogging in place. Directly after Glucose #5 and Insulin #2 lock arms, glucagon will consecutively push Glucose # 6 and #7 out of the liver. Glucose #6 and #7 will slowly walk through the bloodstream. Glucagon returns to the pancreas and the other glucose molecules remain in the liver as stored glycogen. Now, there should be two glucose molecules at the body cells site, two glucose molecules in the bloodstream and two glucose molecules in the liver.

Narrator: "When there is an appropriate balance of glucose in the bloodstream, in the liver and at the cell sites the body reaches glucose homeostasis."

[Optional: Review CHECK FOR UNDERSTANDING 8-12]

Scene 2: Diabetes

Narrator: "Now that we have an understanding about glucose homeostasis and how the body responds if blood glucose levels are too high (hyperglycemia) or too low (hypoglycemia), we can learn more about diabetes. Diabetes is a condition where the body has trouble balancing the amount of glucose that is in the bloodstream."

"We have learned how standard blood glucose levels depend upon the secretion of insulin from the pancreas. So what happens if the pancreas does not secrete enough insulin to keep up with increased blood glucose levels? How does this lack of insulin affect the body? From our previous act we understand that glucose is broken down in the stomach, absorbed by the intestines and is then distributed to all the cells of the body through the bloodstream."

Students (Glucose #'s 1-5, Stomach, Intestines, Body Cells): One at a time, Glucose #1, Glucose #2, Glucose #3, Glucose #4 and Glucose #5 should walk up to the stomach, hug the intestines, enter the bloodstream and slowly head toward the body cells.

Narrator: "However, unlike standard glucose regulation, insulin is not released from the pancreas to escort the glucose into the body cells."

Students (Glucose #'s 1-5, Stomach, Intestines, Body Cells): Glucose molecules #'s 1-5 should gesture as if they were looking for the insulin as they approach the body cells and wait for Glucose #6-9 to arrive. The insulin “fakes sleep” and remains in the pancreas and the body cells should hold up a sign that reads “NO INSULIN, NO ENTRY”.

Narrator: "Therefore, the glucose molecules continue on their journey throughout the bloodstream. Eventually, there is such a high concentration of glucose in the bloodstream that the glucose is excreted from the body in harmful ways."

Students (Glucose #'s 1-9, Insulin #1, Pancreas, Body Cells, Kidney): One at a time, Glucose #6, Glucose #7, Glucose #8 and Glucose #9 should walk up to the stomach, hug the intestines and enter the bloodstream. While walking through the bloodstream, Glucose #'s 6-9 should gesture as if they were

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looking for the insulin and meet Glucose #'s 1-5 at the body cells site. Once all the glucose have arrived at the body cells, they will head towards the kidney. The kidney will hold up a sign that reads "THIS IS NOT AN EXIT." The glucose molecules will walk through the kidney, pick up a sign that reads "URINE" and walk outside the bloodstream, representing being excreted from the body as waste.

Narrator: "Type 1 diabetes occurs when the body produces little to no insulin and, therefore is unable to process sugars. People with this form of diabetes are dependent on insulin injections or pumps to provide insulin for the body. Type 1 diabetes was once called juvenile diabetes because it is frequently diagnosed in children and young adults."

Note: STAGE RESET

Narrator: "There is another way that diabetes can make it difficult for cells to get the glucose that they need to provide energy to the body. This is known as Type 2 diabetes. Type 2 diabetes was previously termed adult-onset diabetes because its risk factors evolved as our body's age (obesity, family history, diet, physical inactivity, etc.) Here, the pancreas still makes insulin but over time the cells cannot use it very well. Let's see what happens with this condition."

Narrator: "Glucose molecules enter the bloodstream."

Students (Glucose #'s 1-4): One at a time, the glucose molecules walk up to the stomach, hug the intestines and walk slowly through the bloodstream.

Narrator: "The pancreas secretes insulin."

