TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK | SOLVE | CREATE | CONNECT

LESSON TITLE

Deciphering Diabetes

Guiding Question: How can we connect with each other?

Ignite Curiosity

- Have you ever had an illness that prevented you from going to school or participating in activities that you love?
- Do you have a friend who lives with a chronic condition like asthma, sickle cell anemia, or another disorder that means he or she has to visit a doctor often?
- Can smartphones provide medical care?
- How can computers help doctors treat patients remotely?

Diabetes is a prevalent disease in the United States. It impacts many senior citizens and leads to other health problems like heart disease and stroke. For many diabetic senior citizens, it is difficult to leave the home for routine medical care. Diabetes patients must test their blood sugar to know their overall health. If a patient forgets to check his or her blood sugar and the glucose level is too low, it could result in acute health problems like a coma. In this lesson, students will act as medical researchers who have been tasked with identifying parameters for an ideal trial group that will test a new device that virtually shares blood sugar information with doctors. They will create a chart of medical data from the Centers for Disease Control and Prevention (CDC), then analyze the data to determine risk factors for patients. In **THINK**, students will examine how different risk factors correlate to diabetes. They will consider the following questions: What benefits would this technology have for family members who act as caregivers? How can we use computers to create greater access to healthcare? What medical technologies can we design that will help solve health crises like diabetes? In **SOLVE**, students will act as medical researchers who have been tasked with identifying the ideal trial group for a new "smart" blood sugar monitor that shares glucose levels virtually with doctors. Students will use the computational thinking skill of analyzing data by creating a hypothesis about how different health traits correlate to diabetes and testing that hypothesis by building a scatter plot. In **CREATE**, students will create a scatter plot of diabetes data from the CDC's National Diabetes Statistics Report, 2017. In **CONNECT**, students will explore how medical scientists research diseases and conduct trials to learn the impact of devices, practices, and medications on human health.

Students will be able to:

- Collect quantitative data related to diabetes to **identify** correlations between age and chronic diseases,
- **Analyze** data to form a hypothesis about how health traits correlate to diabetes, and
- Collaborate in groups to apply information about diabetes and **create** a scatter plot chart.

SUBJECTS

Science
Math

COMPUTATIONAL THINKING PRACTICE

Collaborating Around Computing

COMPUTATIONAL THINKING STRATEGY

Analyze Data

MATERIALS

Data Collection student capture sheet

Summary Ticket student capture sheet

Case Study student handout

Computers with Internet access (optional)

Microsoft Excel (optional)

Students will examine how risk factors like age correlate to diabetes.

1 **Read** the following scenario to the class:

You have just spent the night at your friend's house. Your friend's grandmother has diabetes, and she just woke up feeling very sick. Your friend pulls out a new device and tells you about how it reads her grandmother's blood sugar and reports the results to the doctor because her age makes it difficult for your grandmother to make frequent trips to the doctor's office. Your friend explains that it is a new device and is really helpful to her family. She wishes that more people could use it, but it does not yet have full approval from the government. For the government to approve the device, there needs to be more scientific research using trial patients like your friend's grandmother.

2 **Distribute** the Data Collection student capture sheet and explain that students will be collecting data and then writing statements about diabetes that answer the following questions:

- Which family members OR age ranges are affected most by diabetes?
- What kind of medical care do patients with diabetes need?
- What can we do to help solve health crises like diabetes?

Teacher Note: Write all three questions in a central location. They are also on the Data Collection student capture sheet.

Distribute copies of the following handouts as resources for collecting data:

- A Snapshot: Diabetes in the United States (CDC)
- National Diabetes Statistics Report, 2017 (CDC)
- Diabetes Myths (CDC)
- Native Americans with Diabetes (CDC)

At the end of the Data Collection student capture sheet, instruct students to pick one question to answer, and then prepare to share with the class.

3 **Write** the following questions from the Data Collection student capture sheet in a central location, and then lead students through a discussion to share their answers:

- What benefits would this technology have for family members who act as caregivers?
- How can we use computers to create greater access to healthcare?
- What medical technologies can we design that will help solve health crises like diabetes?

Invite students to write answers on a sticky note or index card to be placed next to each question, or write the answers on the board as students share. Then, instruct students to write in a journal or on the Summary Ticket student capture sheet their "best choice" answer for each question.

