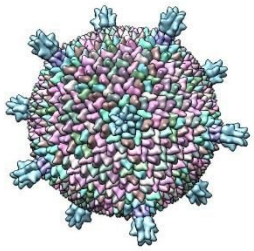
Name(s)_____

Case Study: Can a Virus Cause Diabetes?



Part A: Thirsty Child

Rianne was a healthy 8-year-old who enjoyed playing soccer and going to dance class with her older sister. Her family live in a rural town in central Illinois where the skyline consists of green cornfields and grain silos. She had just started the third grade when her mother noticed that she was losing weight. Rianne's pants were too loose and she seemed tired all the time. At first, she wasn't too worried, perhaps it was just a change to the new school and a new routine. Rianne seemed to be eating and drinking normally. In fact, Rianne was drinking a lot of water. One night, her mother work up to find Rianne awake at three am, drinking a glass of water. At breakfast, she drank another bottle of water and then said, "I'm just so thirsty all the time."

Her mother told her to go to school and scheduled a doctor's appointment, just in case something was wrong. Rianne still seemed tired and thin, and now she even seemed dehydrated. At the doctor's office, Doctor Rashet looked over Rianne's history. "I see you just had your Meningitis vaccine at the end of last year, and you are due for a tetanus shot. Also, your sister had hand foot and mouth disease a few weeks ago, did anyone else in your family have that?"

Rianne made a face and held out her hands to examine the palms. "I don't think so, but Dad definitely got it. It was funny." Doctor Rashet nodded and took out what looked like a small phone. The doctor explained: "This is a glucose meter, want to check something in your blood, so I need to prick your finger."

Rianne was wary about the device. "What's glucose?" The doctor explained that it's a fancy name for sugar.

Reluctantly, Rianne held out her hand and the doctor used a lancet to prick the tip of her finger. A little drop of blood was placed on the device and then a digital readout was displayed. The number on the display said 260 mg/dL. Your blood sugar is really high. It could mean you have diabetes, or it could mean that you just ate a donut. I think we're going to need to do further tests.

Rianne didn't really know what that meant, but she did not like the worried look on her mother's face. By the end of the day, they had a definite diagnosis, Rianne had type 1 diabetes and would need to take insulin injections.

Relieved to have a diagnosis but concerned about her daughter's health, Rianne's mother spent time looking on the internet to find out more about the disease. She didn't understand how Rianne got this disease, or even if diabetes was hereditary; no one in her family has diabetes. Were her other children at risk too?

1. What were Rianne's symptoms?

2. Why was the reading on the glucose meter concerning? What would be a normal level of blood glucose?

3. For each underlined word in the passage, write a short annotation for what the word means.

Part B: What is Type 1 Diabetes?

Type 1 diabetes is characterized by abnormally high blood sugar levels. Specialized cells in the pancreas called beta cells are responsible for producing insulin, which controls the uptake of sugar from the blood into the cells. Without this conversion, cells are deprived of the energy from glucose. Without treatment, the individual will lose weight and suffer damage to the brain and other tissues. Treatment involves injecting insulin daily so that cells can absorb glucose and the patient must constantly monitor their blood sugar levels.

Insulin dependent diabetes mellitis (IDDM) is considered an autoimmune disorder. Autoimmune disorders occur when the immune system attacks the body's own cells and organs. Beta cells of the pancreas are damaged by the immune system and no longer function to create insulin. The reasons for the immune system malfunction are not fully understood and may be the result of genetic differences or exposure to something in the environment, or a combination of those two things.

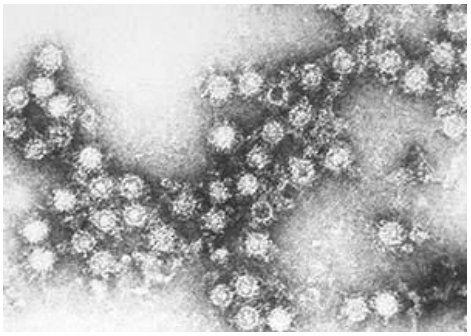
There is no known "diabetes" gene, but those with certain genetic sequences may be more likely to develop the disease. Scientists have recently noted a connection between diabetes and the exposure to a virus.

Coxsackieviruses are nonenveloped viruses with linear single-stranded RNA and are divided into group A and group B. Group A coxsackievirus tend to infect the skin and can cause hand foot and mouth disease. Group B tend to infect the heart and liver. As with many viral infections, symptoms may not appear right away or may never appear, the infection silent and mostly unnoticed.

