Type 1 Diabetes - Managing a Critical Ratio

TEACHER NOTES

Objectives

- Students will learn about how ratios and proportions are a key part of managing Type 1 Diabetes
- Students will learn about the regulation of blood glucose through insulin (hormone) binding with cell receptors to open glucose channels
- Students will learn about Chelcie's career choice of pediatric nursing.

Vocabulary

- Type 1 Diabetes
- Ratios/proportions
- Insulin
- Insulin Pump
- Carbohydrate
- Autoimmunity
- Cell Receptors
- Glucose Meter
- I:C Ratio
- Hypoglycemia
- Hyperglycemia
- Pancreas
- Beta Cells
- Correction Factor

About the Lesson

- The lesson follows a nursing student named Chelcie who has Type 1 Diabetes but doesn't let it slow her down.
- This lesson introduces the concepts of ratios, cell receptors, insulin, blood glucose, and other topics related to Type 1 Diabetes.
- Teaching time: one to two 45-minute class period(s)
- As a result, students will:
  - Understand how ratios apply to Type 1 Diabetes
  - Use simulations to understand the process of blood glucose regulation using insulin replacement therapy
  - Understand that entry into a cell is regulated by hormones (insulin)

TI-Nspire™ Navigator™

- Send out the *Type_1_Diabetes_Managing_a_critical_ratio.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials.

Lesson Files:

Student Activity

- Type 1 Diabetes - Managing_a_critical_ratio_student.pdf

TI-Nspire document

- Type_1_Diabetes Managing_a_critical_ratio.tns

Type 1 Diabetes - Managing a Critical Ratio

TEACHER NOTES

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Background

STEM CAREER - This activity describes the life of Chelcie, a nursing student who also has Type 1 Diabetes. Chelcie's career choice was influenced by several factors. She loved math and science in school and had an inspirational teacher that pushed her to pursue her passion. She also had some familiarity with medicine and nursing with the management of her diabetes. Chelcie's goal is to graduate with her nursing degree and become a pediatric nurse to help kids deal with medical challenges.

SIMULATION - Chlecie's management of type 1 diabetes is presented to the students in an interactive way. They must help Chelcie manage her blood glucose levels by using the appropriate amount(s) of insulin. Students will see what happens if Chelcie doesn't receive insulin or doesn't receive enough insulin. They'll also use their new found knowledge to determine Chelcie's ideal insulin to carbohydrate ratio.

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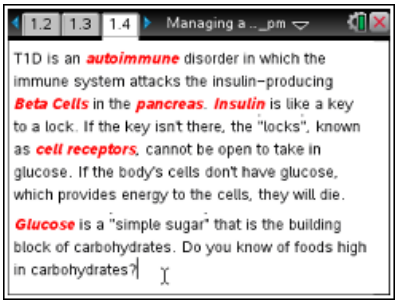
Move to pages 1.2–1.4.

1. Students are introduced to Chelcie, a real-life nursing student finishing her clinical rotations at a Sanford Health hospital. Chelcie also has Type 1 Diabetes and wishes to help children with medical challenges.

2. As the student get to know more about Chelcie, several concepts are introduced. Autoimmunity is the basis for Type 1 Diabetes. The body's immune system attacks specialized cells in the pancreas called Beta Cells. Beta Cells produce insulin and lose that functionality when destroyed by the immune system.



TEACHER NOTES

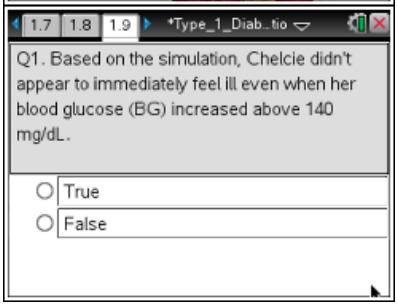
Move to pages 1.5—1.8.

3. These pages introduce students to the first of two simulations. This simulation allows students to test Chelcie's blood glucose levels with a glucose meter, also known as a glucometer. Students will click through meals throughout the day and test Chelcie's blood glucose after each meal. They'll notice that, without insulin, Chelcie's blood glucose quickly increases.

Move to page 1.9. Answer questions here or in the .tns file.

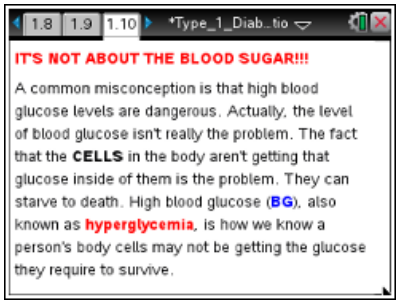
Q1. Choose if Chelcie didn't appear to feel ill just after blood glucose increased above 140 mg/dL.