Students (Insulin #'s 1-4, Glucose #'s 1-4, Pancreas): Insulin #'s 1-4 leave the pancreas and lock arms with Glucose #'s 1-4.

Narrator: "In Type 2 diabetes, the body can produce little to no insulin and/or insulin that no longer communicates cells. When insulin no longer has the matching 'key' to 'unlock' the receptors on the cell or there is a buildup of fat around the receptor cell that has altered its initial shape, glucose fails to provide energy to the cells. Even though insulin can be present, it cannot be used as effectively as it should. "

Students (Glucose #'s 1-4, Insulin #'s 1-4, Body Cells): Insulin/Glucose Pair #'s 1-4 walk over to the body cells. Insulin #1 extends its key toward the cell but the key does not work. The body cell gestures "no" by shaking their head and does not open the door for the pair. The insulin breaks off from the glucose but the pair continues to travel side-by-side through the bloodstream in a clockwise direction. Repeat the same steps for Insulin/Glucose Pairs #2 - #4.

Narrator: "Because the cells are not able to use the glucose that is secreted, glucose levels rise and the pancreas responds by releasing more insulin. Type 2 diabetics will have high levels of insulin and blood glucose at the same time."

Students (Insulin #'s 5 & 6, Glucose(s), Body Cells): Insulin #'s 5 & 6 leave the pancreas and lock arms

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with two random glucose. The Insulin/Glucose Pairs walk over to the body cells. Insulin #5 extends its key toward the cell but the key does not work. The body cell gestures “no” by shaking their head and does not open the door for the pair. The insulin breaks off from the glucose but the pair continues to travel side-by-side through the bloodstream in a clockwise direction. Repeat the same steps for Insulin #6.

Narrator: "Similar to Type 1 diabetes, when the concentration of glucose in the bloodstream rises far above standard levels, that glucose is excreted from the body in harmful ways. People with Type 2 diabetes can also take insulin and/or medications to balance their sugar levels, but they are strongly encouraged to change their diet and increase physical activity as well."

Students (Glucose #'s 1-4, Insulin #'s 1-6, Kidney): Insulin/Glucose Pairs #'s 1-4 should walk towards the kidney. The kidney will hold up a sign that reads “THIS IS NOT AN EXIT.” The glucose molecules will walk through the kidney, pick up a sign that reads “URINE” and end up outside the bloodstream, representing being excreted from the body as waste. Insulin #'s 1-6 will return to the pancreas.



CHECK FOR UNDERSTANDING

1. After a meal, what is the primary molecule used to provide energy to cells of the body? *Glucose*
2. Directly after a meal, do glucose levels increase or decrease within the blood? *Increase*
3. After blood glucose levels rise, what hormone does the pancreas release to reduce blood glucose levels? *Insulin*
4. How does insulin help stabilize blood glucose levels? *Insulin transports glucose to the cells to provide the body with energy.*
5. If the cells have enough glucose to provide energy to the body, where are the “extra” glucose molecules stored? *In the liver.*
6. How are the glucose molecules stored in the liver? *As glycogen*
7. Why does the body need to store glucose molecules? *Glucose is stored in the liver as glycogen and later released when the levels of glucose in the blood are low.*
8. During sleep or between meals the blood glucose levels drop. What hormone does the pancreas release to increase blood glucose levels? *Glucagon*
9. How does glucagon increase blood glucose levels? *Glucagon breaks apart bonds of glycogen molecules, converting them back to glucose. The glucose is then released into the bloodstream to stabilize (increase) blood sugar levels.*
10. The newly released glucose enters the bloodstream and signals the release of which hormone? *Insulin*
11. Define homeostasis. *When our bodies interpret internal and external cues, and react to them, in order to maintain an internal balance.*
12. What is glucose homeostasis? *The interrelationship and balance of two hormones– insulin and glucagon– to maintain a healthy level of glucose in the blood.*
13. What is the difference between Glucose, Glycogen and Glucagon? *Glucose (gloo-kohs) is a simple sugar that provides energy to the cells in our bodies. Glycogen (glahy-kuh-juhn) is a long chain of glucose molecules that can be stored in the liver and then released when the glucose levels in the blood are low. Glucagon (gloo-kuh-gon) is a hormone formed in the pancreas that helps raise blood glucose levels by converting glycogen back to glucose.*

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Now, have your class revisit your warm up activity. Have students review the results of the demonstration and begin discussion.

