UWGSEO
GENOME SCIENCES EDUCATION OUTREACH

Health, Nutrition, and Type 2 Diabetes

Genome Sciences Education Outreach
UNIVERSITY OF WASHINGTON | VERSION 10.18

Curriculum Overview and Teacher Background

Overview

The increase in type 2 diabetes nationally and globally gives meaningful context for learning about nutrition, health, and the environmental and genetic contributions to this challenging disease.

In this unit, students are exposed to the complex, real-world problem of the rapid increase in diagnosed cases of type 2 diabetes across the United States in the past 20 years. Students begin by considering the genetic and environmental contributions to a number of complex health conditions, and expand the term “environment” to include factors such as access to resources, pressures impacting personal choice, the emotional/social environment, as well as the physical environment. Students learn where glucose is found in the foods and drinks we consume, how blood glucose levels are maintained in the body, and how the failure of these mechanisms can result in type 2 diabetes. Students then analyze labels for carbohydrates and other nutrients and determine the durations of physical activity required for balancing calories consumed and calories burned. Throughout the unit, prevention and treatment are emphasized as students learn how good nutrition, exercise, personal choice, public health policies and community engagement can contribute to positive health outcomes.

Enduring Understandings

- Most traits are determined by a combination of genetic and environmental factors, including complex diseases like type 2 diabetes.
- Type 2 diabetes is a growing concern and occurs frequently in our communities.
- Type 2 diabetes is a complex condition that is heavily influenced by environmental factors such as access to resources, personal choice, product marketing, public policy, socio-economic status, and stress.
- Blood glucose levels are regulated to stay within a healthy range. Type 2 diabetes is the result of chronic high blood glucose levels over time as regulation of blood glucose levels fail.
- Glucose, the major energy source for all human cells, is released primarily through digestion of carbohydrates. Food choices impact blood glucose levels.
- Type 2 diabetes is a serious condition with negative health consequences if left untreated.
- Type 2 diabetes can be prevented: factors contributing to a person’s risk include good nutrition and exercise.
- Students can make a meaningful contribution to the prevention of type 2 diabetes.

Overview

Companion Unit	The Enduring Understandings for this curriculum also guide a 5-lesson unit developed for high school biology courses ***Biology, Homeostasis, and Type 2 Diabetes*** which can be found at https://gsoutreach.gs.washington.edu/
Target Level	High school health courses
Health Standards	This curriculum is tied to the National Health Standards and the Washington State Health Standards. In using the complete 5 lesson curriculum and assessment piece, teachers will be connecting to every general National Health Standard and every Nutrition and Wellness standard for Washington State, as shown on the following tables.
Slide Set	The unit is built with an accompanying slide set found at https://gsoutreach.gs.washington.edu/. The Essential Question is posed on the first slide for each lesson. These slides could be used entrance activities, in which students would respond to the question(s) posed on the slide in a variety of ways, as directed by the teacher. Suggested strategies include a think-pair-share, a brief class discussion, or an individual writing exercise.
Timing	This 5-lesson unit plus assessment will take between 7 and 15 classroom days.
The 5 E Model	The unit is designed around the 5E Learning Cycle Model developed by the Biological Sciences Curriculum Study. The 5E model provides a scaffold for guiding and assessing student inquiry and learning through the following stages: Engage; Explore; Explain; Elaborate; and Evaluate.
Assessment	Each lesson provides opportunities to assess student learning through opening and closing activities and questions. In addition, students reflect on their own health goals throughout the curriculum. As a summative assessment, students create nutritional eating plans for themselves and/or people with type 2 diabetes. Students are also introduced to projects that set the stage for leadership opportunities, in which students could implement direct, meaningful, and relevant contributions towards combatting diabetes within their community.

Connections to Health Education Core Idea and Standards
This table provides an overview of the standard topics incorporated into each lesson. Detailed information about the specific outcomes and codes addressed in each lesson can be found on the first page of that lesson.

Washington State Health Core Ideas and Topics	Lesson One	Lesson Two	Lesson Three	Lesson Four	Lesson Five	Assess-ment
Nutrition						
1. Food Groups and Nutrients		●	●	●	●	
2. Beverages	●			●	●	
3. Label Literacy				●	●	
4. Caloric Intake and Expenditure				●	●	●
5. Disease Prevention	●	●	●		●	
6. Nutritional Planning				●		●
Wellness						
1. Dimensions of Health	●	●			●	●
2. Disease Prevention	●	●	●	●	●	●
3. Analyzing Influences	●	●	●			●
4. Access Valid Information		●		●	●	
5. Communication	●		●			●
6. Decision-Making			●	●	●	●
7. Goal-Setting	●	●			●	●

National Health Standards	Lesson One	Lesson Two	Lesson Three	Lesson Four	Lesson Five	Assess-ment
Standard 1: Students will comprehend concepts related to health promotion and disease prevention to enhance health.	●	●	●	●	●	●
Standard 2: Students will analyze the influence of family, peers, culture, media, technology, and other factors on health behaviors.	●	●		●	●	●
Standard 3: Students will demonstrate the ability to access valid information and products and services to enhance health.				●	●	
Standard 4: Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.	●		●			●
Standard 5: Students will demonstrate the ability to use decision-making skills to enhance health.	●	●		●	●	●
Standard 6: Students will demonstrate the ability to use goal-setting skills to enhance health.	●	●				●
Standard 7: Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.	●		●	●	●	●
Standard 8: Students will demonstrate the ability to advocate for personal, family, and community health.		●				●

Lesson	Description	Activities
Lesson 1 Genes and Environment	Students explore unit themes through a Silent Chalk Talk conversation. Students then see how diabetes and obesity have increased dramatically in the United States over the last two decades by watching a slide set from the Center for Disease Control. Students consider how the environment has changed during this time.	• Silent Chalk Talk • CDC slide set illustrating the dramatic increase in t2d • *The Bigger Picture* video • SMART goal creation
Lesson 2 Our Environment: Access and Choice	Students learn how type 2 diabetes is influenced by our environments and assess their own environmental risk factors for type 2 diabetes. Students learn how the change in environment for one population has impacted their health over time.	• Pencil/paper risk tally to determine environmental risks • *Diabetes Among Native Americans* video clip
Lesson 3 Glucose: From Fuel to Toxin	Students model glucose as the building block of most carbohydrates and learn how blood glucose balance is maintained (or not) when type 2 diabetes develops. Students then create analogies to explain the roles of glucose, insulin, and the pancreas.	• Paper cut-out model of carbohydrates, fiber, glucose • Blood glucose traffic analogy • Student-made analogies
Lesson 4 What Are We Eating?	Students examine food and drink labels and calculate the percentage of proteins, fats, and carbohydrates contained in different foods and drinks, and visually illustrate liquid sugars in a beverage. Students consider changes in diet over time and figure out how different types of food impact blood glucose levels.	• Food label calculations to determine calories from fat, carbohydrates, and protein • Visual demonstration of sugar in drinks
Lesson 5 An Ounce of Prevention	Students learn ways in which exercise can aid in treating and preventing type 2 diabetes and determine durations of physical activity required for balancing calories consumed and calories burned.	• Fun size candy bar demonstration • Use of Activity Calculator
Assessment	Students make final contributions to the Chalk Talk posters, identify themes for the unit, and assess the SMART goals they set for themselves. Lastly, students consider how they might make a meaningful contribution to the prevention of type 2 diabetes.	• Silent Chalk Talk final visit and debrief • SMART goal assessment

What is diabetes? Diabetes is a group of diseases marked by high levels of blood glucose resulting from defects in insulin production, insulin action, or both. Diabetes can lead to serious complications and premature death, but people with diabetes, working together with their support network and their health care providers, can take steps to control the disease and lower the risk of complications.

Type 1 diabetes Type 1 diabetes was previously called insulin-dependent diabetes mellitus (IDDM) or juvenile-onset diabetes. Type 1 diabetes develops when the body's immune system destroys pancreatic beta cells, the only cells in the body that make the hormone insulin that regulates blood glucose. To survive, people with type 1 diabetes must have insulin delivered by injection or a pump. This form of diabetes usually strikes children and young adults, although disease onset can occur at any age. In adults, type 1 diabetes accounts for approximately 5% of all diagnosed cases of diabetes. Risk factors for type 1 diabetes may be autoimmune, genetic, or environmental. There is no known way to prevent type 1 diabetes.

Type 2 diabetes Type 2 diabetes was previously called non–insulin-dependent diabetes mellitus (NIDDM) or adult-onset diabetes. In adults, type 2 diabetes accounts for about 90% to 95% of all diagnosed cases of diabetes. It usually begins as insulin resistance, a disorder in which the cells do not use insulin properly. As the need for insulin rises, the pancreas gradually loses its ability to produce it. Type 2 diabetes is associated with older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity. African Americans, Hispanic/Latino Americans, American Indians, and some Asian Americans and Native Hawaiians or Other Pacific Islanders are at particularly high risk for type 2 diabetes and its complications. Type 2 diabetes in children and adolescents, although still rare, is being diagnosed more frequently among American Indians, African Americans, Hispanic/Latino Americans, and Asians/Pacific Islanders.

Gestational Diabetes This is a form of glucose intolerance diagnosed during pregnancy. Gestational diabetes occurs more frequently among African Americans, Hispanic/Latino Americans, and American Indians. It is also more common among obese women and women with a family history of diabetes. During pregnancy, gestational diabetes requires treatment to optimize maternal blood glucose levels to lessen the risk of complications in the infant.

Other types Other types of diabetes result from specific genetic conditions (such as maturity-onset diabetes of youth), surgery, medications, infections, pancreatic disease, and other illnesses. Such types of diabetes account for 1% to 5% of all diagnosed cases.

Lesson 1

Genes and the Environment

Time: 50 min

Lesson Objectives:
Students will be able to answer:

- Why is type 2 diabetes an important public health focus in the U.S.?
- Are most traits determined by genetic factors, environmental factors, or both?

Overview

Students are introduced to the themes explored in the unit through a Silent Chalk Talk conversation in which they share their initial thoughts about factors that contribute to type 2 diabetes. Students then watch a CDC slide presentation that shows how the prevalence of both diabetes and obesity have increased dramatically in the United States between 1994 and 2015. Students ask questions about the phenomenon and develop an expanded understanding of what is considered an environmental factor for diseases like diabetes.

Enduring Understandings

Most traits are determined by a combination of genetic and environmental factors, including complex diseases like type 2 diabetes.

Type 2 diabetes is a complex condition that is heavily influenced by environmental factors such as access to resources, personal choice, product marketing, public policy, socio-economic status, and stress.

Essential Question:

How do genetics and environment play a role in our health?

Lesson Summary with Timings

Chalk Talk and Introduction to the unit	15 min
Diabetes and Obesity over Time CDC PowerPoint	15 min
Discussion: Genes or Environment?	10 min
Video: Lost in translation	10 min
Homework: Family tree of eating habits	

Washington State Health and Physical Education Standards (based on National Standards)

Through this lesson, students will gain competency in the following topics and outcomes:

Nutrition

5. **Disease Prevention:** Analyze and describe the relationship between nutritional choices, physical activity, and chronic diseases. H1. N5.HS

Wellness

1. **Dimensions of Health:** Analyze personal dimensions of health and design a plan to balance health. H1.W1.HS
2. **Disease Prevention:** Analyze prevention, lifestyle factors, and treatment of communicable and non-communicable diseases. H2.W2.HSa

   Assess personal risk factors and predict future health status. H2.W2.HSb
3. **Analyzing Influences**: Analyze how a variety of factors impact personal and community health. H2.W3.HS
4. **Communication:** Demonstrate strategies to prevent, manage or resolve interpersonal conflicts without harming self or others. H4.W5.HS

Materials

Materials	Quantity
PowerPoint slide set for the unit, found at http://gsoutreach.gs.washington.edu	
Video clip *Lost in Translation* from TheBiggerPictureProject.org https://youtu.be/VrpR1LlF8Rs	
Chalk Talk poster instructions	1 per class
Chalk Talk Rules of Participation	1 per class
Large pieces of butcher paper or easel pad paper for Chalk Talk	6 per class
Colored markers for writing on Chalk Talk posters (3 x 6 posters)	18
Diabetes Fact Sheet	1 per student
Student Sheet 1: *Family Tree of Eating Habits*	1 per student
Looking ahead: Lesson 4 requires having a selection of food and beverage labels with nutritional information on hand for students to use. Ask students to bring in food labels from home or provide the labels for them.	

Lesson Preparation

- Familiarize yourself with the different types of diabetes. A one-page background information sheet can be found in the Overview section.
- Create the Chalk Talk Posters as instructed and place three markers by each poster. If possible, use only one color marker per poster.
- Make sure that the PowerPoint presentation, including slides showing the phenomenon of *Diagnosed Diabetes in US Adults-1994-2015* is ready to be projected to the class.
- Make the *Diabetes Fact Sheet* available to students, either electronically or by photocopying it.
- Make two-sided copies of Student Sheet 1: *Family Tree of Eating Habits* for homework.

Procedure

Part I (Engage) Priming the Pump with Silent Chalk Talk (15 min)

Chalk Talk Background: In the formative assessment Silent Chalk Talk, students explore and share their thoughts and ideas about how both genes and the environment influence type 2 diabetes by silently responding in writing to statements, questions and pictures posted on the classroom walls. The goal for this written (silent) conversation is that all students are given an equal voice, remarks are as anonymous as possible, and students feel safe to express their thoughts and feelings. Through the posters, students will get a sense of the breadth of topics about diabetes this curriculum will address. The posters should remain up around the room for the duration of the unit if possible. Students will get a chance to add to the posters at the end of the unit, allowing for an evolution of thought.

Create the posters from the Teacher Resource--Silent Chalk Talk Posters using large blocks of butcher paper or easel pads. Be sure to leave enough space for students to add their comments. If possible, use one color of marker per poster for each day. By

doing so, student comments will be more anonymous and different colors will show whether a comment was written early in the unit or later in the unit.

Instructions:

1. Tell students that the class is beginning a unit that explores how both genes and the environment influence our health, and the focus of the unit will be on type 2 diabetes.
2. Show students the six posters placed around the room. Each explores a different aspect of type 2 diabetes, including social factors that contribute to the condition.
3. Before letting the students respond, read through each poster with students and ask for clarifying questions. Refrain from offering your own opinion or give any information that may change students' responses. Merely ensure that they understand what the questions or statement is addressing. It is important to leave this as vague as possible to allow for students to identify their own starting assumptions or misunderstanding and to allow for evolution of thought throughout the lessons.
4. Post and review rules of participation in a silent chalk talk from Teacher Resource -- Silent Chalk Talk Rules of Participation, shown in Slide 2. (Slide 1 lists the Enduring Understanding for the unit and can be shown if desired.)

Slide 2

5. Give students 10 minutes to contribute to each poster at least once, either by responding to the primary comment on the poster, or responding to other students' comments.
6. Explain to students that they will be using these posters again to continue the conversation.
7. Don't go over any answers or debrief comments on the posters at this time.
8. Create or review discussion norms, as described below.

Communication Norms: Point out for students that discussions about health and type 2 diabetes will involve issues of individual choice, family culture, socio-economic status, physical characteristics including obesity, and other potentially sensitive topics. It is therefore especially important to work together to foster a safe classroom atmosphere. If you have already created discussion ground rules ("norms") please review and discuss them as a class. If not, an agreed-upon set of norms should be in place before beginning the unit. To create discussion norms, ask students what strategies they can use to make the classroom a comfortable space for discussion and to prevent or resolve conflicts. In addition to being respectful, listening actively, monitoring one's own airtime and other general discussion norms, some norms around this particular topic could include:

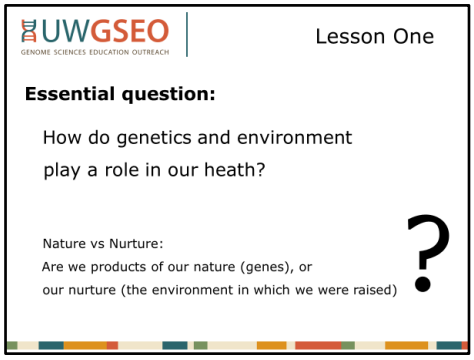
- Honor other people's experiences without judgement.
- An individual's experience is not representative of their entire culture.
- Be sensitive to others sharing personal and family health-related issues.
- Focus on your own health, not the health of others.
- If conflicts arise in a discussion, they must be resolved in a way that maintains everyone's dignity.
- No blaming, finger-pointing, or calling out another person or group.

Note: Chalk Talk is a discussion strategy to allow students an anonymous, equal voice. Communication norms should also apply to the Chalk Talk posters.

Part II (Explain): Unit Introduction (10 min)

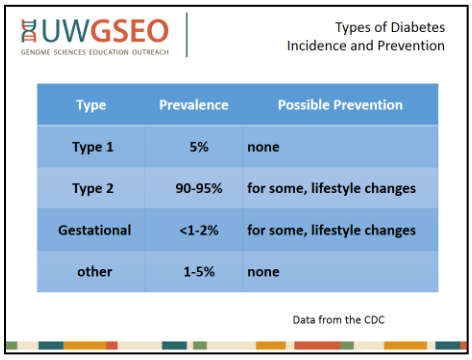
9. After completing Silent Chalk Talk as a formative assessment, show students the next slide which contains the Essential Question for this lesson.

Slide 3



10. Tell students that the answer to the essential question is complex, and we will be using type 2 diabetes as a disease model to help us answer this question throughout the unit. The Chalk Talk posters give students an indication of the complexity of the topic.
11. There are different types of diabetes, with different rates and possible preventions, as shown on the next slide.

Slide 4



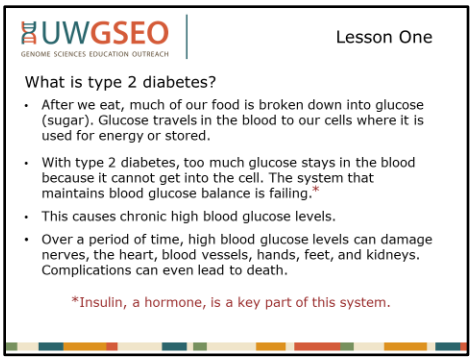
Type 1 diabetes has a strong genetic determination and cannot be prevented. A healthy lifestyle in combination with medical treatment is important to prevent or delay complications.

12. Let students quickly share what they may know about type 1 and type 2 diabetes, gestational diabetes and the other more general category.

13. Ask students why they think this unit is focused on type 2 diabetes. They should point out that type 2 diabetes has the highest prevalence and is preventable for most people, so a focus on t2d has the potential to impact many people.

14. Refer to the next slide for a definition of type 2 diabetes, which will be unpacked over the next week. Tell students that type 2 diabetes is the result of chronic high blood glucose levels and can develop over time as the systems that maintain blood glucose levels fail. If left untreated, it has devastating effects on many organs and systems of the body, including the nervous and circulatory systems, as well as the eyes, hands and feet, heart, and kidneys. Type 2 diabetes can even lead to death.

Slide 5

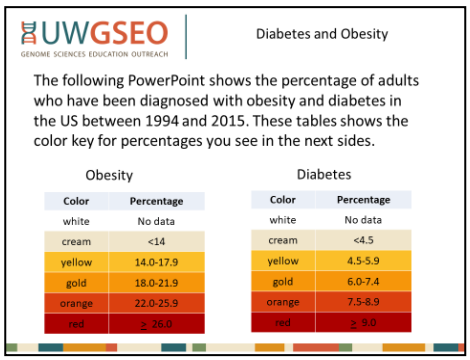


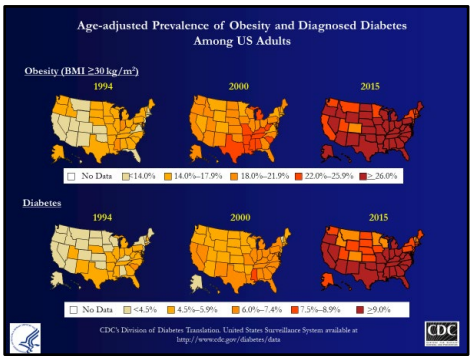
This definition is to orient students to the topic of type 2 diabetes, not as a memorization challenge. Students will be unpacking this during the unit.

