

7.a Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

7.c Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.

Case Study: The Diabetes Generation

DIABETIC?

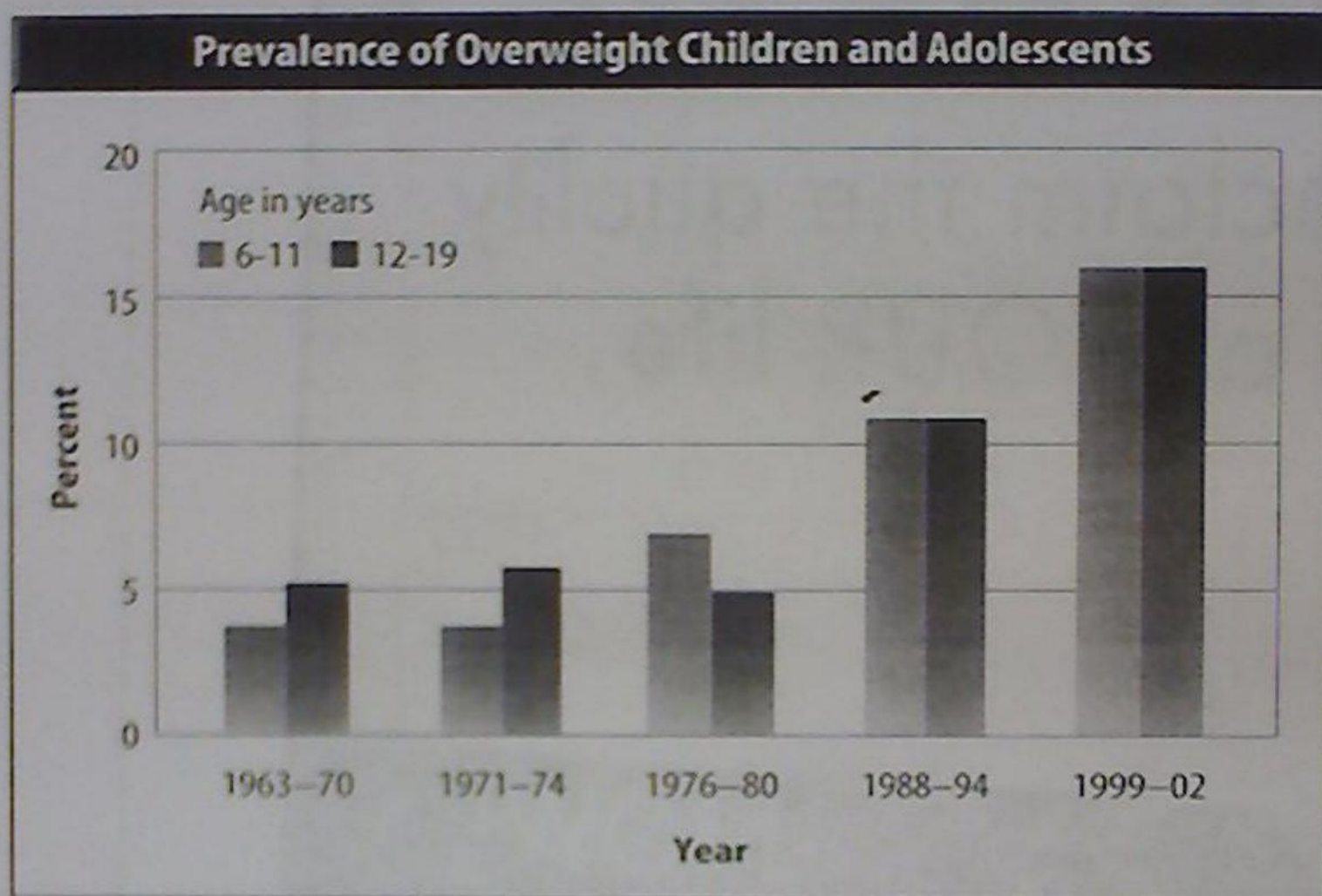
Reclaim the quality
of YOUR life.