Answer: True



Move to pages 1.10

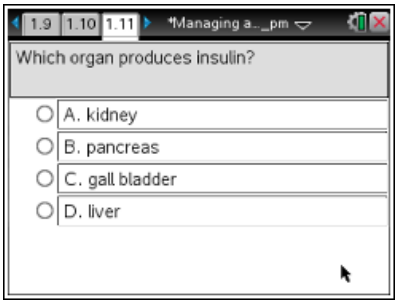
4. Page 1.10 calls out a misconception about Type 1 Diabetes. It explains to students that it's not about the high blood glucose. High blood glucose, or hyperglycemia, is a symptom of the body's cells not allowing glucose to enter. This is dangerous since the cells can die without glucose.



Move to page 1.11 and 1.12. Answer questions here or in the .tns file.

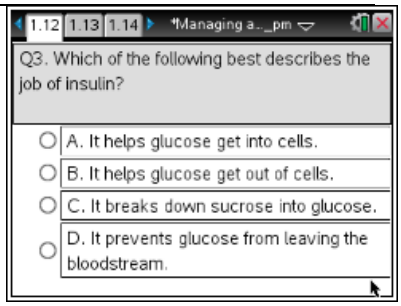
Q2. Which organ produces insulin?

Answer: B. pancreas



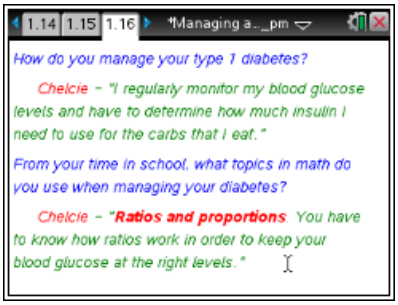
Q3. Which of the following best describes the job of insulin?

Answer: A It helps glucose get into cells.



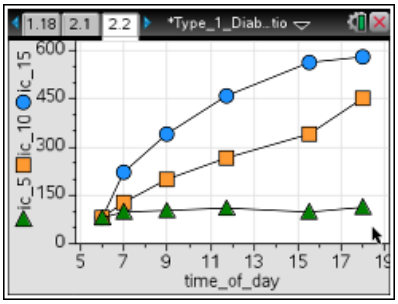
Move to pages 1.13 to 1.18

5. Pages 1.13 to 1.18 detail a conversation with Chelcie about her career choice in nursing and how she manages her diabetes. Students will learn important concepts when reading through the dialog such as the importance of the insulin to carbohydrate ratio, how nursing requires a firm understanding of math, science, and the use of technology, and a challenge for students to try to figure out Chelcie's specific insulin to carbohydrate ratio (I:C).



Move to pages 2.1 and 2.2

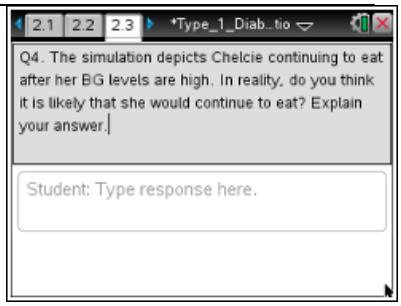
6. These pages have a different version of the first simulation the students encountered. With this simulation, students must decide which dosage of insulin Chelcie should receive at each meal. Since they don't know how many carbohydrates are in each meal, it is a trial and error process. Students start off at 4 units of insulin per meal and will see the graph of blood glucose vs. time is rising beyond the safe ranges of blood glucose. Using 6 units of insulin per meal helps but the blood glucose levels still rise too high throughout the day. Finally, they choose 12 units of insulin per meal which keeps Chelcie's blood glucose levels within a safe range.



TEACHER NOTES

Move to page 2.3 to 2.6. Answer questions here or in the .tns file.

Q4. The simulation depicts Chelcie continuing to eat after her BG levels are high. In reality, do you think it is likely that she would continue to eat? Explain your answer.

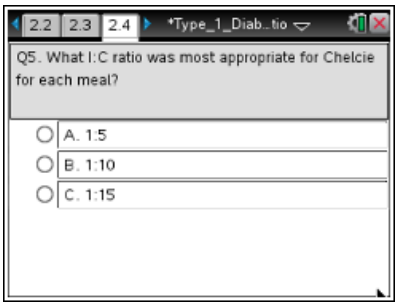


Answer: C. ***Students answers will vary. In general, it is unlikely Chelcie would continue to eat meals when she is feeling sick from sustained high blood glucose. The simulation is meant to give students a feel for how fast blood glucose can increase if not kept in check by insulin.***

Move to page 1.21 and 1.23. Answer questions here or in the .tns file.