Part II (Engage): The Phenomenon of Diabetes (PPT Presentation, 20 min)

15. Show the slides 6 through 30 which map the prevalence of both diabetes and obesity in the United States from 1994-2015. The maps are color coded to indicate the percent prevalence state by state and year by year.

Slide 6 through Slide 29





Age-Adjusted means that different populations (i.e. states) have been weighted to mirror the same age distributes as found in the US census data. This is done so that populations with younger or older members can be compared directly with each other.

Prevalence is the total number of people with diabetes at a certain time, divided by the population at risk.

16. Show the PowerPoint at least two times (by restarting at Slide 7) so that students can absorb the information.

17. Ask the class to write down questions that come up for them as they watch the slide show, either in their notebooks or on sticky notes. The next slide, a summary slide, can be shown while students write questions.

18. Ask students to share questions about the slide set. If time allows, collect the questions and place them in a central area, broadly categorizing the questions as they are posted. For example, questions might fall in the following categories:
    a. Physiology—What causes type 2 diabetes? What does it do to the body? What are the symptoms? What is the link between obesity and diabetes?
    b. Geography—Why are some regions impacted more than others?
    c. Treatments and solutions: Are there treatments? Cures?
    d. Social Factors—What is going on in society to drive the growth? Does advertising and food marketing make a difference?

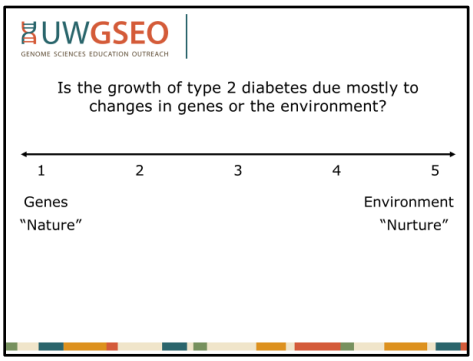
Point out for students that the Center for Disease Control (CDC) is a *.gov* website supported by tax-payer funds, ***not*** a commercial website. It is a source of valid and reliable information.

19. Tell students that both obesity and diabetes are represented on the slides because obesity is a risk factor for type 2 diabetes. As a person gains fat, especially around the middle, they become less able to regulate blood glucose levels. Though there are many connections between obesity and type 2 diabetes, we are focusing on diabetes in this unit.

Part III Explore/Explain Genes or Environment? 20 minutes

20. Show students the next slide. Tell students that humans have been debating the "nature vs nurture" question for years. Ask students, *"Are we products of our nature (genes) or nurture (how we are raised in our environment)?"* and have students hold up 1 – 5 fingers to express their answer. Ask about *height*. Most people understand the genetic elements (short parents tend to have short offspring) yet any visit to a house built before the 1800s shows that humans are growing taller over time due to better nutrition and medical care, which are environmental factors. Height is controlled by both genetic and environmental factors and would land near the middle of the continuum.

Slide 30



The term "environment" will be used quite broadly and encompasses both the physical environment (*How close do you live to a grocery store?*) and the emotional/social environment (*What do you buy at the store, and what influences those choices?*).

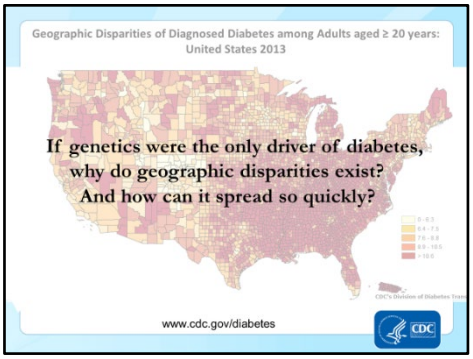
21. Tell students that there are certainly some health conditions that are strongly linked to changes in genes, such as Huntington's Disease or Cystic Fibrosis. Other health conditions are strongly linked to exposures in the environment, such as getting the flu.

22. As students the questions on the slide: *Is the growth of type 2 diabetes due mostly to changes in genes or the environment?* and elicit answers.

23. Tell students that **most common conditions, including type 2 diabetes, result from a complex interplay between genes and environment.** As with many traits, type 2 diabetes is due to variations in ***many genes***. Each gene variant may make a relatively small contribution to the total risk (or benefit) for that condition. All the associated genes taken together may give a person a higher or lower genetic risk for that condition. There are **over 150 gene variants** that have been associated with type 2 diabetes. However, none of them individually correspond a very high risk.

24. Another way to tease out genetic and environmental impacts is to consider geography. Show students the next slide, which shows the impact of type 2 diabetes at the county level. Let students discuss the slide before animating it.

Slide 31



25. Ask students if the speed at which diabetes (and obesity) have spread across the US points to genetic or environmental factors. *Answer: Environmental factors. 20 years is not a long enough time period for traits to be passed on through generations. Even if some people are genetically predisposed to becoming diabetic,*

it has been primarily the change in environmental and lifestyle factors that impact obesity and diabetes in the last two decades.

26. Local connection to diabetes from your own county and neighboring counties can be found here: https://www.cdc.gov/diabetes/data/county.html. Students can explore this as a class, in small groups, or individually as time permits.

Part III **Video: Lost in Translation** **20 min**

27. Tell students that teasing apart the genetic and environmental components of health is especially difficult because **both genes and culture get passed on through families.**
28. Ask students to think about ways that their family or friends share gestures of affection through food. What kinds of foods are offered in those gestures?
29. Watch the video #10 *Lost in Translation* produced by TheBiggerPictureProject.org and found here: https://www.youtube.com/watch?v=VrpR1LlF8Rs

Slide 32

Other videos by The Bigger Picture suggested by field test teachers include:

Monster
Hear No
Perfect Soldiers
The Longest Mile

All can be found here: https://www.youtube.com/playlist?list=PLGWDDcCZS9wIkeYh7AfJTydLaSVgi9vYo

Closure

30. Give students the *Type 2 Diabetes Fact Sheet* for their notebooks, or make it available to them electronically
31. Revisit the Essential Question posed on Slide 3. The take-home messages are:
    - Both genes and the environment play a role for most of our traits
    - With many complex conditions, including type 2 diabetes, *hundreds* of genes and *hundreds* of environmental factors might influence each other to determine a person's health status. This is what adds to the complexity.
    - Certain risk factors, such as obesity, play a large role in type 2 diabetes
    - The speed at which diabetes is spreading across the U.S. points to changes in the environment, not genetics.

Homework

Please assign Student Sheet 1: *Family Tree of Eating Habits* as homework or give students time in class to complete their family tree (actual or fictional). This worksheet will be revisited in Lesson 4.

Extensions

The Bigger Picture organization offers a treasure trove of videos. Have students watch different videos and choose a favorite to share with a group tomorrow.

Create an avatar (HeroForge.com) - choose a strength and a weakness for your avatar, and come up with a plan to implement strategies to achieve a personal health goal.

If students/teachers are interested in achieving a personal health goal, there are a lot of free **food tracker apps** available:

YouAte: Students take pictures of what they eat during the day. No focus on calories per se, but a photo journal of intake. (Free; iTunes)

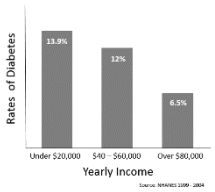
GoMeals tracks food and activity levels, whether eating at home or at a restaurant. There's also a section specifically for keeping track of your blood glucose levels.

MyPlate: Search the database of over 625,000 foods and 1,500 fitness items to track daily caloric intake and burn. Students can track calories over time, write in online food diaries, watch a live food tracking app for users all over the country, and get calorie and exercise breakdowns. (Free; iTunes)

(more found here: http://www.redbookmag.com/body/healthy-eating/advice/g614/lose-weight-apps-tools/?slide=14)

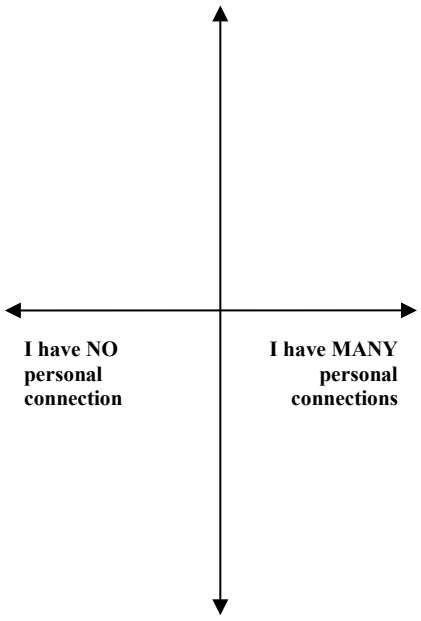
Silent Chalk Talk Posters

Re-create these posters on large pieces of butcher paper or sticky notes. If possible, provide a different color marker each day students respond to the prompts.

<table>
<tr>
<td>What are some roadblocks to good health for you?</td>
<td>What causes type 2 diabetes?</td>
<td>What does this graph mean to you?
 

(See teacher resource for copy master)</td>
</tr>
<tr>
<td>How do diet and/or exercise help prevent or control type 2 diabetes?</td>
<td>Respond to this quote:

“As a culture, we’ve become upset by the tobacco companies advertising to children, but we sit idly by while the food companies do the very same thing. And we could make a claim that the toll taken on the public health by a poor diet rivals that taken by tobacco.”

(See teacher resource for copy master)</td>
<td>I know A LOT about type 2 diabetes
 

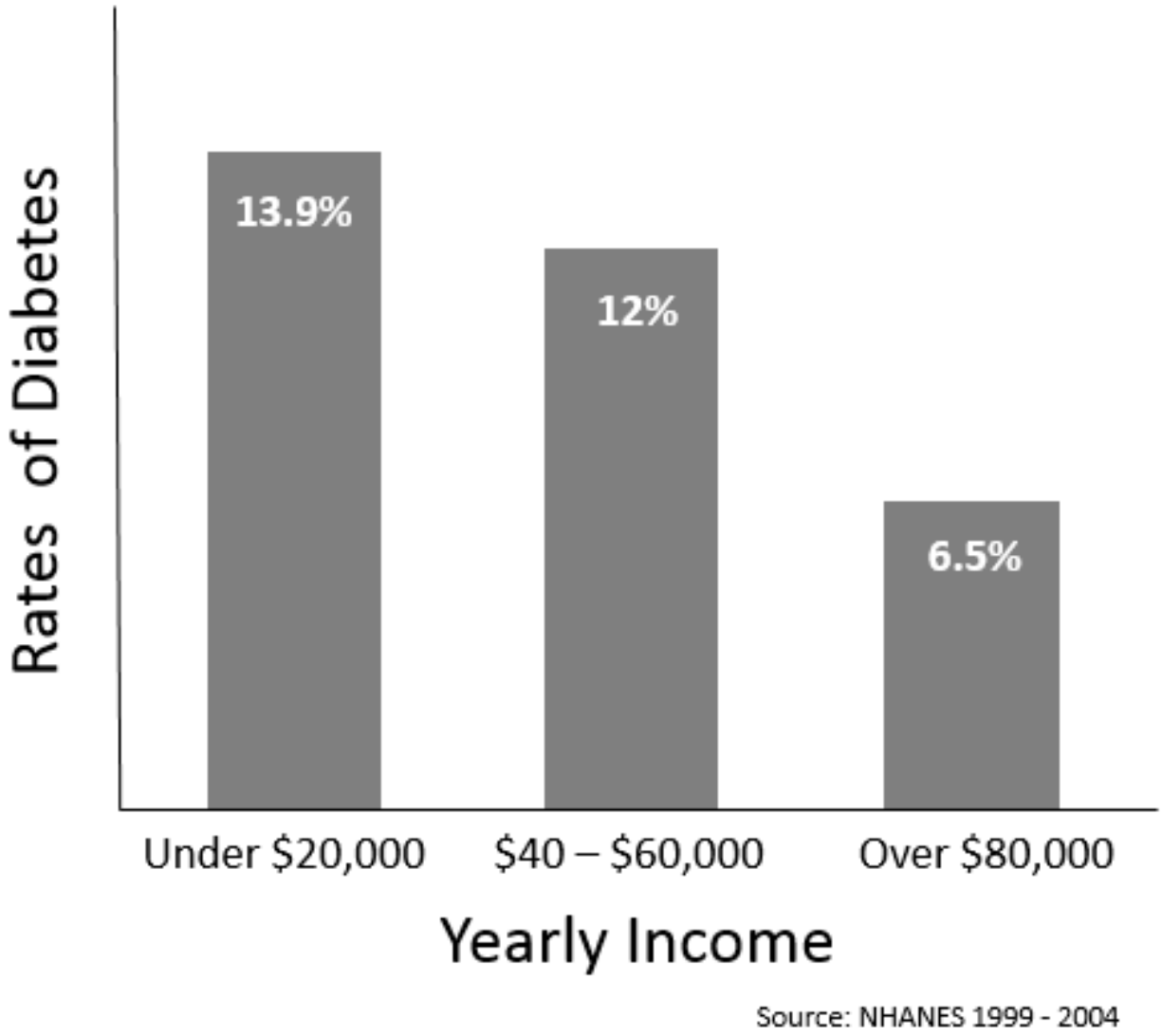
I know LITTLE about type 2 diabetes</td>
</tr>
</table>

(Have students plot their own position/knowledge point using a different class color each day.)

Silent Chalk Talk Rules of Participation

1. Respond to the main comment anywhere on the poster.
2. Respond to others by drawing an arrow from their comment to yours.
3. If you agree with a comment, add an ! or ★ .
4. If you disagree with something, politely explain why.
5. Do not cross out or write over anyone else's comments.
6. Pictures are permissible, just keep them appropriate.
7. Keep all responses respectful.
8. No talking.

Instructions: Print the following two pages and attach them to the Chalk Talk posters.



"As a culture, we've become upset by the tobacco companies advertising to children, but we sit idly by while the food companies do the very same thing. And we could make a claim that the toll taken on the public health by a poor diet rivals that taken by tobacco."

Kelly Brownell, Professor of Psychology and Public Health, Yale University

Name_____ **Date**_____ **Period**_____

Track your family's eating habits. Start with your generation, and include 5-7 foods or drinks you often have. What about prior generations? For each generation, include a typical meal and beverage that they would have eaten when they were growing up. If you need to, ask a parent or grandparent.

You and your siblings	
You live in a: rural area __ town or city __ In what country? Meals are mostly: cooked at home from scratch __ prepared at a grocery/store __ from a restaurant __ Your usual activity level: not very active __ moderately active __ very active __	
What are the most common foods you eat for breakfast, lunch, dinner, and snacks?	What are the most common drinks you have for breakfast, lunch, dinner, and snacks?
	What are some special treat foods, and how often do you have them?
Your parents and their siblings growing up	
They lived in a: rural area __ town or city __ In what country? Meals were mostly: cooked at home from scratch __ prepared at a grocery/store __ from a restaurant __ Their usual activity level: not very active __ moderately active __ very active __	
What were the most common foods they ate?	What were the most common drinks they drank?
	What were some special treat foods, and how often did they have them?
Your grandparents and their siblings growing up	
They lived in a: rural area __ town or city __ In what country? Meals were mostly: cooked at home from scratch __ prepared at a grocery/store __ from a restaurant __ Their usual activity level: not very active __ moderately active __ very active __	
What were the most common foods they ate?	What were the most common drinks they drank?
	What were some special treat foods, and how often did they have them?

After filling out the other side:

1. Mark any changes in diet between generations with a ☆
   What happened to your family's journey that affected that? (Did someone move? Change jobs?)

2. Circle the place on the family tree when you think eating habits were healthiest.
   Did it change over time? What factors were involved in that change?

3. Optional: Highlight anybody on the tree who has been diagnosed with type 2 diabetes.
   How were they effected by this? How did they treat/manage their condition?

4. Think about yourself 30 years from now and your future eating habits. Think about any eating habits you wish to pass on to your children or other relatives in the next generation. Create one SMART goal that you could implement now that would impact your future self. *You will return to this goal at the end of this unit.*

Specific: What is the goal?	
Measurable: How will you measure your progress?	
Attainable: Can you make this come true?	
Realistic: Are you willing and able to do this?	
Timely: By when will you accomplish this goal?	

Fact Sheet

What is type 2 diabetes (t2d)?

It is a chronic disease that results when excess glucose (blood sugar) stays in the blood stream because the body is not able to let glucose into the cells to be used as energy. The pancreas makes a hormone called insulin which acts like a key to let the glucose into the body's cell. Type 2 diabetes happens when the body either does not produce enough insulin or cells no longer respond to insulin. Glucose is the primary energy molecule of the body, and it is formed through the breakdown of the sugars and starches we eat. When glucose builds up in the blood, several complications associated with type 2 diabetes can occur, including damage to the heart and blood vessels, nerve damage, glaucoma (damage to the eye), and kidney disease. Poor circulation and nerve damage cause damage to the feet, including infections that can require amputation.

What are the symptoms of t2d?

Symptoms include thirst and increased urination, hunger, fatigue, weight loss, blurred vision, and slow-healing sores.

What are the causes/risk factors for t2d?

Type 2 diabetes is caused by the body's inability to make insulin or to respond to it. Factors that increase risk for developing it include being overweight, having body fat distributed primarily in the abdomen rather than the hips and thighs, age, family history, having pre-diabetes (increased blood sugar that is greater than normal but not at the level of diabetes), and having gestational diabetes (developing diabetes during pregnancy).

How is it treated?

Treatment can include monitoring blood sugar daily, losing weight, eating a healthy diet, getting daily exercise, and sometimes taking drugs and/or insulin.

Can type 2 diabetes be prevented?

Prevention measures include eating a healthy diet, getting plenty of exercise, and losing weight if overweight.

Source: https://www.cdc.gov/diabetes/basics/diabetes.html.

Lesson 2 | Our Environment: Access and Choice

Time: 50 min

Lesson Objectives:
Students will be able to answer:

- What are two things associated with an *increased* risk for type 2 diabetes?
- What are two things associated with a *decreased* risk for type 2 diabetes?

Overview

Students assess their own environmental factors for type 2 diabetes and consider how these factors interact to reduce or increase risk. Students consider how access to resources and personal choice may increase or decrease risk factors over time. Lastly, students interpret data that shows the impacts of a change in environment for a group of people.

Enduring Understandings

Type 2 diabetes is a growing concern and occurs frequently in our communities.

Blood glucose levels are regulated to stay within a healthy range. Type 2 diabetes is the result of chronic high blood glucose levels and can develop over time as regulation of blood glucose levels fail.

Type 2 diabetes is a complex condition that is heavily influenced by environmental factors such as access to resources, personal choice, product marketing, public policy, socio-economic status, and stress.

Essential Question:

What evidence shows that a person's environment plays a role in developing type 2 diabetes?