Students will act as medical researchers who have been tasked with identifying the ideal trial group for a new "smart" blood sugar monitor that shares glucose levels virtually with doctors.

1. **Distribute** copies of Tables 1a, 1b, 1c, 2a, 3a, and 4a from the appendix of the CDC's National Diabetes Statistics Report, 2017 on pages 12–14. Explain to students that they will now act as medical researchers to identify groups that would benefit most from a "smart" blood sugar monitor that shares glucose levels virtually with doctors. They will choose three groups from the data tables (demographic categories), and then provide a rationale for why the groups would benefit from the "smart" monitor.

2. **Explain** to students that the data represent percentages of demographic groups that have diabetes. For example, the "Total" group represents the percent of all Americans who have diabetes. Introduce students to the term *confidence interval* and refer them to Table 1a of the appendix on page 12 of the CDC's National Diabetes Statistics Report, 2017. Explain that *confidence interval* is another way of saying "margin of error" or "range of accuracy." Instruct students to focus on the average percent, not on the confidence interval. The average percent is located outside the parentheses, while the confidence interval is located inside the parentheses.

3. **Distribute** the Case Study student capture sheet to students, and review the directions on the handout. Instruct students to fill out the capture sheet by listing selected "case study groups" from the demographic categories in the tables provided above, and then enter the data (percent) to support their rationale for selecting the group.

4. **Lead** a conversation about a blood sugar monitor that could be designed as "one size fits all." Instruct students to describe physical features and processes of such a monitor that would allow it to be optimized for every demographic group.

5. **Instruct** students to revisit the three groups they selected. Have students compare the qualities of the "one-size-fits-all" blood sugar monitor with the three groups they have chosen. Instruct students to write answers in a journal or notebook, and then share out whether or not the monitor would fit their groups. Use the following guiding questions:
   - Is there any group that would benefit the most from the monitor? Why?
   - Is there any group that would benefit the least from the monitor? Why?
   - What changes would you make to the monitor? Why?

6. **Lead students in writing** a hypothesis statement based on their answers to the previous questions. The hypothesis statement should include "if" or a condition set by the data, "then" or a prediction based on the condition, and "because," which is a rationale for the prediction. Provide an example, such as: ***If*** *more young males have diabetes than young females,* ***then*** *more old males will have diabetes than old females* ***because*** *males are more prone to diabetes.*

Students will use the graphing features of Excel to create a scatter plot of diabetes data from the CDC's National Diabetes Statistics Report, 2017. If your classroom does not have access to computers, you can guide students to complete the exercise by sketching the graph on graph paper.

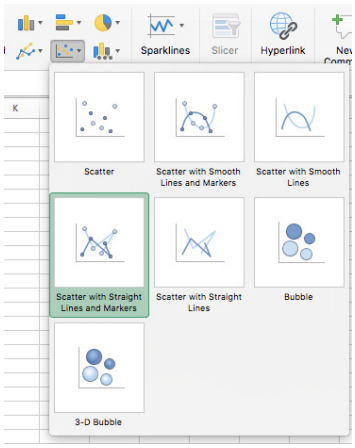
1 **Explain** to students that they will now test their hypothesis. Review the term *confidence interval* with students as necessary (see Solve step 2).

2 **Instruct** students to enter the data points from Table 1a of the appendix on page 12 of the CDC's National Diabetes Statistics Report, 2017 into an Excel spreadsheet using the format seen here:

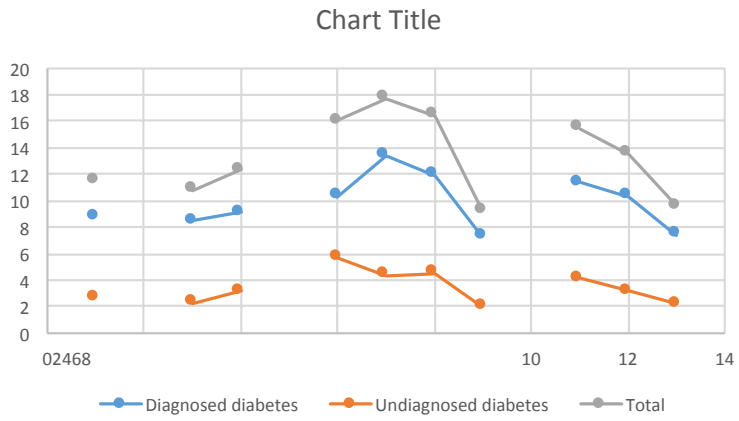
	A	B	C	D
1	**Characteristic**	**Diagnosed Diabetes**	**Undiagnosed Diabetes**	**Total**
2	**Total**	8.7	2.7	11.5
3	**Sex**			
4	Women	8.5	2.3	10.8
5	Men	9.1	3.2	12.3
6	**Race/Ethnicity**			
7	Asian, non-Hispanic	10.3	5.7	16
8	Black, non-Hispanic	13.4	4.4	17.7
9	Hispanic	11.9	4.5	16.4
10	White, non-Hispanic	7.3	2	9.3
11	**Education**			
12	Less than HS	11.4	4.1	15.5
13	High School	10.3	3.2	13.5
14	More than HS	7.4	2.2	9.6