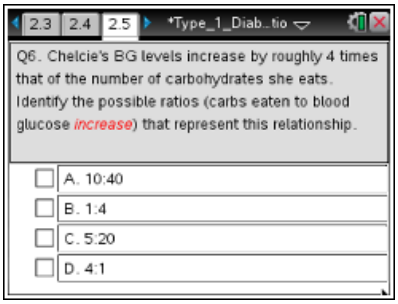
Q5. What I:C ratio was most appropriate for Chelcie for each meal?

Answer: A. 1:5



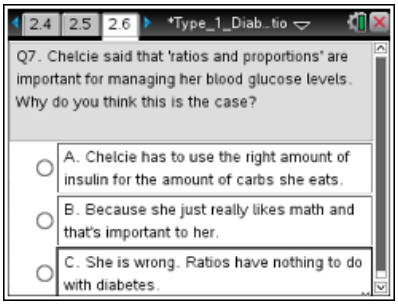
Q6. Chelcie's BG levels increase by roughly 4 times that of the number of carbohydrates she eats. Identify the possible ratios (carbs eaten to blood glucose increase) that represent this relationship.

Answers: A. 10:40, B. 1:4, C. 5:20



Q7. Chelcie said that 'ratios and proportions' are important for managing her blood glucose levels. Why do you think this is the case?

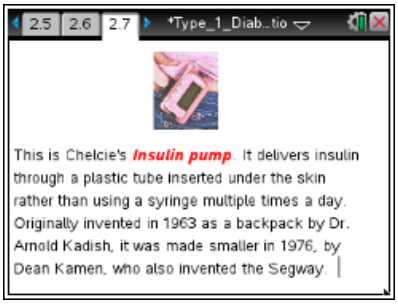
Answer: A. Chelcie has to use the right amount of insulin for the amount of carbs she eats.



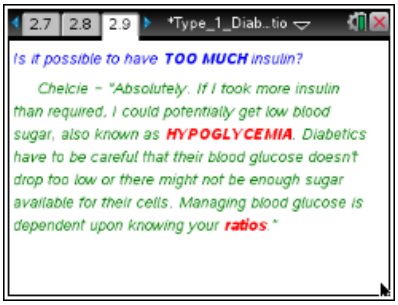
TEACHER NOTES

Move to pages 2.7 – 2.9

7. Pages 2.7 to 2.9 explain to students that although Chelcie once did injections of insulin before each meal, she now wears an insulin pump which decreases the amount of injections she needs to have. The insulin pump was invented in 1963 by Dr. Arnold Kadish as a large backpack but was later shrunk into a small box that could be worn on a belt. Dean Kamen, who also invented the Segway, achieved a more wearable design.



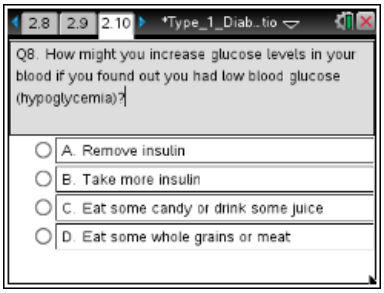
8. Page 2.9 gets back to the conversation with Chelcie where she explains that blood glucose can also go too low resulting in HYPOGLYCEMIA. It's important that diabetics know their ratios and keep their blood glucose within healthy ranges (80 mg/dL for fasting glucose and no more than 140 mg/dL after a meal).



Move to page 2.10 to 2.14. Answer questions here or in the .tns file.

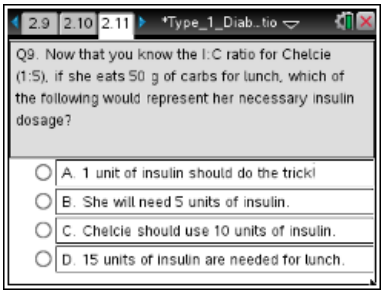
Q8. How might you increase glucose levels in your blood if you found out you had low blood glucose (hypoglycemia)?

Answer: C. Eat some candy or drink some juice



Q9. Now that you know the I:C ratio for Chelcie (1:5), if she consumed 50 g of carbohydrates at each meal, which of the following would represent her necessary insulin dosage?

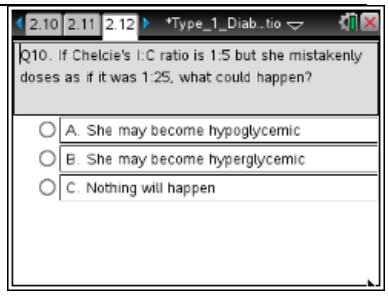
Answer: C. Chelcie should use 10 units of insulin.



TEACHER NOTES

Q10. If Chelcie's I:C ratio is 1:5 but she mistakenly doses as if it was 1:25, what could happen?

Answer: B. She may become hyperglycemic



Q11. In a single day, an average person consumes 250 grams of carbohydrates. Using what you determined Chelcie's I:C ratio is, calculate the units of insulin she would need for the day?