Lesson Summary with timings

Assessing Environmental Access and Choice	30 min
Data Drop: Environmental Influences on the Pima	20 min

Washington State Health and Physical Education Standards (based on National Standards)

Through this lesson, students will gain competency in the following topics and outcomes:

Nutrition

1. **Food Groups and Nutrients**: Predict impact of consuming adequate or inadequate amounts of nutrients. H1.N1.HS

5. **Disease Prevention**: Analyze and describe the relationship between nutritional choices, physical activity, and chronic diseases. H1. N5.HS

Wellness

1. **Dimensions of Health**: Analyze personal dimensions of health and design a plan to balance health. H1.W1.HS

2. **Disease Prevention:** Analyze prevention, lifestyle factors, and treatment of communicable and non-communicable diseases. H2.W2.HSa

   Assess personal risk factors and predict future health status. H2.W2.HSb

3. **Analyzing Influences**: Analyze how a variety of factors impact personal and community health. H2.W3.HS

4. **Access Valid Information**
   Create a resource that outlines where and how students can access valid and reliable health information, products, and services. H3.W4.HS

Materials

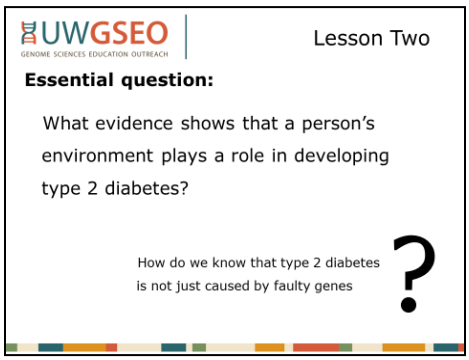
Materials	Quantity
PowerPoint slide set for the unit, found at http://gsoutreach.gs.washington.edu	
Video clip Diabetes among Native Americans – Genes or Environment? from the film Unnatural Causes found at: https://www.youtube.com/watch?v=SfPdhhXcGRQ	1 per class
Student Sheet 2: *Environmental Influences and Options*	1 per student
Optional: The entire documentary ***Unnatural Causes*** from California Newsreel is recommended and can be found here: http://www.unnaturalcauses.org/	1 per class

Procedure

Part I **Assessing Environmental Access and Choice** **(40 min)**

1. Show students the next slide with the Essential Question for the lesson. Answering the question could be an entrance activity for students, if desired.

Slide 33

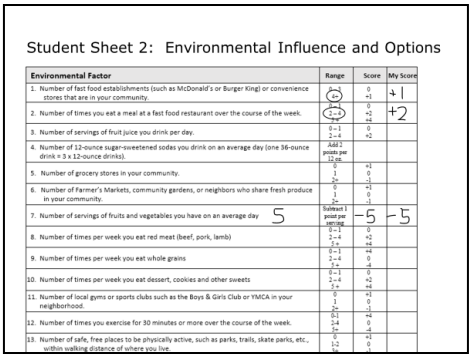


2. Tell students that they will be assessing their environmental risks for acquiring type 2 diabetes. If students don't feel comfortable assessing their own environmental risks, they may choose a fictional representative character to assess.

3. Tell students that a ***factor*** (genetic *or* environmental) can be positive or negative. A positive factor is considered ***protective***, and a negative factor is considered a ***risk***.

4. Pass out Student Sheet 2.1: *Environmental Influences and Options* for students to fill out. It may be useful to go over some factors as a class using the next slide to make sure students understand how to score themselves. Allow students to tally their scores and answer the questions.

Slide 34



Student Sheet 2: Environmental Influence and Options

Environmental Factor	Range	Score	My Score
1. Number of fast food establishments (such as McDonald's or Burger King) or convenience stores that are in your community.	0 1 2+	0 +1 +2	+1
2. Number of times you eat a meal at a fast food restaurant over the course of the week.	0 1–4 5+	0 +2 +4	+2
3. Number of servings of fruit juice you drink per day.	0 – 1 2 – 4 5+	0 +2 +4	
4. Number of 12-ounce sugar-sweetened sodas you drink on an average day (one 36-ounce drink = 3 x 12-ounce drinks).	Add 2 points per 12 oz.		
5. Number of grocery stores in your community.	0 1 2+	+1 0 -1	
6. Number of Farmer's Markets, community gardens, or neighbors who share fresh produce in your community.	0 1 2+	+1 0 -1	
7. Number of servings of fruits and vegetables you have on an average day. 5	Subtract 1 point per serving	-5	-5
8. Number of times per week you eat red meat (beef, pork, lamb)	0 – 1 2 – 4 5+	0 +2 +4	
9. Number of times per week you eat whole grains	0 – 1 2 – 4 5+	+4 0 -4	
10. Number of times per week you eat dessert, cookies and other sweets	0 – 1 2 – 4 5+	0 +2 +4	
11. Number of local gyms or sports clubs such as the Boys & Girls Club or YMCA in your neighborhood.	0 1 2+	+1 0 -1	
12. Number of times you exercise for 30 minutes or more over the course of the week.	0-1 2-4 5+	+4 0 -4	
13. Number of safe, free places to be physically active, such as parks, trails, skate parks, etc., within walking distance of where you live.	0 1-2 3+	+1 0 -1	

Note: The term ***risk*** is used here as it is in the field of public health. A person with increased risk for t2d will not automatically develop t2d. Rather, risk is a measure that compares an individual to population data. In other words, a person's risk of developing a disease given x, y, and z, is based on how many other people who have x, y, and z actually get the disease of concern.

5. When students are finished scoring Student Sheet 2, help them determine which environmental factors are issues of *access*, and which are issues of *choice*. For example, students may live in neighborhoods with good parks (providing access to exercise) but choose not to visit the park to walk, run, play Frisbee or otherwise exercise (an issue of choice). Conversely, students may not have access to a gym, but choose to run on a road.

6. Refer to the CDC slide set shown in Lesson 1, and the correlation between obesity and type 2 diabetes. Are there items in the survey that would impact both conditions?

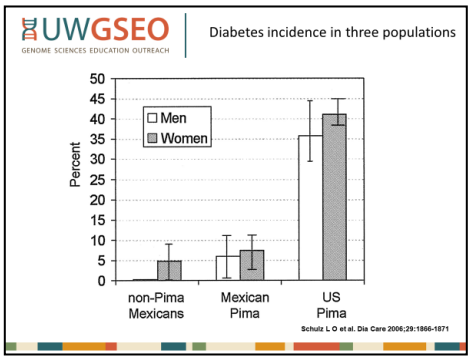
Note: Be sensitive to students who may be uncomfortable about their own body images. It's important to take a view of populations rather than focusing attention on individuals.

7. Be aware that not all the factors on the sheet are easily sorted into *access* or *choice* and be prepared to discuss areas of gray. If lack of time is a contributing factor to not exercising, is that an issue of choice or access? How does age factor into acquiring type 2 diabetes? Are high levels of stress a matter of access or choice?

Part II Data Drop: Environmental Influences on the Pima (30 min)

8. Show students the next slide.

Slide 35



9. The Pima people are a group of Native Americans who have historically lived in southern Arizona, though some have lived across the border in Mexico.

10. Ask students levels of questions about the graph, ideally in a turn-pair-share style. First the literal question: *What does the graph show?* Make sure that students understand the structure of the graph, and what the x and y axes represent.

11. Ask students interpretive questions, such as: *What does the graph mean?* and "*What are some differences in society that may contribute to the data?"*

12. Show students the video linked from the next slide *Diabetes Among Native Americans—Gene or Environment?* found here: https://www.youtube.com/watch?v=SfPdhhXcGRQ

Slide 36

Tell students that within the US, most of the Pima population live in federally-recognized reservations. As rivers that supported their traditional way of life were dammed and the water diverted to non-native farmers, the Pima received supplies from the federal government's commodity food program. The commodities included foods that were higher in fat and calories and lower in fiber than their traditional foods, such as canned meats, soups, and juices; pasta; cereal; rice; cheese; peanut butter; corn syrup; flour; dry, evaporated milk; and vegetable oil. These foods became a mainstay of Pima diets, rather than supplementing their traditional diets. Fry Bread, a flat dough deep fried in lard or oil, is often considered to be a "traditional" Native American food. Fry Bread, however, is not traditional but a testament to the creativity of people who had an excess of white flour and lard provided to them through the commodity food program.

13. Return to the slide showing *Diabetes Incidence in Three Populations* and have students list ways in which a change in the environment contributed to a rise in levels of type 2 diabetes.

Closure

14. As an exit ticket, have students respond to the essential question for this lesson:

What evidence shows that a person's environment plays a role in the development of type 2 diabetes?

Some take-home messages are:

- Changes in environment impact risk for type 2 diabetes. The Pima Indian graph and story provide evidence for this.
- Public policies play an important role in the environment. The zoning of fast food restaurants, the building of sidewalks, the type of food provided through the commodity food program—all these and more impact a person's risk for type 2 diabetes.
- Many environmental factors impact personal choice. A view that type 2 diabetes is caused wholly by an individual's actions does not account for the public policies and structures that shape individual choices.

Extension

Students can access valid information supported by research in the scientific community about each of the environmental factors used in the survey by using the cards at the end of the lesson. Environmental risk cards go into more detail about the factor and provide source information. In addition to the 25 environmental risk cards, 6 cards describing genes that contribute to genetic risk can also be found.

These cards can be used in a variety of ways depending on class time and teacher direction. Some examples include:

- Each student could be asked to provide more research about his or her card, possibly as a homework assignment, using the source information on the card.
- Students could share the information on the card in a round-robin exercise.
- Students could meet in groups of four to share information the cards, and then regroup with new students until students have heard from a range of their peers.

Homework

In Lesson Three, students will complete Student Sheet 3.1 – *Using Analogies for Type 2 Diabetes* while watching a video clip and a Voice Over PowerPoint (VOPPT) that detail the mechanisms of type 2 diabetes. This can be assigned to student as homework before Lesson Three, if desired.

Environmental Influences and Options Student Sheet 2

Directions: Fill in the following table to the best of your ability. You will not be required to share your score unless you choose to. "In your community" means the distance you can walk in 15-20 minutes, or the area you drive through frequently.

Environmental Factor	Range	Score	My Score
1. Number of fast food establishments (such as McDonald's or Burger King) or convenience stores that are in your community.	0 – 3 4+	0 +1	
2. Number of times you eat a meal at a fast food restaurant over the course of the week.	0 – 1 2 – 4 5 +	0 +2 +4	
3. Number of servings of fruit juice you drink per day.	0 – 1 2 – 4	0 +2	
4. Number of 12-ounce sugar-sweetened sodas you drink on an average day (one 36 ounce drink = 3 x 12-ounce drinks).	Add 2 points per 12 oz.		
5. Number of grocery stores in your community.	0 1 2+	+1 0 -1	
6. Number of Farmer's Markets, community gardens, or neighbors who share fresh produce in your community.	0 1 2+	+1 0 -1	
7. Number of servings of fruits and vegetables you have on an average day	Subtract 1 pt per serving		
8. Number of times per week you eat red meat (beef, pork, lamb)	0 – 1 2 – 4 5 +	0 +2 +4	
9. Number of times per week you eat whole grains	0 – 1 2 – 4 5 +	+4 0 -4	
10. Number of times per week you eat dessert, cookies and other sweets	0 – 1 2 – 4 5 +	0 +2 +4	
11. Number of local gyms or sports clubs such as the Boys & Girls Club or YMCA in your neighborhood.	0 1 2+	+1 0 -1	
12. Number of times you exercise for 30 minutes or more over the course of the week.	0-1 2-4 5+	+4 0 -4	
13. Number of safe, free places to be physically active, such as parks, trails, skate parks, etc., within walking distance of where you live.	0 1-2 3+	+1 0 -1	
14. Number of days a week you spend more than 2 hours watching TV.	0-1 2-4 5-7	-2 0 +2	
15. Number of days per week you spend more than 4 hours playing video games or being on a computer or on your smart phone.	0-1 2-4 5-7	-2 0 +2	
16. Are the sidewalks in your neighborhood in good repair and/or do you see other people walking?	Yes No	-1 +1	
17. Are there bike lanes, paved shoulders of roads, or other safe places to ride a bike, near where you live?	Yes No	-1 +1	
18. Number of times you bike or walk to a destination over the course of a week, 1/2 a mile or more.	Subtract 1 point per time		

19. Do you have bus access in your neighborhood or within walking distance of where you live?	Yes No	-2 +1	
20. Number of times you drive to destination less than 2 miles away from your home over the course of a week.	0-5 6+	0 +1	
21. Number of times per day you drink out of an older, hard plastic water bottle that is not BPA-free.	Add 1 point per time		
22. How many hours of sleep do you usually get every night?	Less than 5 5-9 >9	+1 -1 +1	
23. Do you live along a busy road?	Yes No	+1 -1	
24. What is your age?	Up to 45 46-64 65+	0 +2 +4	
25. How are your stress levels, on an average day? (Circle a number) 1 2 3 4 5 Not much Moderate Very stressed	Add the number you circled		

Total your *negative* scores here - plus Total your *positive* scores here + = **Total Environmental Risk Score**

Assessment of Risk Score:

1. Do you consider your environmental risk to be high, low, or average? Why?

2. Compare your score with others in your class. How are your environments the same or different?

3. How could you alter or improve environment risk factors contributing to your risk score?

4. If you found out that your *genetic* risk score was high or low, how would you adjust your behavior in any way?

5. Consider the goals you set for your future self in Lesson One. List three environmental factors that you would considered changing to meet a health goal.

Access and Choice:
Look back at the environmental factors table. Some of the factors are issues of ***access*** (do you have access to many fast food restaurants in your neighborhood?) and some are issues of ***choice*** (how often do you eat at fast food restaurants?). Put a STAR next to the factors that represent a ***choice.***

Lesson Extension Cards

Photocopy the following cards back to back, one set per class. Cards can be cut out along the lines.

Environmental Factor 1

Number of fast food establishments (such as McDonald's or Burger King) or convenience stores that are in your community.

Abby G. Ershow, Sc.D. 2009. Environmental Influences on Development of Type 2 Diabetes and Obesity: Challenges in Personalizing Prevention and Management in Journal of Diabetes Science and Technology, Diabetes Technology Society, 3, 727-734.

Environmental Factor 2

Number of times you eat a meal at a fast food restaurant over the course of the week.

Farah Naja, Hwalla N, Itani L, Salem N, Azar ST, Zeidan MN, 2012. Dietary patterns and odds of Type 2 diabetes in Beirut, Lebanon: a case control study. Nutrition and Metabolism 9: 111-122

Environmental Factor 3

Number of servings of fruit juice you drink per day.

Harvard School of Public Health. The Nutrition Source: Simple Steps to Preventing Diabetes: http://www.hsph.harvard.edu/nutritionsource/preventing-diabetes-full-story/

Environmental Factor 4

Number of 12-ounce sugar-sweetened sodas you drink on an average day (one 36 ounce drink = 3 x 12-ounce drinks).

Harvard School of Public Health. The Nutrition Source: Simple Steps to Preventing Diabetes: http://www.hsph.harvard.edu/nutritionsource/preventing-diabetes-full-story/

Environmental Factor 5

Number of grocery stores in your community.

Curry, Andrew. "Bringing Healthy Fare to Big-City 'Food Deserts.'" Diabetes Forecast. December 2009. http://forecast.diabetes.org/magazine/your-ada/bringing-healthy-fare-big-city-food-deserts

Environmental Factor 6

Number of Farmer's Markets, community gardens, or neighbors who share fresh produce in your community.

Curry, Andrew. "Bringing Healthy Fare to Big-City 'Food Deserts.'" Diabetes Forecast. December 2009. http://forecast.diabetes.org/magazine/your-ada/bringing-healthy-fare-big-city-food-deserts

Environmental Factor 7

Number of servings of fruits and vegetables you have on an average day

Harding, AH, Wareham, NJ, Bingham SA et al (2008) Plasma vitamin C level, fruit and vegetable consumption, and the risk of new-onset type 2 diabetes mellitus: the European prospective investigation of cancer—Norfolk prospective study. Arch Intern Med 168:1493-1499.

Environmental Factor 8

Number of times per week you eat red meat (beef, pork, lamb)

Harvard School of Public Health. The Nutrition Source: Simple Steps to Preventing Diabetes: http://www.hsph.harvard.edu/nutritionsource/preventing-diabetes-full-story/

Lesson Extension Cards

Back of cards

A study from Beirut, Lebanon showed that people with type 2 diabetes are 2.80 times more likely to eat a high fast food diet than people without type 2 diabetes.	A study in Portland, OR showed that an increase in fast food outlets is associated with a 7% increase in being overweight and obese. Li F, Harmer PA, Cardinal BJ, Bosworth M, Acock A, Johnson-Shelton D, Moore JM. Built environment, adiposity, and physical activity in adults aged 50–75. Am J Prev Med. 2008; 35 (1):38–46.
Based on data from several studies, for every 12 oz. serving of a sugary drink per day, diabetes risk increases by 25%. Research on the effects of artificially-sweetened beverages is still unclear about association with t2d, but one large study of men showed that drinking one 12 oz can of diet soda per day does not affect t2d risk.	Drinking 2 or more servings per day of fruit juice is associated with a 31% increase in t2d risk compared to drinking less than 1 serving per month. There is growing evidence that daily drinking of sugary drinks also results in chronic inflammation, high triglycerides, decreased HDL ("good" cholesterol) and increased insulin resistance.
There is a strong correlations between increased rates of type 2 diabetes and people who live in areas without access to affordable, healthy food options within a convenient travelling distance.	A study of Chicago neighborhoods found that people who did not have access to affordable, healthy food options within a convenient travelling distance died from diabetes at twice the rate as people from areas offering access to grocery stores.
Eating red meat (beef, pork, or lamb) or processed red meat daily, even a small serving about the size of a deck of cards, increases diabetes risk by 20%. Replacing red meat with a daily serving of fish, poultry, nuts, or whole grains results in a 35% reduction in diabetes risk.	A 12-year study showed that people with higher levels of vitamin C were less likely to develop diabetes. Vitamin C is a good indicator of fruit and vegetable consumption because fruits and vegetables are the main source of vitamin C in the western diet. Even small amounts of them may be beneficial, and protection against diabetes increases with the amount of fruits and vegetables consumed.

Front of cards

Environmental Factor 9 Number of times per week you eat whole grains. Harvard School of Public Health. The Nutrition Source: Simple Steps to Preventing Diabetes: http://www.hsph.harvard.edu/nutritionsource/preventing-diabetes-full-story/	**Environmental Factor 10** Number of times per week you eat dessert, cookies and other sweets Farah Naja, Hwalla N, Itani L, Salem N, Azar ST, Zeidan MN, 2012. Dietary patterns and odds of Type 2 diabetes in Beirut, Lebanon: a case control study. Nutrition and Metabolism 9: 111-122
Environmental Factor 11 Number of local gyms or sports clubs such as the Boys & Girls Club or YMCA in your neighborhood. Auchincloss AH, Roux, A, Mujahid MS, et al. (2009) Neighborhood resources for physical activity and healthy foods and incidence of type 2 diabetes mellitus: the multi-ethnic study of atherosclerosis. Arch Intern Med. 12(18):1698-1704.	**Environmental Factor 12** Number of times you exercise for 30 minutes or more over the course of the week. Gill JM and Cooper AR. Physical activity and prevention of type 2 diabetes mellitus. Sports Med. 2008; 38(10):807-24. Harvard School of Public Health. The Nutrition Source: Simple Steps to Preventing Diabetes: http://www.hsph.harvard.edu/nutritionsource/preventing-diabetes-full-story/
Environmental Factor 13 Number of safe, free places to be physically active, such as parks, trails, skate parks, etc., within walking distance of where you live. Li F, Harmer PA, Cardinal BJ, Bosworth M, Acock A, Johnson-Shelton D, Moore JM. Built environment, adiposity, and physical activity in adults aged 50–75. Am J Prev Med. 2008; 35 (1):38–46.	**Environmental Factor 14** Number of days a week you spend more than 2 hours watching TV. Harvard School of Public Health. The Nutrition Source: Simple Steps to Preventing Diabetes: http://www.hsph.harvard.edu/nutritionsource/preventing-diabetes-full-story/
Environmental Factor 15 Number of days per week you spend more than 4 hours playing video games, being on a computer or on a phone. Owen N, Healy GN, Matthews CE, Dunstan DW. Too Much Sitting: The population-Health Science of Sedentary Behavior. Exerc Sport Scien Rev. July 2010; 38(3): 105-113.	**Environmental Factor 16** Are the sidewalks in your neighborhood in good repair and/or do you see other people walking? Auchincloss AH, Roux, A, Mujahid MS, et al. (2009) Neighborhood resources for physical activity and healthy foods and incidence of type 2 diabetes mellitus: the multi-ethnic study of atherosclerosis. Arch Intern Med. 12(18):1698-1704.