3 **Instruct students to create** a scatter plot of the data in the Excel spreadsheet.

- Highlight the entire table of data by clicking and dragging from cell A1 to cell D14.
- Click "Insert" at the top (ribbon).
- In the Charts group, click "Scatter Plot" and select "Scatter with Straight Lines and Markers."

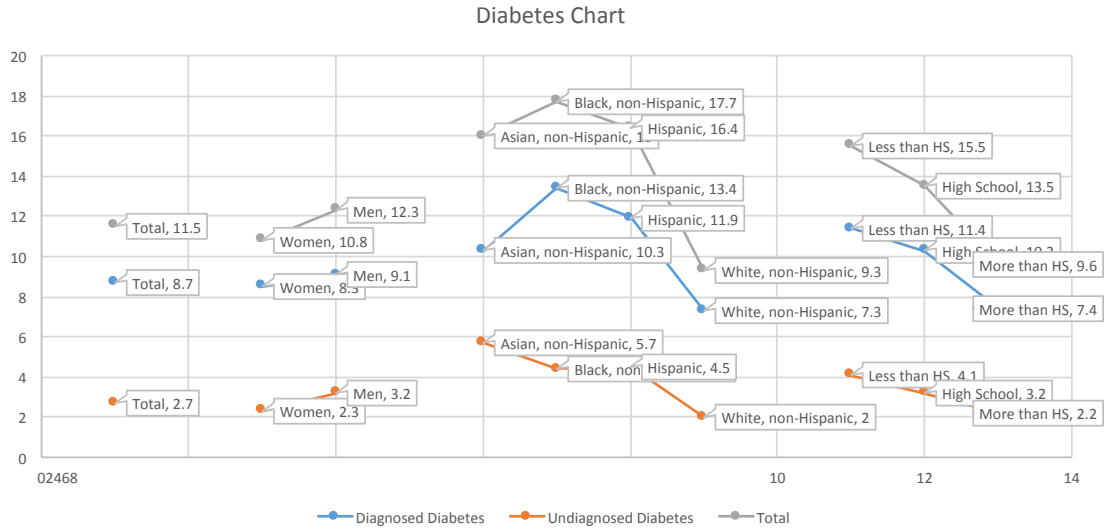


- The result should look like this:



- Change the title by double-clicking it and typing new text.
- Add data callouts to see the sub-groups under Sex, Race/Ethnicity, and Education:
  - Click on the scatter plot.
  - Click "Design."
  - Click "Add Charts Element."
  - Click "Data Labels."
  - Click "Data Callout."

- Resize the scatter plot for better visibility.



4 **Lead a summary discussion** to guide students in finding correlations in the data. Write the following questions in a central location, and invite students to post answers next to them with sticky notes or index cards and tape.

- Which group has the highest rate of diabetes?
- Which group has the lowest rate of diabetes?
- Are there any percentages that are significantly different from the national total?

5 **Refer** students back to their hypothesis from the Solve section. Use the following guiding questions to connect the scatter plot to the hypothesis:

- What patterns do you see in the groups you selected for the "smart" monitor?
- Why was the hypothesis you constructed correct or incorrect?
- What would you say to recommend your selected groups for the "smart" monitor case study?

Students will explore how medical scientists research diseases and conduct trials to learn the impact of devices, practices, and medications on human health.