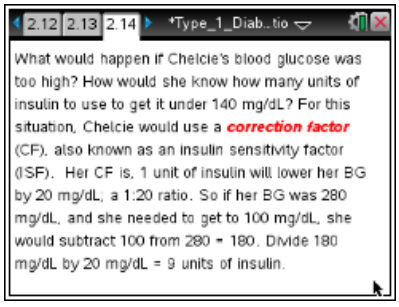
Answer: Students should realize that Chelcie's I:C is 1 unit of insulin to 5 grams of carbs, from previous explorations. Based on the 1:5 I:C ratio, Chelcie would work out her insulin needs by dividing her total carbs for the day by the 5 carbs in her I:C ratio.

250 grams of carbohydrates ÷ 5 grams of carbohydrates/unit of insulin =

50 units of insulin for the day

Move to page 2.14

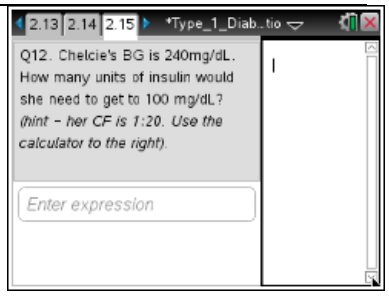
9. Up to this point, students have learned how to determine insulin needs for meals that are about to be eaten. But what would happen if Chelcie found her BG level to be higher than it should? How would she determine how much insulin to take? This page introduces students to the **correction factor.**



10. The correction factor is usually determined by the diabetic's doctor and is based on a number of variables such as insulin sensitivity, or how a person responds to bolus vs. quick-acting insulin. In this example, Chelcie's correction factor is 1 unit of insulin can decrease BG by 20 mg/dL…a 1:20 ratio. Students must subtract Chelcie's goal BG level (100 mg/dL in this example but it could be between 100 to 140 mg/dL) from her current BG level (280 mg/dL in the example) and then divide that difference by 20 to determine the number of insulin units required.

TEACHER NOTES

Move to page 2.15 Answer questions here or in the .tns file.



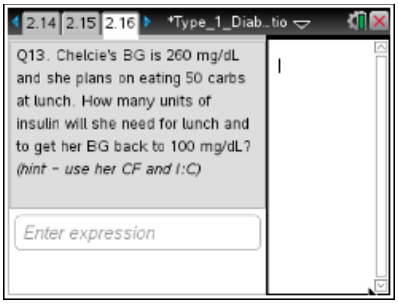
Q12. Chelcie's BG is 240mg/dL. How many units of insulin would she need to get to 100 mg/dL? (hint - her CF is 1:20. Use the calculator to the right).

Answer: Students should subtract 100 mg/dL (the goal BG) from 240 mg/dL (the current BG) = 140 mg/dL.

They should then divide the difference by the CF.

140 mg/dL ÷ 20 mg/dL =

7 units of insulin is her CF



Q13. Chelcie's BG is 260 mg/dL and she plans on eating 50 carbs at lunch. How many units of insulin will she need for lunch and to get her BG back to 100 mg/dL? (hint - use her CF and I:C)

Answer: This problem adds the addition of a meal to the equation. Students should subtract 100 mg/dL (the goal BG) from 260 mg/dL (the current BG) = 160 mg/dL.

They should then divide the difference by the CF.

160 mg/dL ÷ 20 mg/dL =
8 units of insulin is her CF

Then, they must calculate the units of insulin she will need for her meal using her I:C ratio of 1:5

50 grams ÷ 5 grams =
10 units of insulin is for her meal

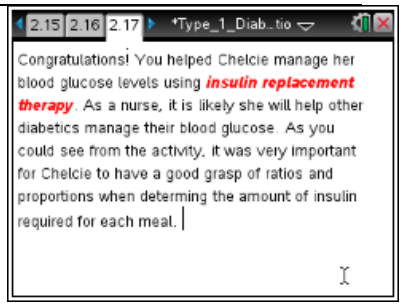
Students must then add the two together –

10 + 8 = 18 total units of insulin

TEACHER NOTES

Move to page 2.17

11. Pages 2.17 concludes the activity with a congratulations page for helping Chelcie manage her blood glucose levels using insulin replacement therapy.



TI-Nspire Navigator Opportunities

Make a student the Live Presenter to demonstrate his or her asteroid simulation graphs.

Wrap-Up

Students will likely have questions about Type 1 Diabetes and the best place to find answers is at the Sanford web site at http://www.sanfordresearch.org/ .

Assessment

- Students will answer questions throughout the lesson to ensure they understand the concepts of Type 1 Diabetes, Ratios and Proportions, Insulin, Blood Glucose, and Cell Receptors.