Back of cards

A study from Beirut, Lebanon showed that people with diabetes are 3.85 times more likely to east a diet high in refined grains and dessert, than people without type 2 diabetes.	In one study of women followed over 18 years, women who ate 3 or more servings of whole grains per day had a 30% lower risk of t2d than those who ate little or no whole grains. Based on several large studies, eating an extra 2 servings of whole grains per day reduces risk by 21%.
Vigorous physical activity is associated with a 20-30% reduction in diabetes risk, and brisk walking for 3.5-5 hours/week can improve risk of not developing type 2 diabetes by 30%. Active muscles involved in physical activity are able to take up increased amounts of glucose. This is balanced by the liver producing more glucose.	A study following people over 5 years found that better neighborhood resources, such as those that offered opportunities to be physically active and access to healthy food, were associated with a 38% lower incidence of type 2 diabetes.
One study found that for every two hours a day spent watching television instead of doing something more active resulted in a 20% increase in diabetes risk.	A Portland, OR study found that a mix of more street intersections interspersed with green spaces and parks was associated with more neighborhood walking. A 10% increase in land-use mix resulted in a 25% reduction in the prevalence of people being overweight and obese, which affects type 2 diabetes.
A study following people over 5 years found that better neighborhood resources, such as those that offered opportunities to be physically active and access to healthy food, were associated with a 38% lower incidence of type 2 diabetes.	One study found that the more time a person sits per day correlates to higher levels of blood glucose and fasting glucose, even in active adults. This study coined the term “Active Couch Potato” to describe adults who got enough physical activity to meet healthy guidelines, but still sat for long periods of time each day

Front of cards

Environmental Factor 17 Are there bike lanes, paved shoulders of roads, or other safe places to ride a bike, near where you live? Auchincloss AH, Roux, A, Mujahid MS, et al. (2009) Neighborhood resources for physical activity and healthy foods and incidence of type 2 diabetes mellitus: the multi-ethnic study of atherosclerosis. Arch Intern Med. 12(18):1698-1704.	**Environmental Factor 18** Number of times you bike or walk to a destination over the course of a week, 1/2 a mile or more. Gill JM and Cooper AR. Physical activity and prevention of type 2 diabetes mellitus. Sports Med. 2008; 38(10):807-24.
Environmental Factor 19 Do you have bus access in your neighborhood or within walking distance of where you live? Li F, Harmer PA, Cardinal BJ, Bosworth M, Acock A, Johnson-Shelton D, Moore JM. Built environment, adiposity, and physical activity in adults aged 50–75. Am J Prev Med. 2008; 35 (1):38–46.	**Environmental Factor 20** Number of times you drive to a destination less than 2 miles away from your home over the course of a week. Gill JM and Cooper AR. Physical activity and prevention of type 2 diabetes mellitus. Sports Med. 2008; 38(10):807-24.
Environmental Factor 21 Number of times per day you drink out of an older, hard plastic water bottle that is *not* BPA-free. Alonso-Magdalena P, Morimoto S, Ripoll C , Fuentes E, Nadal A. Effect of Bisphenol A Disrupts Pancreatic B-Cell Function *In Vivo* and Induces Insulin Resistance. Environmental Health Perspectives. 2006; 114(1):106-112.	**Environmental Factor 22** How many hours of sleep do you usually get every night? Gangwisch JE, Heymsfield SB, Boden-Albala B, Buijs RM, Kreier F, Pickering TG, Rundle AG, Zammit GK, Malaspina D. Sleep duration as a risk factor for diabetes incidence in a large US sample. Sleep. 2007; 30(12):1667–1673.
Environmental Factor 23 Do you live along a busy road? Ursula Krämer, Christian Herder, Dorothea Sugiri, Klaus Strassburger, Tamara Schikowski, Ulrich Ranft, Wolfgang Rathmann, 2010. Traffic-Related Air Pollution and Incident Type 2 Diabetes: Results from the SALIA Cohort Study. Environ Health Perspect 118:1273-1279 (2010).	**Environmental Factor 24** What is your age? http://www.diabetes.org/diabetes-basics/statistics/

Lesson Extension Cards

Back of cards

Vigorous physical activity is associated with a 20-30% reduction in diabetes risk, and brisk walking for 3.5-5 hours/week can improve risk of not developing type 2 diabetes by 30%. Active muscles involved in physical activity are able to take up increased amounts of glucose. This is balanced by the liver producing more glucose.	A study following people over 5 years found that better neighborhood resources, such as those that offered opportunities to be physically active and access to healthy food, were associated with a 38% lower incidence of type 2 diabetes.
Vigorous physical activity is associated with a 20-30% reduction in diabetes risk, and brisk walking for 3.5-5 hours/week can improve risk of not developing type 2 diabetes by 30%. Active muscles involved in physical activity are able to take up increased amounts of glucose. This is balanced by the liver producing more glucose.	A study in Portland, OR found that more public transit stations in an area were associated with people walking more for transportation.
Routinely getting 5 hours or less sleep per night as an adult is associated with developing type 2 diabetes. This effect is attributed to weight gain and chronic stress due to low sleep. There is also an association between getting more than 9 hours sleep per night as an adult and type 2 diabetes. This association may be due to increased release of small proteins which cause sleepiness, and disrupt glucose balance and β cell function.	Bisphenol A (BPA) is used in making polycarbonate plastics and leaches from plastics. BPA is found in the urine of most Americans, and higher levels of BPA in the urine are associated with type 2 diabetes. In studies of mice with higher levels of BPA, beta cells produced and released more insulin, which increased insulin resistance.
As people get older, their risk for type 2 diabetes goes up. About 11% of the people between the ages of 20 and 64 have diabetes. After the age of 65, almost 27% of people in this age group have diabetes. As in other age groups, type 2 diabetes is associated with obesity.	In a longitudinal study of women in an industrialized section of Germany, risk of type 2 diabetes was increased by 15% for each doubling in exposure to particulate matter such as that found in air pollution near busy roads.

Front of cards

Environmental Factor 25

How are your stress levels, on an average day?

Diabetes.co.uk (2013). Diabetes warning for stressed men. http://www.diabetes.co.uk/news/2013/Feb/type-2-diabetes-warning-for-stressed-men-96045737.html

Gene 1

Melanocortin-4 (MC4) Receptor

http://www.diabetes.org/news-research/research/research-database/molecular-genetics-of-human-obesity.html

Gene 2

Leptin (LEPR) Receptor

http://ghr.nlm.nih.gov/condition=leptin-receptor-deficiency

Gene 3

PPAR Gene Family

http://www.diabetesselfmanagement.com/Articles/Diabetes-Definitions/ppar_agonists/

Marie-France Hivert et al., Updated Genetic Score Based on 34 Confirmed Type 2 Diabetes Loci is Associated with Diabetes Incidence and Regression to Normoglycemia in the Diabetes Prevention Program. 2011. Diabetes, 6, 1340-1348.

Gene 4

TC7L2

Marie-France Hivert et al., Updated Genetic Score Based on 34 Confirmed Type 2 Diabetes Loci is Associated with Diabetes Incidence and Regression to Normoglycemia in the Diabetes Prevention Program. 2011. Diabetes, 6, 1340-1348.

http://www.ncbi.nlm.nih.gov/omim
http://www.ncbi.nlm.nih.gov/SNP/

Gene 5

FTO

Frayling, T. M., Timpson, N. J., Weedon, M. N., Zeggini, E., Freathy, R. M., Lindgren, C. M., Perry, J. R. B., Elliott, K. S., Lango, H., Rayner, N. W., Shields, B., Harries, L. W., and 30 others. A common variant in the FTO gene is associated with body mass index and predisposes to childhood and adult obesity. Science 316: 889-894, 2007.

http://www.ncbi.nlm.nih.gov/omim
http://www.ncbi.nlm.nih.gov/SNP/

Gene 6

CDKAL1

Marie-France Hivert et al., Updated Genetic Score Based on 34 Confirmed Type 2 Diabetes Loci is Associated with Diabetes Incidence and Regression to Normoglycemia in the Diabetes Prevention Program. 2011. Diabetes, 6, 1340-1348.

http://www.ncbi.nlm.nih.gov/omim
http://www.ncbi.nlm.nih.gov/SNP/

Back of cards

	From a 35 year longitudinal study of 7000 Swedish men, it was found that chronically stressed men had a 45% higher risk of developing type 2 diabetes. Stress results in the release of the hormone cortisol, which raises blood pressure, and raises blood glucose by causing insulin resistance.
Leptin is a hormone produced by fat cells that manages appetite and metabolism. Binding of leptin to leptin receptors reduces the amount of glucose released into to the blood by the liver and increases glucose uptake from the blood into the muscle. A mutation to the LEPR (leptin receptor) is a rare cause of obesity.	The MC4 receptor is expressed in the brain and helps match food intake to energy expenditure. Mutations in the MC4 receptor can predispose an individual to severe obesity. Mutations in the MC4 receptor gene account for 1 to 6% of cases of severe obesity cases
The protein coded for by the gene TC7L2 is involved in maintaining glucose homeostasis. Risk alleles in this gene have been shown to be associated with impaired β cell function and type 2 diabetes in European populations	This gene family regulates the body's breakdown of fatty acids, the generation of fat cells and affects blood glucose control. A variation in the PPAR-gamma gene is associated with a *reduction* in the risk for type 2 diabetes as it predisposes people to having less fat. A group of anti-diabetic drugs targets the PPAR-gamma gene
The gene CDKAL1 is expressed the most in skeletal muscle and the brain. The protein from this gene may be involved with insulin release, and certain allele combinations decrease insulin levels by 20%.It is thought to be associated with decreased β cell function.	The gene FTO is involved in hunger control, and people with the risk alleles are associated with increased body mass indexes and rates of obesity, both of which are linked to type 2 diabetes.

Lesson 3 | Glucose: From Fuel to Toxin

Time: 90 minutes

Lesson Objectives:
Students will be able to answer:

- Where is glucose found in food and drinks?
- How do food choices impact blood glucose levels?
- How do insulin resistance and damage to the pancreas lead to type 2 diabetes?

Overview

Students create paper models of different carbohydrates, including starch, fiber, sucrose, fructose and glucose, and make the connection between blood glucose regulation and type 2 diabetes. After learning the ways in which blood glucose balance fails in type 2 diabetes, students create analogies to explain the roles of glucose, glucose transporters, insulin, insulin receptors, and the pancreas in the disease. Students learn that although glucose is needed by every cell of the body for fuel, too much glucose can be toxic to tissues of the body. This lesson includes a student homework assignment about the availability of high fructose corn syrup.

Enduring understandings:

Glucose, the major energy source for all human cells, is released primarily through digestion of carbohydrates. Food choices impact blood glucose levels.

Blood glucose levels are regulated to stay within a healthy range. Type 2 diabetes is the result of chronic high blood glucose levels and can develop over time as regulation of blood glucose levels fail.

Type 2 diabetes is a serious condition with negative health consequences if left untreated.

Essential question:

Where is glucose in food and drinks, and what does it have to do with type 2 diabetes?

Lesson Summary with Timings

Where do sugars come from? A food paper model	30 min
Watching Lesson 3 Traffic Analogy	10 min
Blood Glucose Analogies	50 min

Washington State Health and Physical Education Standards (based on National Standards)
Through this lesson, students will gain competency in the following topics and outcomes:

Nutrition

1. **Food Groups and Nutrients:** Predict impact of consuming adequate or inadequate amounts of nutrients. H1.N1.HS

5. **Disease Prevention**: Analyze and describe the relationship between nutritional choices, physical activity, and chronic diseases. H1. N5.HS

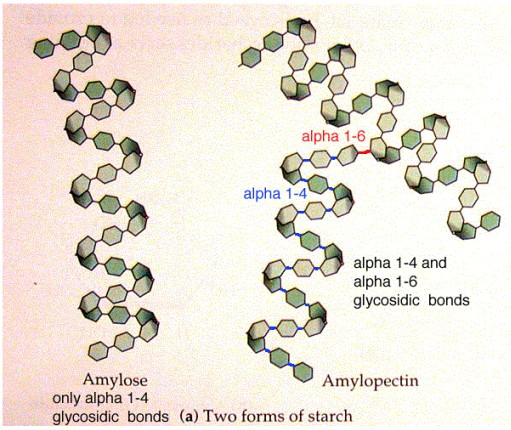
Wellness

2. **Disease Prevention:** Assess personal risk factors and predict future health status. H2.W2.HSb
3. **Analyzing Influences:** Analyze how a variety of factors impact personal and community health. H2.W3.HS
6. **Decision-Making:** Predict potential short- and long-term outcomes of a personal health-related decision. H5.W6.HS

Background on Carbohydrates

Glucose, a **monosaccharide**, is the primary energy molecule of the body. Surprisingly, much of the food we eat is not in the form of glucose. More commonly, glucose is found as part of **disaccharides** like sucrose (found in fruit) and lactose (in milk) or as a starch.

How is starch digested to glucose?



Starch, a **polysaccharide**, is a natural **polymer** of glucose, formed in a variety of plants by the chemical linkage of hundreds or even thousands of individual glucose units. Corn, wheat, potatoes and rice are main sources of starch used in the U.S. Other plants with high starch content (*e.g., cassava, milo, sorghum)* are more abundant in other parts of the world. The common starches differ in that they contain different amounts of two types of glucose polymers. One of these polymers is **amylose** (see figure to the right), a linear chain of 500 to 2000 glucose units. The other starch polymer, **amylopectin** (see figure to the right), has a tree-like shape, with linear chains like those in amylose connected at branch points. Each branch contains about 20 to 30 glucose units and the molecule is made up of several hundred branches.

Digestion of carbohydrates begins in the mouth. Saliva contains a large amount of alpha-amylase, an **enzyme** that breaks starch into smaller fragments. With the help of additional digestive enzymes, these fragments are broken down into **glucose.** Glucose molecules are then absorbed from the small intestine into the blood stream. Once in the blood stream, glucose is transported into cells with the help of **insulin**. Insulin is a small **protein hormone** that regulates the amount of glucose in the blood by stimulating cells to transport glucose in from the blood stream. Once in our cells, glucose can be broken down for energy. In addition to alpha-amylase, other digestive enzymes that are responsible for making glucose available to cells for energy include sucrase and lactase. Sucrase (also known as invertase) digests sucrose (*table sugar*; also found in foods containing high fructose corn syrup) to glucose plus fructose, and lactase digests lactose (*milk sugar*) to glucose plus galactose. Also, some foods contain glucose without enzyme digestion.

Starch is broken down to glucose in two stages, each requiring specific enzymes that act upon different portions of the molecule. Due to the size of the starch molecule and the specificity of the enzymes, starchy foods can take longer to digest than foods containing a predominance of mono- or di-saccharides (such as foods containing high fructose corn syrup). Foods that are digested more slowly release glucose into the blood stream more slowly.

Most **fiber** is also a polysaccharide and a natural polymer of glucose. **Fiber** is plant matter such as cellulose that cannot be broken down by human digestive enzymes, though bacteria in the human digestive tract can digest some types of fiber. Fiber is important to the diet because the roughage aids in digestion, and a high fiber meal can provide a feeling of fullness without adding calories. Fiber also slows down the rate of sugar absorption by the body.

Nordqvist, C. (2013, November 4). "What is fiber? What is dietary fiber? Fiber rich foods." Medical News Today. Retrieved from http://www.medicalnewstoday.com/articles/146935

Materials

Materials	Quantity
PowerPoint slide set for the unit, found at http://gsoutreach.gs.washington.edu	1 per class
Voice Over PowerPoint – Lesson 3 Traffic Analogy, found at https://gsoutreach.gs.washington.edu	1 per class
Understanding Type 2 Diabetes video from *Animated Diabetes Patient*: https://www.youtube.com/watch?v=JAjZv41iUJU	1 per class
8.5 x 11 inch sheet of paper, *or* Teacher Copy Master 3	1 per student
Scissors	1 per student
Tape	1 per group
Background on Carbohydrates	teacher discretion
Teacher Copy Master 3 Carbohydrate Chains	1 per student
Student Sheet 3.1 – *Using Analogies for Type 2 Diabetes*	1 per student
Student Sheet 3.2 – *High Fructose Corn Syrup*	1 per student

Teacher Notes

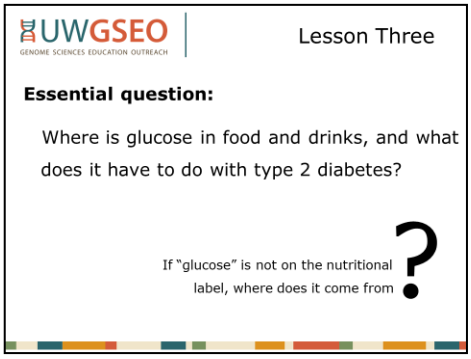
As type 2 diabetes is defined as chronically high levels of blood glucose, this lessons focuses on carbohydrates, including glucose, and the important role they play in nutrition. While the simple sugar glucose is fuel for every cell in the body, chronic high glucose levels can lead to glucose toxicity, debilitating illness, and type 2 diabetes. The *Background on Carbohydrates* reading is not mandatory for students but can be used at the teacher's discretion depending on the level of the class.

Procedures

Part I (Engage and Explain): Modeling Carbohydrates (30 min)

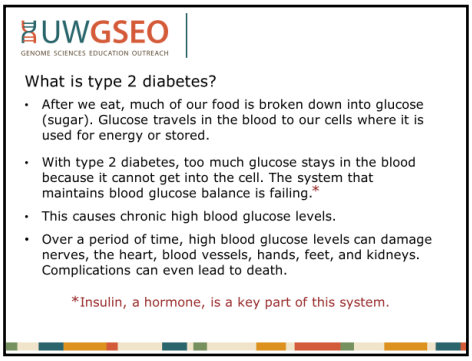
1. Show students the first slide for this lesson, which provides the Essential Question.

Slide 37



2. Circle back to the definition of type 2 diabetes introduced in Lesson One by showing the next slide. Since type 2 diabetes is due to chronic high blood glucose levels, it is helpful to know what glucose is and where it comes from.

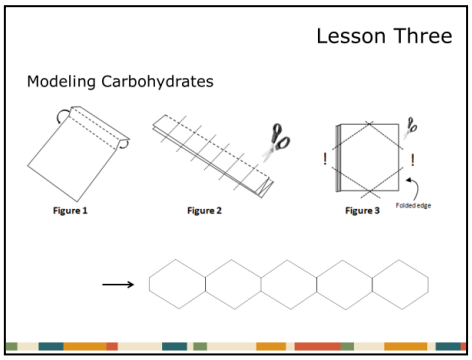
Slide 38



3. Tell students that they will be making paper models to illustrate where glucose comes from.

4. Hand out a blank 8.5 x 11 inch piece of paper to each student. The next slide may be helpful to illustrate the instructions.

Slide 39



If time is short, print and cut out strips of simple sugars using Teacher Copy Master 3, then jump to Step 5. Alternately, teachers could demonstrate Section I.