Some physicians have noted that children who get infected with this virus sometimes develop type 1 diabetes. Is there a causal relationship?

4. Consider what you know about cells. What structure of the beta cells of the pancreas are most likely affected by the immune system? Provide reasoning for your choice.

5. Develop a hypothesis related to diabetes and virus exposure. Remember this should be a testable statement.



6. Consider ways you could test this hypothesis. For ethical reasons, you cannot deliberately infect children with the virus. Describe your research method.

Part B – Collecting Data

Given that it would be unethical to purposely infect children with a virus that might cause a life-threatening illness, researchers have developed a way to test a hypothesis. They look at the risk of developing the disease if you have been exposed to the factor in question. For example, doctors looked at smokers and nonsmokers and found the risk for developing lung cancer was much higher in smokers. In this case, the factor they are investigating is the exposure to Coxsackievirus B and whether that increases the risk of diabetes. There are two methods for conducting this type of study:

- Case Control Studies examine a series of patients who have a disease and a control group that does not have the disease. Researchers compare the proportion of each group with their exposure to the factor in question.
- Cohort Studies classify subjects based on the presence or absence of exposure to the factor and then follow the subject for a period of time to determine if they develop the disease in question.

The raw data tables obtained from a physician records include a variety of information. Some may not be that useful for the case. Examine the raw data on the next page.

*Note: The presence of Coxsackie B antibodies indicates that the patient was exposed to the virus at some point.

7. Scan the data, why do you think sibling information is included?

8. Why do you think that onset of IDDM is included? What is the average age of onset?

9. Based on the data table, would you characterize this as a case study or a cohort study? Why?

10. To analyze data, a two-by-two table is used to compare the exposure to the factor and the presence of the disease. Create this table your data.

	Disease +	Disease -	
Exposure +	a	b	a + b
Exposure -	c	d	c + d
Total	a + c	b + d	

11. The odds ratio is the ratio of odds of exposure among cases to the odds of exposure among controls. For example, an odds ratio of 3.4 would indicate that those individuals with exposure to the factor in this study were 3.4 times more likely to get the disease than individuals without exposure. Calculate the odds ratio for your data.
Calculate the odds ratio (OR). OR = (ad) / (bc)

12. Conclusions: Use the CER method (claim-evidence-reasoning) to state a claim regarding the question of whether virus exposure can result in the onset of juvenile diabetes.

CLAIM:	
Evidence:	Reasoning:

Subject	Sibling with IDDM	Coxsackie B antibodies	IDDM	Age if Onset of IDDM
1	+	-	-	
2	+	+	+	11
3	-	+	-	
4	+	+	+	9
5	-	+	-	
6	-	+	+	8
7	-	-	-	
8	+	+	-	
9	-	+	+	10
10	-	+	+	7
11	+	+	+	12
12	-	-	-	
13	+	+	+	8
14	-	+	+	9
15	-	-	+	8
16	-	-	-	
17	-	+	+	11
18	+	+	-	
19	-	+	+	10
20	-	+	-	
21	+	-	-	
22	+	+	+	9
23	-	-	-	
24	-	+	+	8
25	+	+	+	11
26	-	+	-	
27	+	-	-	
28	-	-	-	
29	-	+	+	7
30	+	+	+	12
31	-	+	+	8
32	+	-	-	
33	-	-	-	
34	+	+	+	10
35	-	+	-	
36	-	+	+	9

CER RUBRIC

Component	Level 3 Proficient	Level 2 Developing	Level 1 Emerging	Level 0 Not Evident
Claim	Claim answers the question, is accurate, and is complete. Completely describes the trend in the relationship between two variables.	Claim does answer the question but it is inaccurate or incomplete.	Claim does not answer the question.	Does not make a claim.
Evidence	Provides appropriate and sufficient evidence to support the claim. Summarizes data.	Provides appropriate, but insufficient evidence to support the claim. May include some inappropriate evidence.	Evidence does not support the claim; only provides inappropriate evidence.	Does not provide evidence.
Scientific Reasoning	Includes logic statements that link the claim, evidence and science concepts (including words such as 'because…' 'therefore…') that clearly demonstrates logical reasoning.	Attempts to include a logic statement that links the evidence to the claim but does not adequately link the evidence to the claim.	Restates evidence or claim and does not include a logic statement that links the evidence to the claim.	Does not include scientific reasoning.