1 **Distribute** copies of the article about former MIT students who started a company to solve problems with diabetes by going digital. The article explains that one problem patients encounter is not using appropriate dosages of insulin, which leads to more health issues in the long run and increases healthcare costs overall. They used data from research to come to this determination, and then they designed a "smart" insulin pen as a solution.

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1 **Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.

2 **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.

3 **Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.

4 **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Students probably know a friend or family member with diabetes or have diabetes themselves because nearly 1 in every 10 people has diabetes.

Most students can easily access and understand phone apps. If a phone app could control blood sugar monitoring, students with the disease could easily monitor their blood sugar. Students could also assist family members who are disabled or elderly using the app. A "smart" insulin pen would be similar to an app and just as easy for students to operate.

Recent graphical models such as infographics use charts to represent data and recognize correlations. Infographics are a great way to summarize data in a big-picture thinking strategy. They are also user friendly and appear more engaging to students than regular graphs and charts.

How does this connect to careers?

Statisticians work for a variety of businesses to collect and analyze data. They work with research data, performance data, and data that the CDC and other health organizations produce. Their work solving problems impacts businesses, the environment, health, and a variety of other industries and fields.

Medical Scientists conduct research on public health to improve the well-being of society. They produce advancements in medicines and treatments for illnesses and disease. Medical Scientists' work involves investigative research and clinical trials to produce data about human health.

Registered Nurses work directly with patients to administer medicines and assist with medical procedures. They also provide health education and organize patient care. Registered Nurses work in hospitals, doctor's offices, and other medical facilities.

Dietitians and Nutritionists work with patients to monitor health data and design treatment plans to improve overall health.

Biomedical Engineers create devices and equipment for use in healthcare.

How does this connect to our world?

Diabetes affects people around the world. Developing an app to monitor and report blood sugar levels to doctors positively impacts society on several levels. First it reduces the "distance" between doctor and patient. Second, apps are readily available to everyone with a smartphone. Third, apps can enhance existing technology that takes blood sugar readings.

Statistics to improve health are a world language because math is a world language. Data and equations are understood in the same way around the world and need no translation. If students, health professionals, or scientists use statistics to solve a problem related to health, the data they produce can help others improve on their current work.

National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices

Developing and Using Models

- Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
- Models of all kinds are important for testing solutions.

ETS1.C: Optimizing the Design Solution

- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.

LS1.A: Structure and Function

- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

National Standards

COMMON CORE STATE STANDARDS CONNECTIONS

CCSS.MATH.CONTENT.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

CCSS.MATH.CONTENT.8.SP.A.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

CCSS.MATH.CONTENT.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 7: Communicating Around Computing
Communication involves personal expression and exchanging ideas with others. In computer science, students communicate with diverse audiences about the use and effects of computation and the appropriateness of computational choices. Students write clear comments, document their work, and communicate their ideas through multiple forms of media. Clear communication includes using precise language and carefully considering possible audiences.

Works Cited

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4029126/
- http://www.pbs.org/newshour/updates/doctors-monitor-patients-vitals-via-smartphones-fitness-trackers/
- http://www.mayoclinic.org/healthy-lifestyle/consumer-health/in-depth/telehealth/art-20044878
- http://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/blood-sugar/art-20046628

Data Collection

Using handouts provided by the teacher, collect data in the form of "fact statements" to answer the following questions:

1. Which family members OR age ranges are affected most by diabetes?
2. What correlations are there between diabetes, the CDC, and patient care?
3. What interventions are in place to help solve health crises like diabetes?

Write the facts below, and then circle which question each answers.

Fact Statements	Answers question #		
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3

Answer one of the following questions and prepare to share your answer:

- What benefits would this technology have for family members who act as caregivers?
- How can we use computers to create greater access to healthcare?
- What medical technologies can we design that will help solve health crises like diabetes?

Summary Ticket

After previewing all answers, write your "best choice" answer for each question below:

What benefits would this technology have for family members who act as caregivers?	How can we use computers to create greater access to healthcare?	What medical technologies can we design that will help solve health crises like diabetes?

Case Study

You are in charge of selecting a group to participate in a case study that will research the effects of "smart" blood sugar monitors that report information to doctors. Review the data provided by your teacher, then select three groups that would benefit from the technology. Provide a rationale for each group in your list that is supported by the data.

Group	Rationale	Data

If you could give a "one-size-fits-all" monitor to all of the groups listed above, how would that monitor be designed?