5. Have students fold the paper down about an inch along the short side. "Accordion" the paper by folding it back and forth to the end (Figure 1).

6. Once flat, have students cut the paper into squares (Figure 2).

7. Lastly, have students snip the corners off the top and bottom of each square to create connected *6-sided* shapes to represent single-ring sugars such as ***glucose*** (Figure 3). ***Be careful*** to leave the midsection intact.

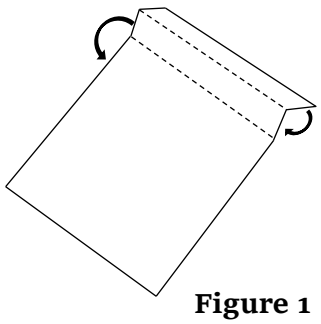


Figure 1

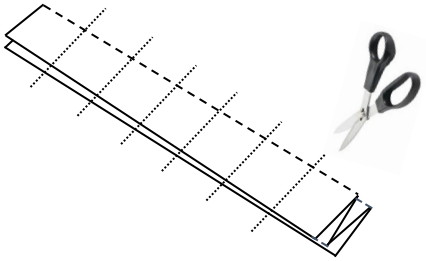


Figure 2

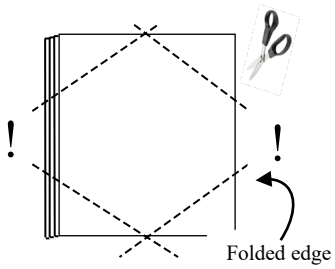


Figure 3

8. Have students unfold their paper models into chains. Tell students that these chains represent ***carbohydrates*** in the form of ***polysaccharides*** (poly = many; saccharide = sugar)**.**

9. Have students tape a few of the chains together to make longer chains. Encourage them to join chains with other individuals or groups to make both straight chains and branched chains.

10. These longer, more complex polysaccharide chains represent large carbohydrates such as **starch** and **cellulose**. The starches in our diets are found in foods such as *corn, rice, wheat,* and *potatoes*. These can be made up of hundreds or even thousands of individual units, which eventually get broken down through the action of enzymes into the single units.

Polysaccharides are often referred to as ***complex carbohydrates***.

Mono- and ***disaccharides*** are often referred to as ***simple carbohydrates***.

11. Choose one group of students to draw colored lines using a marker between the single units of one of the larger chains. (This will represent ***fiber***.)

12. The chains with colored lines between units represent dietary ***fiber***. Fiber is plant matter such as cellulose that cannot be broken down by human digestive enzymes—we don't have the molecular scissors to cut the colored bond—though bacteria in the human digestive tract can digest some types of fiber. **Fiber is important to the diet because the roughage aids in digestion, and a high fiber meal can provide a feeling of fullness without adding calories. Fiber also slows down the rate of sugar absorption by the body.**

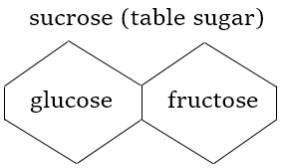
13. Ask each student to take *one* of his or her chains and cut or tear it into individual hexagons. Tell students that each hexagonal piece they just cut represents a single sugar, or ***monosaccharide,*** (mono = one) when detached from the chain.

14. Explain that ***glucose*** is a monosaccharide, and have students label a few monosaccharide pieces as ***glucose***. Glucose is the fuel for cellular respiration—the way the body gains energy from food. Most of the starches in our diets (corn, wheat, rice, potatoes) are long chains of glucose (polysaccharides).

15. Explain that ***fructose*** is also a monosaccharide and have students label of few more monosaccharide pieces as ***fructose***. Fructose is a very sweet sugar found in some plants such as fruits and berries. It is metabolized differently than glucose by the body. [Teacher note: fructose is a 5-ring sugar but will be represented the same way as glucose in this activity.]

16. Ask students to break another chain into groups of two hexagons. Each of these represents a ***disaccharide*** (di = two). ***Sucrose*** (table sugar) is a disaccharide.

17. ***Sucrose*** is made of two monosaccharides, ***fructose*** and ***glucose.*** These two monosaccharides are often found together. Have students label a few disaccharides sucrose and label the individual monosaccharides as fructose and glucose.



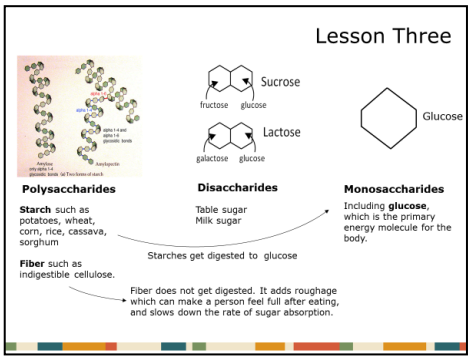
18. Explain that in the body ***enzymes*** are the "molecular scissors" that break the sugars apart so that the body can get energy from the individual units such as glucose.

19. Instruct students to clearly label their models of glucose, fructose, sucrose, and chains of starch and fiber, and tape the models in their notebooks.

Lactose, the sugar found in milk, is also a disaccharide. It is made up of the monosaccharides ***glucose*** and ***galactose***. This sugar is not as sweet as sucrose. People who are lactose intolerant are lacking the enzyme that breaks apart the double-ring sugar into the two single-ring sugars.

20. The next slide can be used to summarize the information.

Slide 40



Note: Make sure that students understand that carbohydrates (sugars) are not the only source of calories in the diet. Protein and fat also contribute to calorie intake.

21. Information about high fructose corn syrup can be found on Student Sheet 3.2 and can be given as homework if desired.

Part II (Explain and Elaborate) Blood Glucose Analogies (50 min)

22. Remind students that type 2 diabetes is a problem with blood glucose regulation. Though glucose is needed by every cell of the body for fuel, too much can be toxic to tissues of the body.

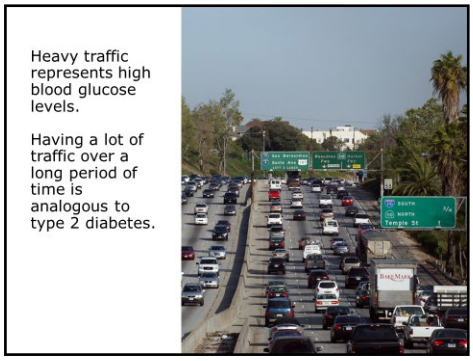
23. Tell students that our bodies have systems that keep blood glucose within a range. Type 2 diabetes can occur when these systems fail to work properly. Show students the 3:45 minute video from *Animated Diabetes Patient* found here: https://www.youtube.com/watch?v=JAjZv41iUJU

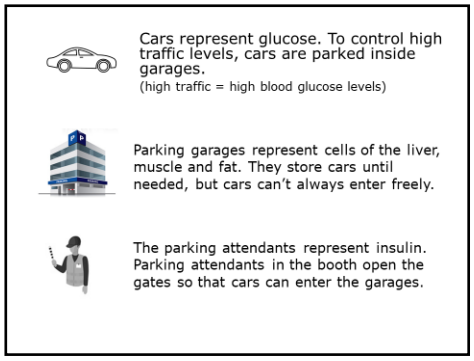
24. The video introduces to students the mechanisms that the body uses to allow glucose to enter cells to be used for energy, including the role of insulin, the pancreas, and two major causes of type 2 diabetes: insulin resistance and damage to the pancreas.

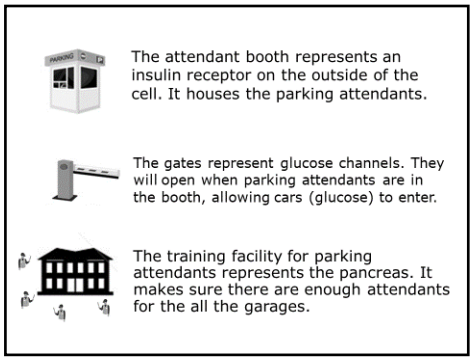
25. Students will be creating analogies that to help explain the cellular causes of type 2 diabetes to their peers. They will need to represent **glucose, cells, insulin, insulin receptors**, **glucose channels** and the **pancreas** in their analogy, as explained on Student Sheet 3.1. The following car/traffic analogy provides one example for their own analogies.

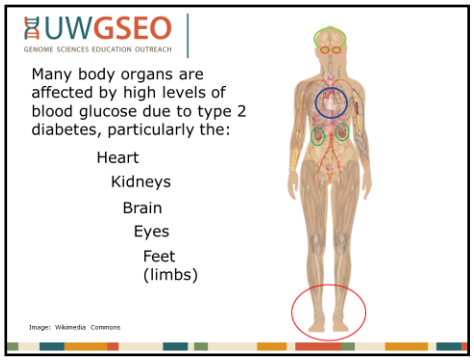
26. Hand out Student Sheet 3.1 – *Using Analogies for Type 2 Diabetes* for students to complete during and after they view the VOPP.

27. Show students the draft Lesson 3 Traffic Analogy found at https://gsoutreach.gs.washington.edu/GEMNet. This can be watched as a class as a VOPP, narrated by the teacher using the presenter notes, or assigned for students to watch as homework after Lesson 2. The VOPP uses cars in traffic as an analogy for blood glucose levels. Select slides are shown below.









28. After watching the pre-made analogy, students can work in teams to create their own analogy using Student Sheet 3.1.

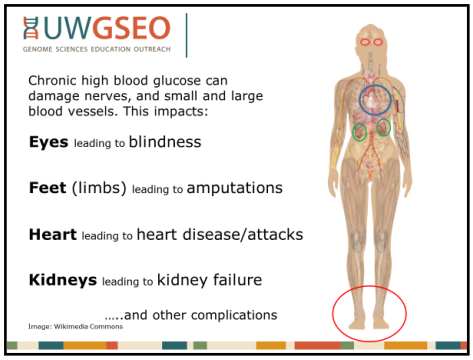
29. Have students present their analogies to each other. Ask groups to use their analogies to explain the following concepts:

    a. How insulin resistance causes type 2 diabetes.
    b. How damage to the pancreas might cause type 2 diabetes.
    c. How diet can impact type 2 diabetes.
    d. How exercise can impact type 2 diabetes.

    (Students can make predictions about how diet and exercise impact type 2 diabetes. Lessons 4 and 5 will go into more detail about these topics.)

30. After students have shared their analogies, show the next slide to reinforce the downstream effects of type 2 diabetes on the body.

Slide 41



Part III (Evaluate)

31. Return to the Essential Question for this lesson *"Where is glucose in food and drinks, and what does it have to do with type 2 diabetes?"* and have students work in groups to use their paper chain models to answer the question. Some take-home messages include:

    - Glucose is the building block of most carbohydrates and can be found in small carbohydrates (table sugar, lactose) and large carbohydrates (rice, beans, corn, potatoes and other starches as well as fiber).
    - The body's inability to regulate blood glucose levels is the root cause of type 2 diabetes.
    - High blood glucose levels over time cause many problems, such as damage to the eyes, heart, kidneys, and small blood vessels in the feet which can lead to amputations.

Homework

Student can complete Student Sheet 3.1 and/or 3.2 for homework.

Glossary

Carbohydrate: Types of sugar, starch, and cellulose that are made of carbon, hydrogen and oxygen, usually in a ratio of 1:2:1.

Complex Carbohydrate: Another name for polysaccharides, or starches formed by longer saccharide chains. These take longer to break down than simple carbohydrates.

Disaccharide: di- (two) + saccharide (sugar). A sugar composed of two single sugars (monosaccharides). Examples are sucrose, lactose and maltose.

Dietary Fiber: A carbohydrate found in plant matter (such as cellulose) that cannot be broken down by human digestive enzymes. Fiber can be soluble and insoluble in water, and is sometimes referred to as roughage.

Enzyme: A biological molecule (a protein) that speeds up the rate of a chemical reaction.

Fructose: A simple, single-ringed sugar found in many plants that often bonds with glucose to make up the two-ringed sugar sucrose (table sugar).

Galactose: A simple, single-ringed sugar often found bonded with glucose to make up the two-ringed sugar lactose, found in milk.

Glucose: A simple, single-ring sugar that is the main source of energy for living organisms through the process of cellular respiration. It also is the building block of many carbohydrates.

Lactose: A two-ringed (disaccharide) sugar made of glucose + galactose sugars. It is the major sugar in milk. It can be broken down by the enzyme lactase.

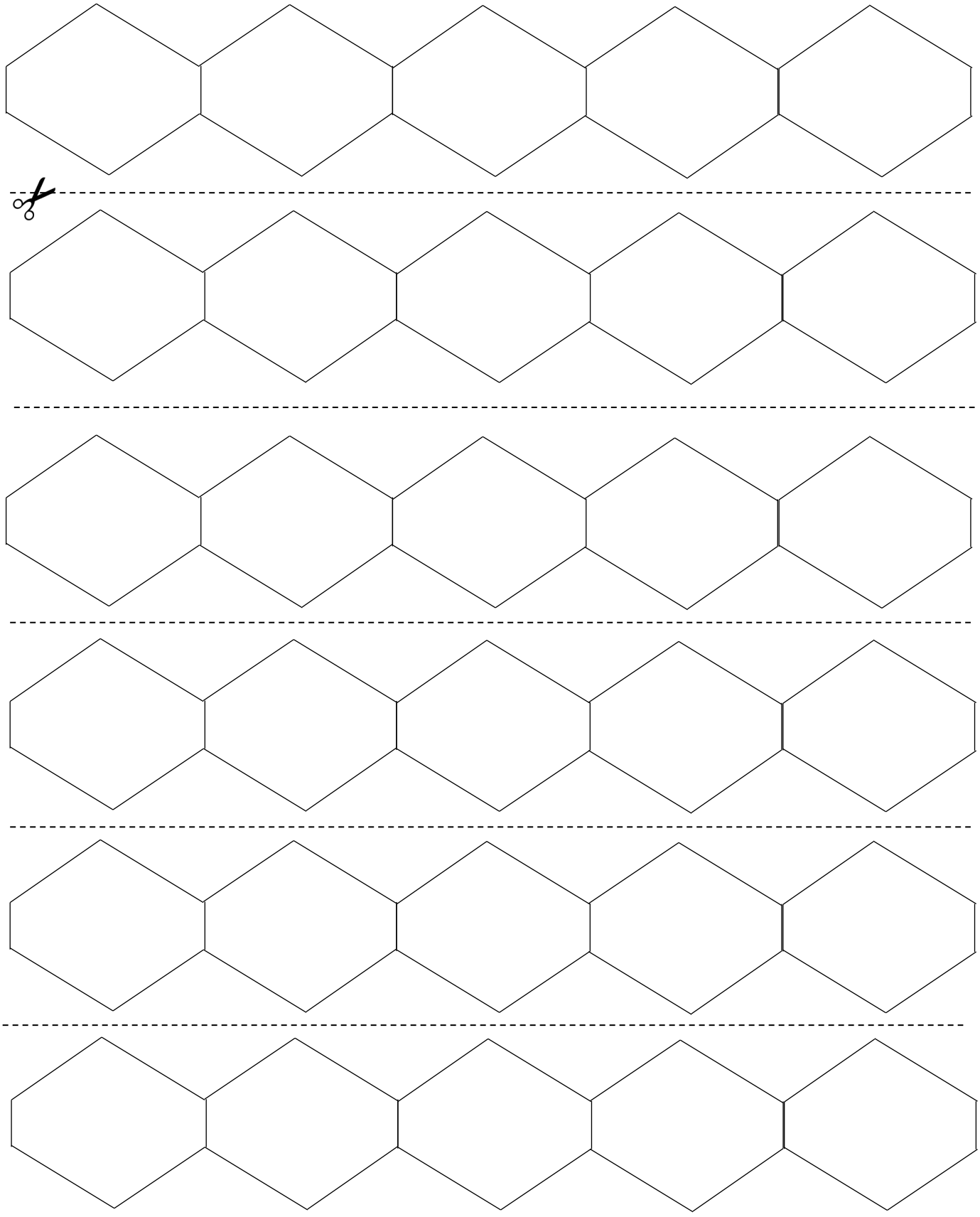
Monosaccharide: mono- (one) + saccharide (sugar). A simple, one-ring sugar such as glucose or fructose. Monosaccharides are the building blocks of more complex sugars.

Polysaccharide: poly- (many) + saccharide (sugar). A carbohydrate made by repeating units; a complex sugar made of a chain of monosaccharides joined together by bonds.

Simple Carbohydrate: Another name for monosaccharides and/or disaccharides, (single or double ringed sugars).

Starch: A carbohydrate made of many glucose units joined together.

Sucrose: A two-ringed sugar (disaccharide) that is made up of glucose + fructose. It is used widely as a sweetener and made from sugar beets and sugar cane. It can be broken down by the enzyme sucrase.

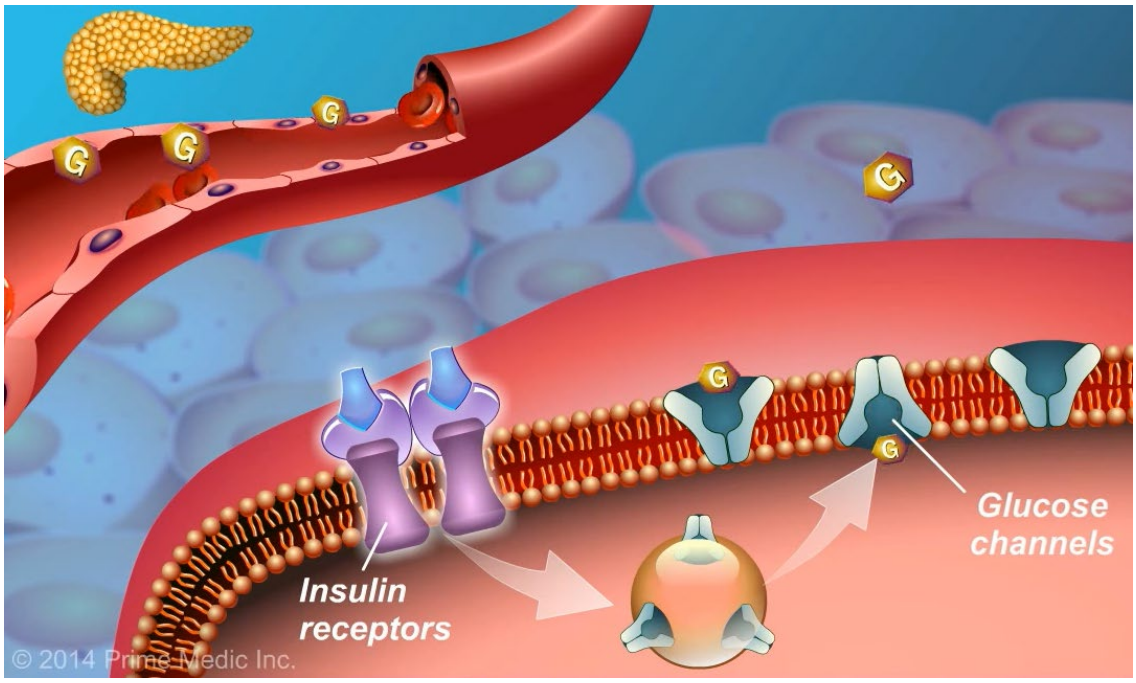


Using Analogies for Type 2 Diabetes: Student Sheet 3.1

Name: _____ **Date:** _____ **Period:** _____

Note: Type 2 diabetes results from a problem with blood glucose regulation. Though glucose is needed by every cell of the body for fuel, too much can be toxic to tissues of the body.

1. Watch the video **Understanding Type 2 Diabetes** from *Animated Diabetes Patient* found here: https://www.youtube.com/watch?v=JAjZv41iUJU



On the picture above, label the following components:

Glucose **Cells** **Insulin** **Insulin receptors** **Glucose channels** **Pancreas**

2. You will be creating an analogy to explain the mechanism of type 2 diabetes. In your analogy, you will need to represent the words that are bolded above.