1. Which method was best for transferring blood glucose to the body cells? *The sponge was the most effective method for transferring the red water to the container. The sponge has the ability to absorb and transport more water than the sandpaper.*
2. Which method do you think represents a person with diabetes? *The sandpaper demonstration.* Without diabetes? *The sponge demonstration.* Why? *People with diabetes have a difficult time transporting glucose from the blood to the cells to make energy for the body. After comparing both methods, one should conclude that the sandpaper was a more difficult method than the sponge. Therefore, the sandpaper demonstration would represent a person with diabetes and the sponge would represent a person without diabetes.*
3. What do you think the sponge represents? *The sponge represents properly functioning insulin.* The construction paper? *The construction paper represents limited or defective insulin.*



DIFFERENTIATED INSTRUCTION

1. Break this lesson into three separate parts. This may cause you to extend the lesson over several class periods.
 - Slowly guide students through the play; assist by directing student's body placement during script and elaborating on content. Take breaks to review Check for Understanding questions.
 - Have students complete the play on their own, only providing assistance as needed. Once students have mastered the play and concepts, use a video recorder to film students.
 - Have students watch recorded play and then discuss what they have learned.
 - Have students complete the play without communicating at all (no talking, gesturing, etc.)
2. Adjust the script so that half of the class is participating in the play while the other half is observing (fishbowl model). Allow the groups to switch responsibilities—perhaps even mid-play—and then discuss what they have learned at the end.



EXTENSIONS

ART

Have your students design their own role-play cards. Allow the students to draw, paint and/or cut out images to represent their role.

LANGUAGE ARTS

Note: this activity can be used at the beginning or the end of the lesson.