3. To illustrate how an analogy might work, watch *A Traffic Analogy for Type 2 Diabetes*. Use the following page to guide you.

GEMNet analogy:

Is represented by this in the GEMNet analogy:	**Component**	**Function**	How is this represented in YOUR analogy?
Cars 	**Glucose**		
Parking garages 	**Cells**		
Attendant 	**Insulin**		
Attendant's booth 	**Insulin Receptors**		
Parking arm that goes up and down 	**Glucose channels**		
Training facility for attendants 	**Pancreas**		

Type 2 diabetes results from two main factors: *insulin resistance* and *decreased insulin production* in the pancreas.

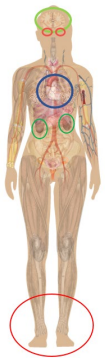
4. What is insulin resistance?

5. Use your model to demonstrate insulin resistance to another person or group.

6. What happens when the pancreas cannot produce enough insulin?

7. Use your model to show what happens when the pancreas cannot produce enough insulin.

8. Name three organs that are impacted by type 2 diabetes. How are they impacted?



9. We always hear that "diet and exercise" are the best way to prevent type 2 diabetes. Using the traffic analogy, predict how both diet and exercise might impact type 2 diabetes.

POSSIBLE ANSWERS Blood Glucose and Type 2 Diabetes: An analogy

Type 2 diabetes results from two main factors: *insulin resistance* and *decreased insulin production* in the pancreas.

4. What is insulin resistance?

   Glucose cannot enter the cells readily, even when insulin is present. This leads to high blood glucose levels. Insulin resistance is often a sign of prediabetes, a precursor to type 2 diabetes. Fat storage and obesity are tied to insulin resistance.
   (In other words, failure of the gates to open at the parking garages, even though plenty of attendants are available. This causes the traffic to continue to build up on the roadways.)

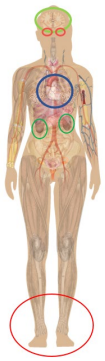
5. Use your model to demonstrate insulin resistance to another person or group.

6. What happens when the pancreas cannot produce enough insulin?

   When the pancreas cannot produce enough insulin, glucose stays in the blood because it cannot get into the cells that will use the glucose. This leads to high blood glucose levels. (In other words, not enough attendants are available to open the gates. This means cars cannot get off the roadway and into parking. Traffic builds up.)

7. Use your model to show what happens when the pancreas cannot produce enough insulin.

8. Which organs are impacted by type 2 diabetes? How are they impacted?



   The heart, kidneys, brain, eyes and feet (limbs) are all affected.

   A build-up of glucose in the blood can damage small blood vessels in the kidneys, eyes, hands, and feet, leading to kidney disease, blindness, infections, and amputations. Diabetes also causes a hardening of the arteries, which can lead to heart disease. Nerves that control the heart are also damaged.

   People don't usually die directly of type 2 diabetes, but from the complications from the disease, particularly heart disease.

9. We always hear that "diet and exercise" are the best way to prevent type 2 diabetes. Using the traffic analogy, predict how both diet and exercise might impact type 2 diabetes.

   If diabetes is due to too much traffic on the road (glucose in the blood), then a person can lessen glucose by: 1) controlling the amount of glucose entering the blood through diet by eating or drinking fewer sugary foods/drinks that dump a lot of sugar in the blood at once, and 2) exercise muscles that use glucose for fuel. The glucose that is used up for exercise was removed from the blood at some point before it became fuel.

Background information: Until the 1970's, sucrose (table sugar) made from sugar cane or sugar beets was the most commonly used sweetener. As demand for sugar increased and the prices for these commodities went up, food scientists looked for a cheaper source of sweetener. Due in part to farm subsidies, corn was in surplus and corn starch was readily available in the United States. Corn syrup can be used as a sweetener, but it is not as sweet as sucrose. Using enzymes to convert about half of the glucose in corn starch to fructose, food scientists were able to create High Fructose Corn Syrup (HFCS). This provided a sugar source that was as sweet as sucrose, cheaper than sugar made from sugar cane or sugar beets, was made from a crop that grew in abundance in the U.S. In addition, HFCS is easily transported and dissolves well in liquids.

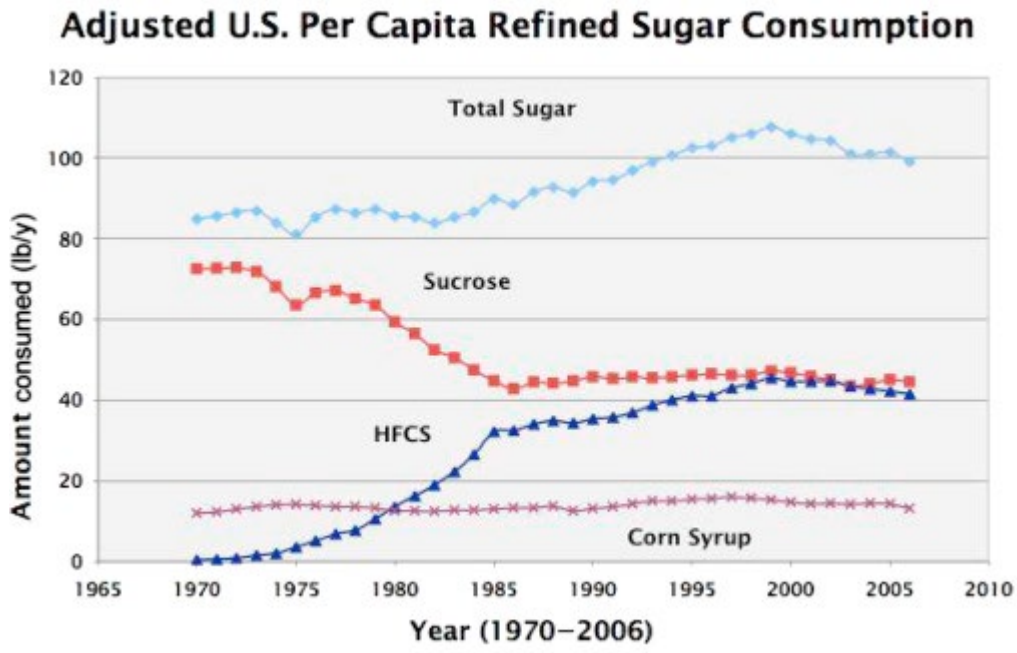
A. Watch the video at the following link:

WHAT DOES SUGAR ACTUALLY DO TO YOUR BODY?

https://www.youtube.com/watch?v=utXcI3FqzeM&feature=youtu.be

1. What is the take-away message for you from the video?

B. Consider the following graph:



Source:
Das, U. (2015) *Nutrition*

2. How does this graph relate to what you are learning about type 2 diabetes?

Lesson 4 | What Are We Eating?

Time: 90 minutes

Lesson Objectives:
Students will be able to answer:

- How can we tell what percentage of calories in food is derived from fat, carbohydrates and proteins?
- How is eating broccoli different than drinking soda for your body?

Prerequisite Knowledge
Prior understanding of macromolecules such as carbohydrates, proteins, and fats is helpful, but not necessary.

Overview

Using food labels, students produce graphs that illustrate the percentage of proteins, fats, and carbohydrates found in different foods and drinks, and display baggies showing the amount of sugar found in certain beverages. Students then challenge each other to guess the food/beverage based on the graph or baggie. Students consider changes in diet over time, learn about the role of fiber in the diet, and figure out how different types of food impact blood glucose levels.

Enduring understandings:

Type 2 diabetes is caused by the effects of high blood glucose levels over time.

Type 2 diabetes can be prevented: factors contributing to a person's risk include good nutrition and exercise.

Essential question:

How are the foods we eat different, and what does this have to do with type 2 diabetes?

Lesson Summary with Timings:

Calculating Food and Drink Labels; Liquid Sugar Activity	40 min
What food or drink is that?	10 min
Data Drop: Does it matter what we eat?	20 min
Closure and review of Student Sheet 4	20 min

Washington State Health and Physical Education Standards (based on National Standards)

Through this lesson, students will gain competency in the following topics and outcomes:
Nutrition

1. **Food Groups and Nutrients**
   Predict impact of consuming adequate or inadequate amounts of nutrients. H1.N1.HS
2. **Beverages:** Analyze the impact of school rules and community and federal laws on beverage availability and choice. H2.N2.HS
3. **Label Literacy:** Cite evidence from Nutrition Facts labels useful for making informed and healthy choices. H5.N3.HS
4. **Calorie Intake and Expenditure**: Demonstrate how to balance caloric intake with expenditure to maintain, gain, or reduce weight in a healthy manner. H7.N4.HS
6. **Nutritional Planning:** Design, monitor and adjust a personal nutrition plan considering cost, availability, access, nutritional value, balance, freshness and culture. H7.N6.HS

Wellness

2. **Disease Prevention:** Assess personal risk factors and predict future health status. H2.W2.HSb
4. **Access Valid Information:** Demonstrate how to access valid information. H3.W5.5
6. **Decision-Making:** Predict potential short- and long-term outcomes of a personal health-related decision. H5.W6.HS

Materials

Materials	Quantity
PowerPoint slide set for the unit, found at http://gsoutreach.gs.washington.edu	
Teacher *Copy Master* of blank bar graphs	1 per class
Computers for students with internet access to: *USDA Food Composition Database*, *Calorie Control Council's Healthy Weight Tool Kit*, or *My Fitness Pal*. (URLs in text box below)	1 per student or group
A variety of food labels, including nutritional content	4 per student
Calculator	1 per student
Tape or glue	1 per group
Green, red, and purple markers	1 each per student
Student Resource 4: *Calculating Food and Drink Labels*	1 per group
Student Sheet 4: *Calculating Food and Drink Labels*	1 per student
Sugar cubes *or* granulated sugar and scales *or* teaspoons	
Baggie and labelling pen	1 per group
Student Sheet 1: *Family Tree of Eating Habits* from Lesson 1	1 per student

Lesson Background

- This lesson requires having a selection of food and beverage labels with nutritional information on hand for students to use. Ask students to bring in food labels from home, provide the labels for them, or make sure that students have internet access.

- This lesson focuses on the caloric contribution of different macromolecules in food. If students haven't already learned about macromolecules in previous units, teachers may wish to teach about fats, proteins and carbohydrates, and their contributions to diet, role in the body, and how these macromolecules are stored. While helpful for the lesson, prior information about macromolecules is not crucial.

Options and notes about on-line nutritional information: We recommend the following sites.

- **USDA Food Composition Databases** (https://ndb.nal.usda.gov/ndb/search/list)
- **Calorie Control Council's Healthy Weight Tool Kit (**https://caloriecontrol.org/healthy-weight-tool-kit/food-calorie-calculator/)
- **My Fitness Pal** (www.myfitnesspal.com)

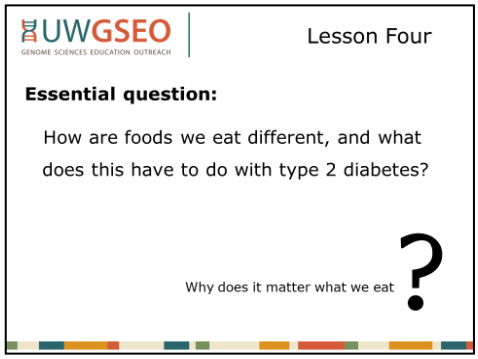
Note: The **USDA** manages the source database from which most nutritional sites draw their data, including the Calorie Control Council. The USDA is a *.gov* and supported by taxpayer funds. It can difficult to navigate, however, so make sure that students are looking at values *per item*, or *per serving* rather than *per 100 g* of the item. The **Calorie Control Council** site is a *.org*, a designation originally for non-profit organizations. Although without ads, it represents a sector of the food and beverage industry. **My Fitness Pal** is a *.com,* a commercial site. It is user-friendly, and students can easily go between the FOOD tab and the EXERCISE tab, which will be useful in the next lesson. Students, however, will be exposed to ads on this site.

Procedures

Part I (Engage and Explain) Calculating Food and Drink Labels (40 min)

1. Show student the first slide for this lesson, which shows the Essential Question.

Slide 43



2. Show students the collection of labels or food/drink containers to be used in this lesson. Ask students, *"How can you tell what ingredients, nutrients and macromolecules foods contain?"* or *"How can you tell which foods are healthiest?"*

3. Pass out Student Resource 4: *Calculating Food and Drink Labels.*

4. Tell students that they will be assessing the nutritional labels from different foods and beverages, and calculating the total number of calories from fats, carbohydrates, and proteins.

5. Using the corn label on Student Resource 4 as a guide, demonstrate for students how to convert the number of grams of fats, carbohydrates and proteins from a food label into calories.

Grams of Fat x **9** cal/gram = _____ calories from fat

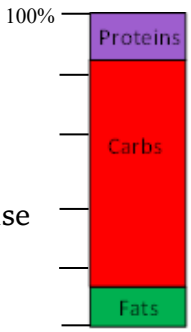
Grams of Carbohydrate x **4** cal/gram = _____ calories from carbohydrates

Grams of Protein x **4** cal/gram = _____ calories from proteins

Total Calories: _____

6. Next, demonstrate for students how to find the relative percentage of calories that come from either fat, carbohydrates, or protein for that food.

$$\frac{\text{Number of [fat] calories}}{\text{Total calories}} \times 100 = \text{percent calories from [fat]}$$



7. Lastly, show students how to graphically represent the relative percentages of calories using the bar graph. Make sure that students use green for fat, red for carbohydrates and purple for protein.

8. Have students complete Student Sheet 4 *Calculating Food and Drink Labels*, including the Liquid Sugar Activity described below.

9. When students finish graphing their nutritional labels, have them choose a beverage from their Student Sheet 4, or find a new one using an online tool such as the My Fitness Pal (www.myfitnesspal.com) the Calorie Control Council https://caloriecontrol.org/healthy-weight-tool-kit/food-calorie-calculator/ or the USDA Food Database: (https://ndb.nal.usda.gov/ndb/search/list).

10. Have student groups represent the amount of sugar in their beverage of choice by putting the correct amount of sugar into a labelled baggie. Students can do this by *either* a) weighing the correct amount of table sugar in grams, *or* b) using sugar cubes to show the correct amount of sugar cubes (3g per 1 cube) *or* c) converting grams of sugar into teaspoons (4g per teaspoon).

11. Tell students that liquid sugar is the biggest source of added sugar in the American diet and set up a display area for all the baggies.

Challenge students who finish early to further subdivide the red carbohydrate bar in their graphs to represent fiber and sugar. The carbs not associated with fiber or sugars are starches.

Part II (Evaluate): What Food or Drink is That? (10 min)

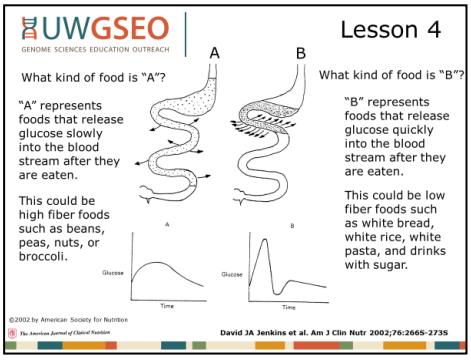
12. When students have finished Student Sheet 4 and illustrated the amount of sugar in a beverage, gather a selection of bar graphs and bags of sugar in a central location. It might be helpful to group similar-looking graphs in the same area.

13. Without showing the name of the food or drink, have a few students exhibit a graph or baggie of sugar and ask their peers to predict the type of food or drink.

14. Remind students that the red carbohydrate bar represents both sugars and fiber, which they learned about in Lesson 3. Sugars get absorbed quickly into the blood stream, causing blood glucose levels to go up quickly. Fiber helps slow the release of glucose into the blood stream.

15. The next slide shows a hypothetical schematic representing two kinds of diets. Ask students what sorts of foods might be represented in A (high fiber foods like beans, peas, nuts, broccoli) and B (low fiber foods like white bread, white rice, white pasta, and especially sugar drinks like soda).

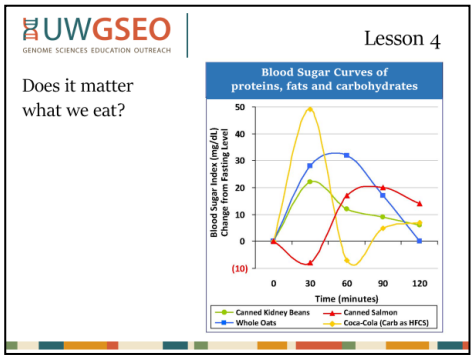
Slide 44



Part III (Elaborate) **Does it Matter What We Eat?** **(20 min)**

16. Show students the next slide and ask them questions about the graph, ideally in a turn-pair-share style. First a literal question: *What does the graph show?* Make sure that students understand the structure of the graph, and what the x and y axis represent.

Slide 45



Note: The data in this slide illustrate one person's blood glucose levels as self-monitored using a blood glucose meter after eating the foods mentioned. The data do not represent a large enough sample size or enough trials to be considered generalizable.

Why do blood glucose levels fall after eating salmon?
Salmon is mostly protein and fat. The dip happens because there is a little bit of insulin secretion that is anticipatory when eating. Protein will start breaking down into peptide fragments in the stomach which will stimulate insulin release. The fat will also stimulate insulin release but more slowly. Insulin release from both fat and protein will cause glucose in the blood to fall. The red line starts going back up again because protein is also a strong stimulus for glucagon, the hormone that releases stored glucose from the liver back into the blood. Salmon stimulates both insulin and glucagon, creating a rise and fall in blood glucose levels.

17. Next, ask students interpretive questions, such as: "*What does the graph mean?*" "*How does this tie to type 2 diabetes?*" and "*Are there social implications of this data?*"

18. Lastly, have students use the information in the slide and the car analogy from Lesson 3 to describe ***why it matters what we eat***. Some taking points could include:

    When a person eats or drinks a carbohydrate, it is turned into glucose quickly if it is not bound as fiber. This means everything from oats, rice, potatoes, and corn to sodas and juices become car traffic in the analogy.

    1) Type of food we eat matters: Drinking a can of coke rushes cars directly onto the roadways all at once, causing a temporary spike in traffic. The city responds by sending out a lot of gate guards (insulin) at once. In your body, flooding the circulatory system with a lot of sugar at one time causes the insulin levels to spike. Over time, this may be harmful to the pancreas. Eating foods that take longer to break down to glucose is helpful, as glucose is released more slowly into the bloodstream. Food high in fiber takes longer to break down, which is why coke and whole oats have different curves. This is why eating an apple is better for you than drinking a glass of apple juice.

2) Food volume matters: In Slide 45, the participant has eaten similar volumes of food for each type. However, if a person is consistently overeating (sending a huge number of cars into the city) the city responds as it should for a while. After time, the systems used to park the cars and get them off the road break down. Blood glucose levels are not well regulated.

3) Fat storage: Excess cars (glucose) are stored as fat in never ending parking garages. The fat impacts the whole system in many ways. One way is that components of fat are building blocks used to reduced lane width, which causes the traffic to back up even more. Visceral fat (the fat that is deposited around the belly and gut) is particularly resistant to insulin, which means that blood glucose levels keep building.

Part IV (Evaluation) Closure (20 min)

19. As a class, review the Essential Question and/or go over the answers to the questions on Student Sheet 4: *Calculating Food and Drink Labels*

Q2. How can nutrition fact labels be useful for making informed and healthy choices?
Nutrition fact labels are an important tool to help consumers know the nutritional content of food and beverages. The information helps consumers make healthy food and beverage choices by reducing fat, sugar, and salt intake, monitoring carbohydrates, comparing similar foods for nutritional value, knowing the caloric value of foods, and controlling for serving size.

Q3. What are some meal planning considerations for a person at risk for type 2 diabetes?

A meal should be high in fiber (greens, beans, peas, nuts) and low in processed carbohydrates such as white bread, white rice, and white pasta. Sugar-sweetened beverages should be avoided. Healthy proteins and dairy products can be included. This type of meal would be beneficial for most people, not only people at risk of type 2 diabetes.

Note: Students might also be interested in researching where food labels come from, how food labels will change in the near future, who monitors them for accuracy, and what the acceptable margin of error is for the labels. It is interesting to note that although the labels are mandated by the FDA, the food company itself, not the FDA, is responsible for their accuracy. The law allows up to a 20% margin of error on food labels.

Teacher Resource
A great resource for the role of micro-nutrients can be found at *The Linus Pauling Institute* at the University of Oregon: http://lpi.oregonstate.edu/

Homework
Student can finish Student Sheet 4 at home if needed or write about the prompts in Step 18.

Extension/Homework
Ask students to research what kind of diet is the best for a person with diabetes. They are likely to find out that there is a lot of different, and conflicting, information on the internet. Research has shown that people on well-controlled diets tend to lose weight and lower blood glucose levels. What the diets all have in common, however, is they are restrictive in some important ways that leads to a caloric deficit. The "Danger Zone" of the American diet is the *combinations* of high fats and high carbs. These foods tend to be more processed, and have lower levels of fiber, vitamins, and nutrients.

Example: Calculating Food and Drink Labels

1. Using the above label, calculate the total calories in Green Giant Whole Kernel Sweet Corn per serving.

   a. Grams of Fat __1__ x 9 calories/gram = __9__ calories

   b. Grams of Carbohydrates __20__ x 4 calories/gram = __80__ calories

   c. Grams of Protein __2__ x 4 calories/gram = __8__ calories

   d. Total calories: __97__ calories

   Note: *the total calculated calories may not be identical to the label because grams of nutrients are rounded for label printing. Use your calculated number of calories to find the percentages of calories for each type of food, not the number from the label.*

2. Calculate the percent calories of each of the food types (fat, carbs, and protein):

   To find %: $\frac{\text{Part of calories}}{\text{Whole (total)}}$ X 100 = percentage

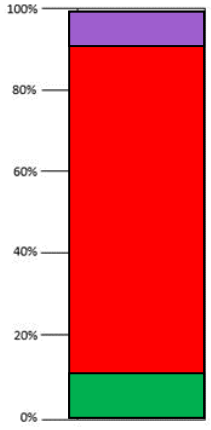
   a. % calories from fat = 9/97 fat calories/total calories x 100 = __9.3__ %

   b. % calories from carbs = 80/97 carb calories/total calories x 100 = __82.5__ %

   c. % calories from protein = 8/97 protein calories/total calories x 100= __8.2__ %

3. Represent the percentages from Step 2 as a bar, as you see here. Label the name of the food and provide the total calories per serving. ***Note:*** make sure to use the following colors:

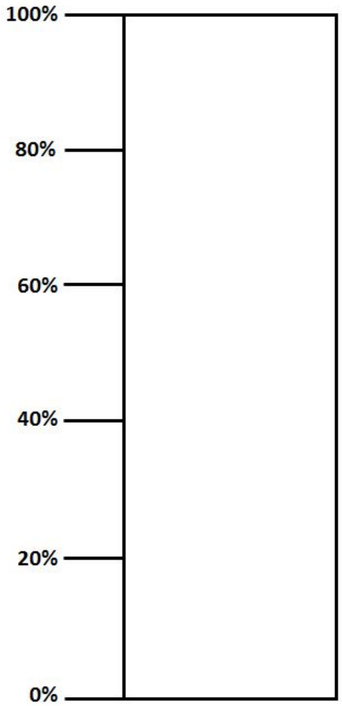
   fat (green), carbohydrates (red) and protein (purple).



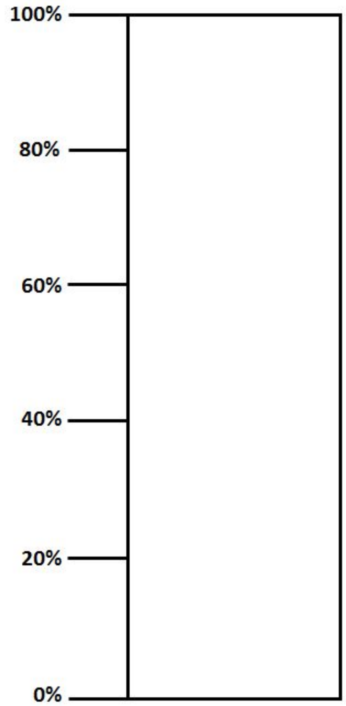
Name: Sweet corn kernels, canned
Calories: 97

Copy Master

Additional bar graphs for representing percentages of food calories



Name:
Total cal:



Name:
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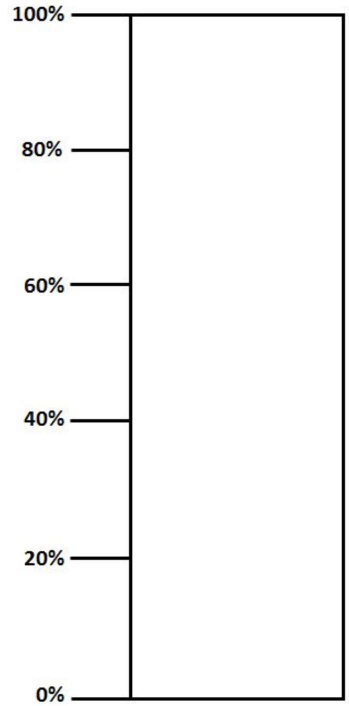

Name:
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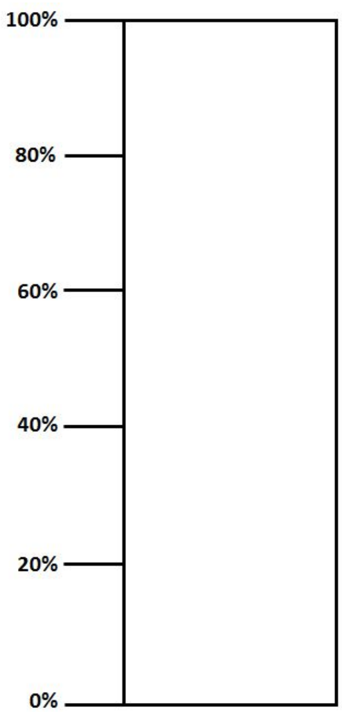

Name:
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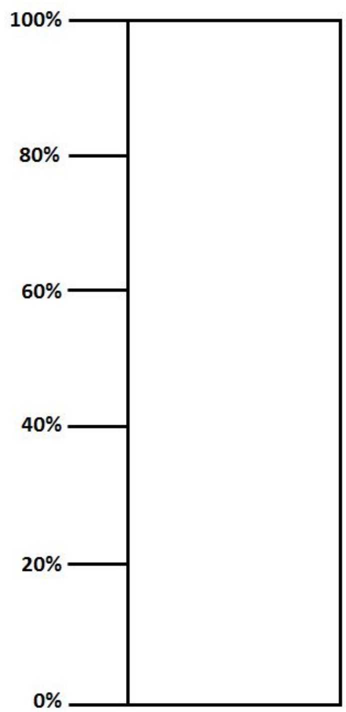

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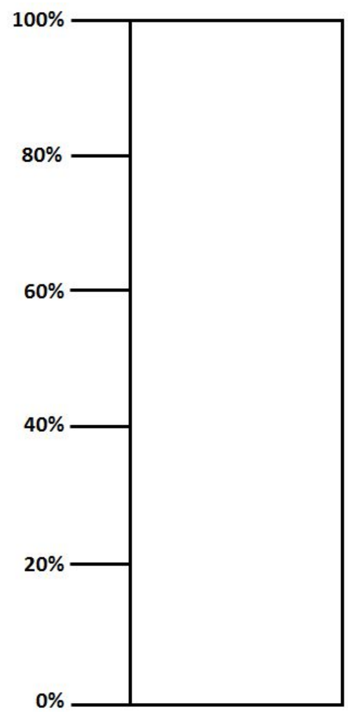


Name:
Total cal:

Calculating Food and Drink Labels Student Sheet 4

Name: _____ **Date:** _____ **Period:** _____

Instructions: Use food labels or an internet search to compare four different foods/beverages. Choose one food and one beverage that you regularly consume, and one food and one beverage frequently consumed by your parents or grandparents using the family tree of eating habits from Lesson One. Complete the calculations and fill out the bar graphs.

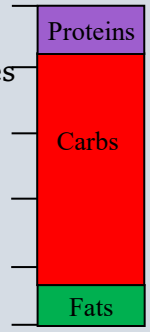
Grams of Fat x **9** cal/gram = _____ calories from Fats

Grams of Carbohydrate x **4** cal/gram = _____ calories from Carbohydrates

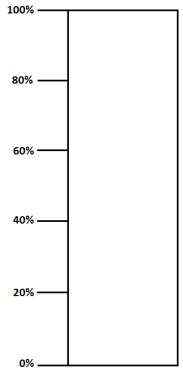
Grams of Protein x **4** cal/gram = _____ calories from Proteins

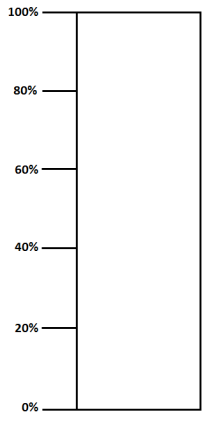
_____ total calories

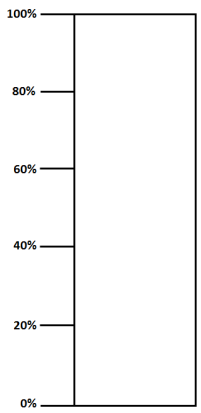
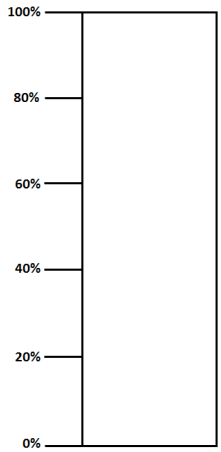
$$\frac{\text{Part of calories}}{\text{Total calories}} \times 100 = \text{percent calories}$$



Nutritional information sites: MyFitnessPal.com, USDA Food Composition Databases

Food #1: A common food for you			**Total Calories:**
From the label...	*Calculate the...*	*Calculate the...*	
Grams of Fat:	Calories from Fat:	% calories from Fat:	
Grams of Carbs:	Calories from Carbs:	% calories from Carbs:	
Grams of Protein:	Calories from Protein:	% calories from Protein:	
	Total calories:		

Food #2: A common drink for you			**Total Calories:**
From the label...	*Calculate the...*	*Calculate the...*	
Grams of Fat:	Calories from Fat:	% calories from Fat:	
Grams of Carbs:	Calories from Carbs:	% calories from Carbs:	
Grams of Protein:	Calories from Protein:	% calories from Protein:	
	Total calories:		

Food #3: A common food for your parents/grandparents			**Total Calories:**
From the label…	*Calculate the…*	*Calculate the…*	
Grams of Fat:	Calories From Fat:	% calories from Fat:	
Grams of Carbs:	Calories from Carbs:	% calories from Carbs:	
Grams of Protein:	Calories from Protein:	% calories from Protein:	
	Total calories:		
Food #4: A common drink for your parents/grandparents			**Total Calories:**
From the label…	*Calculate the…*	*Calculate the…*	
Grams of Fat:	Calories From Fat:	% calories from Fat:	
Grams of Carbs:	Calories from Carbs:	% calories from Carbs:	
Grams of Protein:	Calories from Protein:	% calories from Protein:	
	Total calories:		

1. a. Choose one of your beverages (or find a new one) and do an internet search to find out the amount of sugar in that beverage for the serving size you usually drink.

   Amount of sugar _____

   b. Put that amount of sugar into a labelled baggie by *either* weighing the correct amount of table sugar in grams, *or* using sugar cubes to show the correct amount of sugar cubes (3g per cube) *or* converting grams of sugar into teaspoons (4g per tsp). What do you notice?

2. How can nutrition fact labels be useful for making informed and healthy choices?

3. What are some meal preparation considerations for a person at risk for type 2 diabetes?

Lesson 5 | An Ounce of Prevention

Time: 50 minutes

Lesson Objectives:
Students will be able to answer:

- How can calories and exercise be analyzed using on-line tools?
- What are two important ways to help prevent type 2 diabetes?

Overview

Students learn ways in which exercise can aid in treating and preventing type 2 diabetes and determine durations of physical activity required for balancing calories consumed and calories burned.

Enduring understandings:

Type 2 diabetes can be prevented: factors contributing to a person's risk include exercise and good nutrition.

Students can make a meaningful contribution to the prevention of type 2 diabetes.

Essential question:

How does exercise impact type 2 diabetes?

Lesson Summary with Timings:

Why Exercise?	15 min
Snickers Bar Demonstration	10 min
How Much Exercise?	25 min

Washington State Health and Physical Education Standards (based on National Standards): students will gain competency in the following topics and outcomes:

Nutrition

1. **Food Groups and Nutrients**: Evaluate resources for accessing valid and reliable information, products, and services for healthy eating. H3.N1.HS
4. **Caloric Intake and Expenditure:** Demonstrate how to balance caloric intake with caloric expenditure to maintain, gain, or reduce weight in a healthy manner. H7.N4.HS
5. **Disease Prevention:** Analyze and describe the relationship between nutritional choices, physical activity, and chronic diseases. H1. N5.HS

Wellness

1. **Dimensions of Health:** Analyze personal dimensions of health and design a plan to balance health. H1.W1.HS
2. **Disease Prevention:** Analyze prevention, lifestyle factors, and treatment of communicable and noncommunicable diseases. H2.W2.HSa
   Assess personal risk factors and predict future health status. H2.W2.HSb
4. **Access Valid Information:** Demonstrate how to access valid information. H3.W5.5.HS
6. **Decision-Making:** Predict potential short- and long-term outcomes of a personal health-related decision. H5.W6.HS
7. **Goal Setting:** Implement strategies to achieve a personal health goal. H6.W7.H

Materials

Materials	Quantity
PowerPoint slide set for the unit, found at http://gsoutreach.gs.washington.edu	
Computers for students with access to food and exercise information. Suggested sites include: • **My Fitness Pal:** www.myfitnesspal.com • **USDA Food Composition Database:** https://ndb.nal.usda.gov/ndb/search/list ***or*** • **Activity Calculator**: www.caloriecontrol.org/healthy-weight-tool-kit/lighten-up-and-get-moving	1 per student or group
Fun-sized candy bar, preferably Snickers	1 per class
Student Sheet 5: *How Much Exercise?*	1 per student
Student Sheet 5: *How Much Exercise?* KEY	1 per class

Lesson Background and Preparation

- This lesson asks students to consider how much physical activity is needed to balance the caloric intake. While the balancing of "calories in = calories out" is a useful concept for students, it is helpful for students to know that not all calories are created equally. For example, 140 calories from a handful of nuts will digest slowly due to the fiber content, provide protein, and contribute to a feeling of fullness. 140 calories from a 12-oz can of sugared soda will dump 39 g of sugar into the blood stream without providing fiber or protein.

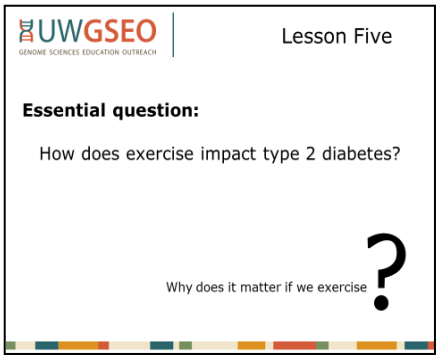
- The simple "calories in = calories out" calculations are complicated by number of factors. The number of calories each person extracts from food is impacted by which bacteria are in that person's gut, the type of the food, how that food is prepared, and how much energy a person uses to digest different foods.

Procedures

Part I (Engage and Explain) **Why Exercise?** **(15 min)**

1. Project the first slide for the class, showing the Essential Question for this lesson.

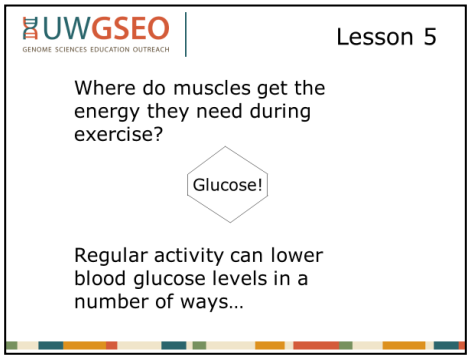
Slide 47

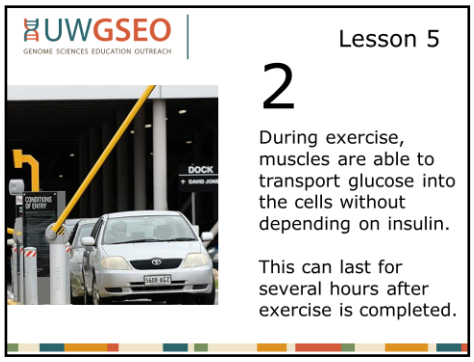


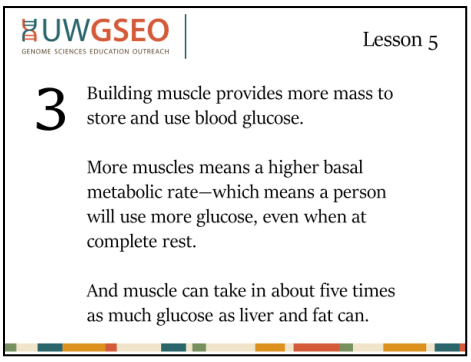
2. Brainstorm the benefits of exercise. A list could include numerous benefits such as better sleep, weight control, stress control, boosting of energy levels, strengthening of the heart and muscles, improvement of mood, as well as promoting fun and social activities.

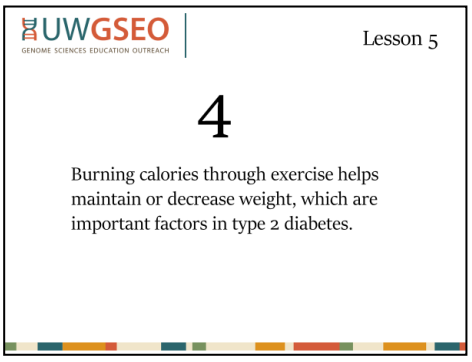
3. Ask students why exercise might be especially important in the prevention and treatment of type 2 diabetes and show the next series of slides.

Slides 48 - 52



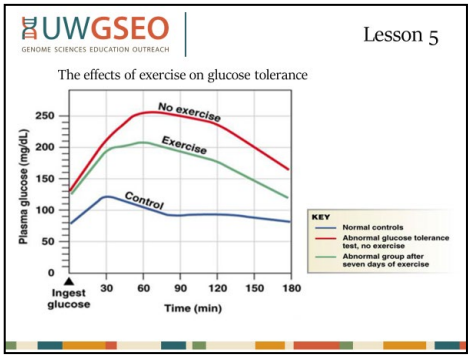






4. The next slide shows a blood glucose curve for normal controls (people without diabetes) and people with abnormal glucose tolerance (pre-diabetic or diabetic) before and after exercise. Make sure that students understand the *x* and *y* axis and graph labels. Before advancing the animation, have students predict where the line for exercise will be, and how much time might be required for exercise to have an effect.