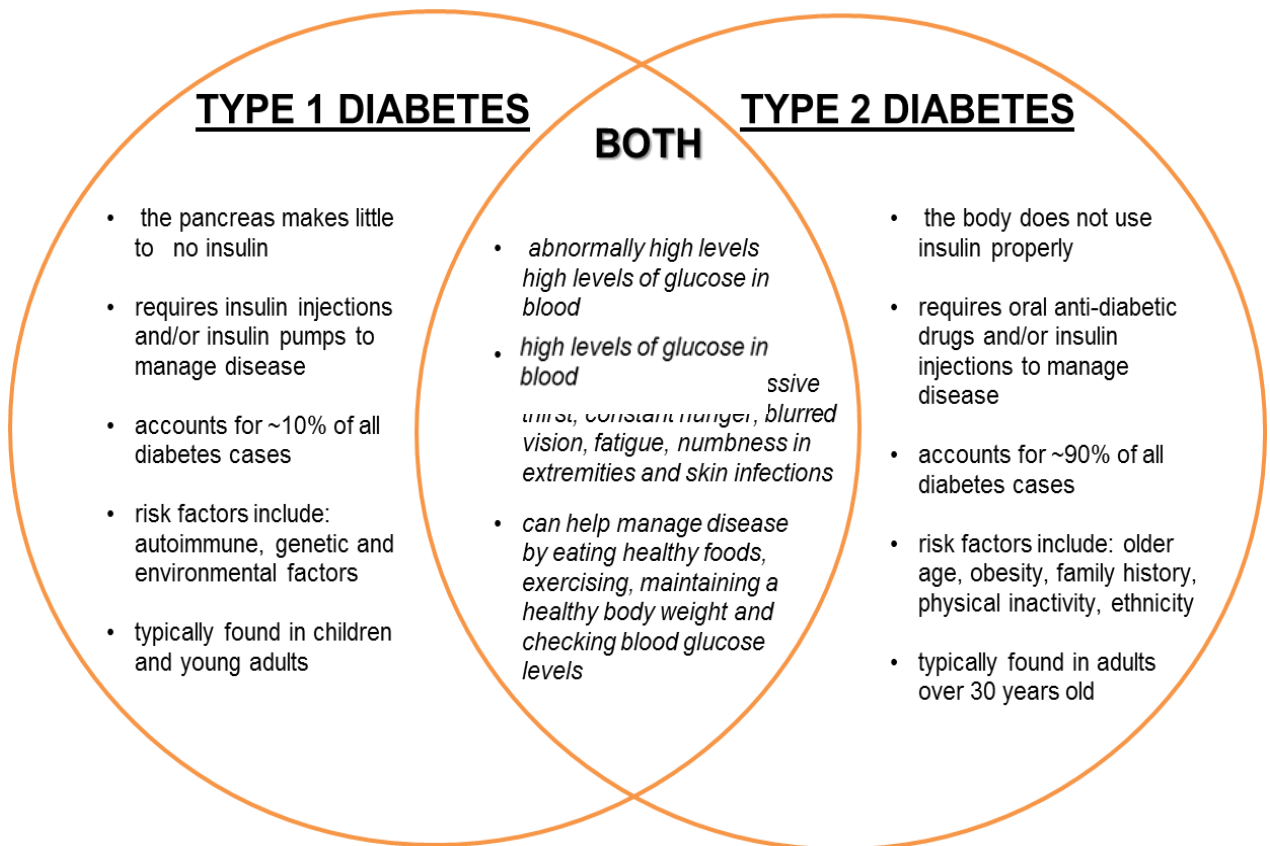
Often times the media depicts diabetes in a biased way; focusing only on correlations between obesity and physical inactivity. Some of your students might have family members with diabetes, or could be diagnosed with the disease themselves. While we should always promote healthy lifestyles to our students, this lesson has highlighted other risk factors that lead to the disease. Allow your students to learn about famous celebrities that live with diabetes. This activity might limit anxieties and decrease personal, negative correlations during your diabetes lesson. Examples: Halle Berry (Type 2), Jay Cutler (Type 1), Selma Hayek (Gestational), Nick Jonas (Type 1), Vanessa Williams (Type 1), Randy Jackson (Type 2), Sherri Sheppard (Type 2), Tommy Lee (Type 2), Paula Deen (Type 2), Sonia Sotomayor (Type 1).

Are you surprised that any of the celebrities have diabetes? Does this make you feel differently about the disease? Have your students journal their thoughts after the discussion.

DIABETES

SCIENCE

Break students into small groups and have them list the similarities and differences between Type 1 and Type 2 diabetes. Have the students share their answers and create a classroom Venn diagram on a poster or chalkboard. A sample diagram is available below.



DIGITAL RESOURCES

- Chicago Department of Public Health—Healthy Chicago Initiative
<http://www.cityofchicago.org/city/en/depts/cdph/provdrs/healthychicago.html>
- American Diabetes Association:
<http://www.diabetes.org/>
- Center for Disease Control—Diabetes Public Health Resource:
<http://www.cdc.gov/diabetes/>
- Diabetes UK Charity:
<http://www.youtube.com/watch?v=jHRfDTqPzj4>
- How Stuff Works?—“How Diabetes Works:
<http://science.howstuffworks.com/life/human-biology/diabetes.htm>
- All About You: Diabetes Video:
<https://www.youtube.com/watch?v=372lRn3azQk&feature=youtu.be>

RELATED EXHIBITS

You! the Experience: Parts of this exhibit include homeostasis, nutrition, health, and wellness.