Slide 53



Part II (Explain) Snickers Bar Demonstration (10 minutes)

5. Tell students that burning calories through exercise is an important part of maintaining or decreasing weight, which can be helpful in preventing type 2 diabetes. We often have an unrealistic understanding of how much exercise is needed, however.

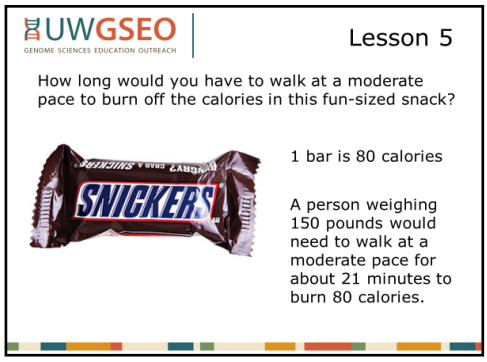
6. Hold up a fun size candy bar and ask students, "How long would you have to walk at a moderate pace to burn off the calories in this snack? Have students write down their best guesses.

7. Demonstrate for students how to find the calories of the Snickers bar snack that was just held up or use the next slide.
   - Go to www.MyFitnessPal.com
   - Click on the FOOD tab
   - Enter *Fun Size Snickers* in the Food Search box
   - Scroll down and click on the correct food
   - Adjust the serving size to 1 bar
   - Show that one fun sized Snickers bar is 80 cals.

Note: Nutritional information can also be found on the *USDA's Food Composition Database* or the *Calorie Control Council's Lighten Up and Get Moving* site.

8. Next, demonstrate for students how to find the numbers of calories burned from exercise.
   - From the MyFitnessPal site, click the EXERCISE tab
   - Enter *walking* in the exercise database search box
   - Scroll down and click on *walking, 3.0 mph, mod. pace*
   - Using 150 pounds as an "average person" enter a time estimate provided by a student
   - If the estimate is too short, add more time until you approximate 80 calories.
   - It would take a 150-pound person about 21 minutes of moderate walking to burn off the calories from a fun size Snickers bar.

Slide 54



9. Enter the weights of two differently-sized people, real or fabricated. Students will notice that a heavier person burns more calories than does a lighter person doing the same activity for the same amount of time. This is due to differences in ***basal metabolic rates***, or the number of calories required to sustain cellular respiration and bodily functions of a person when at rest. A heavier person requires more calories to maintain their weight and burns more calories when exercising. As a person loses weight, their caloric needs decrease.

Part III (Elaborate) How Much Exercise? (25 minutes)

10. Pass out Student Sheet 5: *How Much Exercise?*. Let students work independently or in groups to record information from the foods/drinks listed on the student sheet and calculate the amount of activity needed to burn off calories from various foods. Students are instructed to choose one drink, one fast food, and two choice foods.

11. Have students complete the questions on Student Sheet 5 as they proceed. Selected answers can be found on the Student Sheet 5: *How Much Exercise?* KEY.

Part III (Evaluate) Closure (5 minutes)

12. Return to the Essential Question for this lesson, "How does exercise impact type 2 diabetes?" and have students discuss in small groups, write in their notebooks, or write down answers as an exit ticket. Some take-home messages include:

    - Exercise helps to control blood glucose levels in many important ways:
      1) Muscles use glucose to burn for energy during exercise,
      2) Glucose can enter the cells without insulin during and after exercise
      3) Exercise builds muscle, and more muscles use more glucose, and
      4) Exercise burns calories which helps maintain a healthy weight.

    - Studies have shown that people generally underestimate the amount of exercise it requires to burn off the food we eat. Becoming familiar with the number of calories in certain foods and the duration of activity required to burn the calories in those foods can help us maintain caloric balance.

Name: _____ **Date:** _____ **Period:** _____

Choose four snacks from the vending machine or from your home and use the labels or an online search to determine how many calories are in each of these snacks.

Go to www.MyFitnessPal.com and click on the EXERCISE tab. Choose an exercise from the database, and determine how long you would need to participate in this activity to burn off the calories from the four snacks.

	Calories	Activity	Duration
A. Drink:			
B. Fast Food:			
C. Choice:			
D. Choice:			

1. What do you think happens to excess calories (i.e., carbohydrates fats, or protein) that are not consumed (i.e., burned) during daily physical activity and metabolism?

2. Based on your answer to question 1, do you think it is important to be aware of the number of calories that you consume daily and whether you are getting a balanced diet of carbohydrates, fats and proteins? Why or why not?

3. List 3 benefits of exercise for someone who is pre-diabetic or has type 2 diabetes.

4. Which snack would be a better choice? Give three reasons to support your answer.

Peanut butter and banana sandwich

Choose an amount: 1 sandwich

+ Add to Food Tracker

Food Info | Nutrient Info

Nutrient	Amount	% of Daily Target or Limit
Total Calories	322	16% limit
Protein	11 g	24% target
Carbohydrate	43 g	33% target
Dietary Fiber	4 g	17% target
Total Sugars	12 g	No daily target or limit
Added Sugars	3 g	6% limit
Total Fat	13 g	No daily target or limit
Saturated Fat	3 g	13% limit

Snickers Bar

Choose an amount: 1 bar (2 oz)

+ Add to Food Tracker

Food Info | Nutrient Info

Nutrient	Amount	% of Daily Target or Limit
Total Calories	280	14% limit
Protein	4 g	9% target
Carbohydrate	35 g	27% target
Dietary Fiber	1 g	5% target
Total Sugars	29 g	No daily target or limit
Added Sugars	25 g	50% limit
Total Fat	14 g	No daily target or limit
Saturated Fat	5 g	23% limit

1. What do you think happens to excess calories (i.e., carbohydrates fats, or protein) that are not consumed (i.e., burned) during daily physical activity and metabolism?

   Excess calories from carbohydrates that are consumed but not burned during metabolism or additional physical activity can be stored as glycogen in the liver or muscles, or stored in adipose tissue as fat. Excess fat could be stored in adipose tissue as fat. Excess protein is often eliminated from the body.

2. Based on your answer to question 1, do you think it is important to be aware of the number of calories that you consume daily and whether you are getting a balanced diet of carbohydrates, fats and proteins? Why or why not?

   It is important to know your balance of calories consumed versus burned, and to be aware that excess calories in the form of carbohydrates, fat and proteins are not stored in the same way. It may also be important to know that different forms of exercise (e.g., exercise intensities) burn different energy storages (e.g., fat versus glycogen).

3. List 3 benefits of exercise for someone who is pre-diabetic or has type 2 diabetes.

   Exercise can lower blood glucose levels in many ways: 1) Skeletal muscles remove glucose from the blood to use as an energy source during exercise, 2) During exercise, muscles are able to transport glucose into the cells without depending on insulin, which can improve blood glucose levels for hours after exercise is completed, 3) Building muscle provides more mass to store and use blood glucose which creates a higher basal metabolic rate, 4) Burning calories through exercise helps maintain or decrease weight, which are important factors in type 2 diabetes.

4. Which snack would be a better choice? Give three reasons to support your answer.

Peanut butter and banana sandwich

Choose an amount: 1 sandwich

Add to Food Tracker

Food Info | Nutrient Info

Nutrient	Amount	% of Daily Target or Limit
Total Calories	322	16% limit
Protein	11 g	24% target
Carbohydrate	43 g	33% target
Dietary Fiber	4 g	17% target
Total Sugars	12 g	No daily target or limit
Added Sugars	3 g	6% limit
Total Fat	13 g	No daily target or limit
Saturated Fat	3 g	13% limit

Snickers Bar

Choose an amount: 1 bar (2 oz)

Add to Food Tracker

Food Info | Nutrient Info

Nutrient	Amount	% of Daily Target or Limit
Total Calories	280	14% limit
Protein	4 g	9% target
Carbohydrate	35 g	27% target
Dietary Fiber	1 g	5% target
Total Sugars	29 g	No daily target or limit
Added Sugars	25 g	50% limit
Total Fat	14 g	No daily target or limit
Saturated Fat	5 g	23% limit

While students might choose the Snickers Bar since it has fewer calories, it is important to note that the peanut butter sandwich 1) offers grains and fruit, both of which provide fiber which slows digestion and contributes to a feeling of fullness, 2) The sandwich has by far fewer empty calories, 3) The sandwich provides more protein, and 4) The sandwich has fewer sugars, and far fewer added sugars. If students dig a bit deeper on the USDA database, they will find that the sandwich also provides more minerals and vitamins.

Assessment

Time: 50 minutes

Lesson Objective:
Students will be able to answer:

- How can I make a meaningful contribution to the prevention of type 2 diabetes?

Overview

This assessment offers opportunities to evaluate students and encourage them to take action within their own communities. To continue the formative assessment started in Lesson One, students contribute to the Chalk Talk posters for the last time and engage in a whole class discussion about how their understanding and beliefs about the causes, preventions and impacts of type 2 diabetes have shifted. Students then revisit and evaluate the SMART goal they set for themselves in Lesson One. Lastly, students consider opportunities for future projects and how they might make a meaningful contribution to the prevention of type 2 diabetes for themselves or in their community.

Enduring understandings:

Type 2 diabetes can be prevented: factors contributing to a person's risk include exercise and good nutrition.

Students can make a meaningful contribution to the prevention of type 2 diabetes.

Essential questions:

How can we apply what we have learned during this unit to our own lives and our communities?

Lesson Summary with Timings:

Chalk Talk debrief and discussion	20 min
Reflections on Chalk Talk and SMART goals	25 min
Looking Forward: Call to Action Projects	5 min

Washington State Health and Physical Education Standards (based on National Standards):
students will gain competency in the following topics and outcomes:

Nutrition

5. **Disease Prevention:** Analyze and describe the relationship between nutritional choices, physical activity, and chronic diseases. H1. N5.HS

Wellness

1. **Dimensions of Health:** Analyze personal dimensions of health and design a plan to balance health. H1.W1.HS
2. **Disease Prevention:** Analyze prevention, lifestyle factors, and treatment of communicable and noncommunicable diseases. H2.W2.HSa
   Assess personal risk factors and predict future health status. H2.W2.HSb
6. **Decision-Making:** Predict potential short- and long-term outcomes of a personal health-related decision. H5.W6.HS
7. **Goal Setting:** Implement strategies to achieve a personal health goal. H6.W7.H

Materials

Materials	Quantity
PowerPoint slide set for the unit, found at http://gsoutreach.gs.washington.edu	1 per class
Chalk Talk posters from Lesson 1	6
Colored markers for writing on Chalk Talk posters (3 x 6 posters)	18
Student Sheet 6: *Reflections*	1 per student
Student Sheet 1: *Family Tree of Eating Habits* from Lesson 1	1 per student
Call to Action Resource Sheet	As needed

Lesson Background and Preparation

Have the Chalk Talk posters that were presented in Lessons 1 available to write on. Put three markers next to each poster. If possible, use a new color marker for each poster so that today's comments can be distinguished from prior comments.

Procedures

Part I (Evaluate) Chalk Talk Participation and Discussion (25 min)

1. Remind students of the rules for Chalk Talk using the following slide.

Slide 55

2. Give students about 10 minutes to make further comments on the Chalk Talk posters. Make sure students comment on each poster at least once.

3. When students have finished commenting, read through each poster as a class and have students synthesize themes that arise from each prompt. This is a good opportunity for students to "own" a poster and lead a discussion about that poster, using the take-home messages in the next step.

4. Some take-home messages for the posters:

   What are some roadblocks to good health for you?

   If some common themes arise (i.e. lack of time or access to healthy foods), brainstorm strategies for overcoming these barriers. For example, many people choose unhealthy snacks when they are tired and rushed. Planning ahead and packing a baggie of carrots, grapes, or an apple can give a person

something to reach for when in a hurry. Encourage discussion about healthy snack and meal planning and the sharing of healthy eating strategies.

What causes type 2 diabetes?

Type 2 diabetes is a complex condition that is impacted by many factors. It may be helpful to break the causes into two areas—those that occur *inside the body* (physiological causes) and those that occur *outside the body* (environmental/lifestyle causes).

Physiological causes: Over time, the body's inability to remove glucose from the blood and use it and/or store it in cells leads to high levels of blood glucose. Insulin is needed to "open the gates" so that glucose can leave the blood and enter most cells. Type 2 diabetes can develop when cells ignore insulin's signal or the body stops producing enough insulin. Without enough insulin, glucose remains in the blood.

As a summative assessment, student can formally respond to the two questions "*What causes type 2 diabetes?*" and "*How do diet and/or exercise help to prevent or control type 2 diabetes?*"

Environmental and lifestyle causes: Our environments and lifestyles have changed remarkably over the last generation. People sit more, move less, and have easy access to high calorie foods that are low in nutrition. This has led to more people being overweight and obese. When a person is overweight, especially around the middle, cells become less sensitive to insulin. Stress levels also impact type 2 diabetes.

What does this graph (yearly income vs rates of diabetes) mean to you?

People with lower incomes tend to have higher rates of diabetes.

Point out that chronic stress that comes from low-income conditions (inadequate housing, the strain of being short on money) can spike stress hormones. Constantly elevated stress hormones that are preparing for "fight or flight" can cause high blood glucose levels. People living in low-income neighborhoods may also not have access to fresh, healthy, affordable foods. The high cost of medical care, insurance, and equipment such as glucose test strips can also be a factor.

How do diet and/or exercise help to prevent or control type 2 diabetes?

Refer to lessons 4 and 5 to underscore the importance of caloric balance, fiber, treating sugar-sweetened beverages as an occasional treat, building muscle, and exercise as a way for glucose to enter muscle tissue even without insulin.

Respond to this quote (about the toll of a poor diet on public health being equal to that of tobacco):

Encourage students to share their views on this topic. Point out that solutions for type 2 diabetes often rely on an individual's choices and behaviors, but we also have social and cultural obligations for promoting good health.

I know A LOT <- -> A LITTLE graph

Hopefully over the course of this unit, students' dots will move up the chart, even if they have few personal connections to the topic.

Part II (Elaborate) Reflections (20 min)

5. Pass out Student Sheet 6: *Reflections* and have students reflect individually on some of the Chalk Talk prompts and their SMART goals.
6. Students should retrieve Student Sheet 1: *Family Tree of Eating Habits* from Lesson 1 and turn to question 4 to revisit their SMART goal.

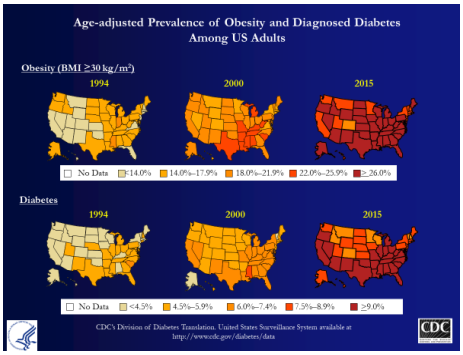
Think about yourself 30 years from now and your future eating habits. Think about any eating habits you wish to pass on to your children or other relatives in the next generation. Create one SMART goal that you could implement now that would impact your future self. *You will return to this goal at the end of this unit.*

Specific: What is the goal?	
Measurable: How will you measure your progress?	
Attainable: Can you make this come true?	
Realistic: Are you willing and able to do this?	
Timely: By when will you accomplish this goal?	

Part III (Closure) Looking Forward (10 min)

7. Wrap up the unit by showing the following slide from Lesson One and have students each share one way that they feel like they can help prevent the spread of diabetes in their families or communities.

Slide 57



8. If students have a leadership/project component to their education, they could be encouraged to create a type 2 diabetes-themed Call to Action project based on their responses. Relate to students that nature of the complex topic of type 2 diabetes lends itself well to extended learning through student projects, as detailed below.

Looking Forward: Call to Action Projects

Type 2 diabetes is a complex condition that brings together issues of health care, scientific research, environmental influences, personal choice, access to resources, diet and exercise, social justice, public policy, and more. The nature of this complex topic lends itself well to extended learning through student projects. If students have a leadership/project component to their education, they could be encouraged to create a type 2 diabetes-themed Call to Action project, in which they synthesize and apply their learning throughout the unit by creating a product that demonstrates their understanding of type 2 diabetes, addresses a specific diabetes-related problem, and contributes to a solution. Successful Call to Action projects implement direct, meaningful, and relevant actions to make a contribution towards combatting diabetes within the students' communities.

Project Ideas

Ideas for projects may include:

- Educate peers and others on sugar content of common drinks
- Survey and analyze foods typically given at food banks
- Create a media literacy lesson for peers using food and drink marketing
- Develop a cookbook
- Enroll a team/create an educational table for a *Tour de Cure* or other event
- "Do This, Not That" (in parallel to book "Eat This, Not That")
- Develop a script for a "living room focus group"
- Propose public policy at local or state level to improve health
- Develop a monthly healthy menu plan for a family of four given a budget
- Assess the nutritional quality of school lunch programs
- Use a personal tracking device or health app to analyze one's own practices

A set of resources can be found at the end of this lesson.

Name: _____ **Date:** _____ **Period:** _____

Chalk Talk

1. **What causes type 2 diabetes?** Make sure to address at least one physiological factor and one environmental factor.

2. **How do diet and exercise help to prevent or control type 2 diabetes?**

3. **Choose one other Chalk Talk poster to respond to here:**

4. **How would you plan a healthy meal for a person with type 2 diabetes?**

SMART Goal

5. **Review the SMART goal you set for yourself in Lesson One.**

   a) Did you accomplish your goal?

   b) If yes: What was the easiest part of accomplishing your goal?

   What was the most difficult part?

   c) If no: Why not?

   Was the goal itself not realistic, or did you not attain it?

   What can you do to ensure that you reach your goal next time?

6. **In one or two sentences, what is the most important thing you learned in this unit?**

Call to Action Resource Sheet

Name of resource
International Diabetes Federation. <www.idf.org> A Health Literacy Curriculum for ESOL Learners (Intermediate Level) | Queens Library. <http://www.queenslibrary.org/services/health-info/english-for-your-health/teacher-intermediate-level>. American Diabetes Association: Diabetes. <http://www.diabetes.org/>. "America's Move to Raise a Healthier Generation of Kids." Let's Move! USDA. Web. 29 May 2012. <http://www.letsmove.gov/>. Centers for Disease Control and Prevention. <http://www.cdc.gov>. World Health Organization (WHO). 2012. Web. 22 May 2012. <http://origin.who.int/mediacentre/factsheets/fs312/en/> "Diabetes Public Health Resource." Centers for Disease Control and Prevention. 2012. Web. 22 May 2012. <http://www.cdc.gov/diabetes/>. United States Department of Agriculture <http://www.fns.usda.gov> Gill-Carey, O., and AT Hattersley. "Genetics and Type 2 Diabetes in Youth." National Center for Biotechnology Information. U.S. National Library of Medicine, 2007. Web. 29 May 2012. <http://www.ncbi.nlm.nih.gov/pubmed/17991132>. "NHLBI-Portion Distortion Quiz." Stay Young At Heart. National Heart, Lung and Blood Institute. Web. 29 May 2012. <http://hp2010.nhlbihin.net/portion/index.htm>. "NIH and the Weight of the Nation - Health Information - National Institutes of Health (NIH)." U.S National Library of Medicine. 15 May 2012. Web. 29 May 2012. <http://www.nih.gov/health/NIHandweightofthenation/>. National Heart, Lung and Blood Institute. National Institute of Health. <http://www.nhlbi.nih.gov>. MedlinePlus Medical Encyclopedia. U.S. National Library of Medicine <http://www.nlm.nih.gov/medlineplus/ency/article/000313.htm>. **The Weight of the Nation resources:** "The Weight of the Nation." HBO. Home Box Office, Inc., 2012. Web. 29 May 2012. <http://theweightofthenation.hbo.com/>.

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