Since 1999, health professionals have criss-crossed the country in souped-up travel trailers, collecting data on the physical fitness of America's youth. They are interviewing children and teens about what they eat and how much exercise they get. The scientists give physical exams in the trailers decked out with all the tools you'd find in a doctor's office: scales, blood pressure cuffs, eye vision charts, and syringes to collect blood samples for testing.

Obesity on the Rise

In 2004, scientists looked over the data they had collected in the first three years of the National Health and Nutrition Examination Survey. The study results alarmed everyone: the number of overweight children and teens shot up in the late 1980s. Four times as many youth weigh too much nowadays as they did in the 1960s. That's 1 out of every 7 kids with too much fat on his or her bones.



The results of the National Health and Nutrition Examination Survey revealed that the percentage of overweight children and young adults increased sharply starting in the late 1980s.

Obesity and Diabetes

Researchers know that obesity can lead to diabetes. Sonia Caprio at Yale University in Connecticut and scientists she worked with wanted to know how many kids could develop diabetes. They conducted a study to find out how many children and teens have early signs of the disease.

Diabetes and Sugar

People likely to develop diabetes have too much sugar in their blood. So, the scientists took blood from 167 obese children and teens and measured how much sugar each person carried. They found that almost a fourth of the study volunteers had unhealthy amounts of blood sugar. The scientists also found that 4 teens of the 167 volunteers had diabetes and weren't aware of it.

The Outlook for Obese Children

But those were adults. Can children seemingly destined to get diabetes benefit from exercise? Bernard Gutin at the Medical College of Georgia in Atlanta studies how exercise improves the health of children and teens. He hypothesized that working up a sweat every day would reduce bad fat in children, even if they didn't change their diet. He took 74 overweight children between the ages of 7 and 11 years of age. Some he made exercise for 40 minutes every day. The rest went about their daily routines. After 4 months, he measured visceral fat using MRI.

Although both groups of children gained visceral fat, the group that exercised gained much less visceral fat than the other group. The exercising group weighed less at the end of 4 months than the non-exercising group as well. He concluded from this experiment that exercise got children in better shape, even without changing their diets.

Lesson Learned

Fortunately, all of the scientific data supports the hypothesis that most obese children can avoid diabetes. The best route to good health for all children and young adults involves a combination of improved diet and exercise. Staying away from foods high in fat and refined sugars, and getting exercise every day can make a major difference.



The researchers found that 40 minutes of exercise every day can reduce visceral fat in children.



For children and adults alike, studies show that a healthy diet combined with exercise is the most effective way to reduce the risks of both obesity and diabetes.

Measuring the Effects of Insulin

Then they had to figure out how sensitive the children's bodies were to insulin. Much like the scientists in the rat study, Goran's team injected insulin into the children's blood, which in healthy kids would cut the amount of sugar in their blood. Then they took a sample of blood every few minutes for three and a half hours. In a laboratory, scientists measured the amount of insulin and sugar in the samples.



Then the researchers looked for relationships in the data they had collected. They compared the amount of each child's fat with how their bodies responded to insulin. The researchers found that children with more visceral fat took longer to stop pumping sugar into blood—children with more visceral fat were more insulin resistant than children with less visceral fat. But the researchers found that children with more fat under the skin were no more likely to be insulin resistant than children with less fat under their skin. The team concluded that visceral fat, but not other kinds of fat, contributed to insulin resistance, and possibly, diabetes.

Goran's team of researchers took blood samples from the children in the study in order to measure the amount of sugar and insulin in their blood.

Reversing the Diabetes Trend

Many overweight people have high blood sugar and are insulin resistant. Scientists wondered if the road to diabetes could be reversed for some insulin resistant people by exercise and diet. A group of scientists at the National Institutes of Health started the Diabetes Prevention Program to find out. They took more than 3000 overweight adults from across the United States and divided them into smaller groups. Some they made exercise and eat better than they had been. Others they allowed to behave as they had previously.

After 3 years, the scientists checked the health of the volunteers. Those who exercised regularly and lost about 5% of their weight were far less likely to have diabetes than the other groups.



The Diabetes Prevention Program is helping adults reduce their risk of diabetes through improved diet and exercise.

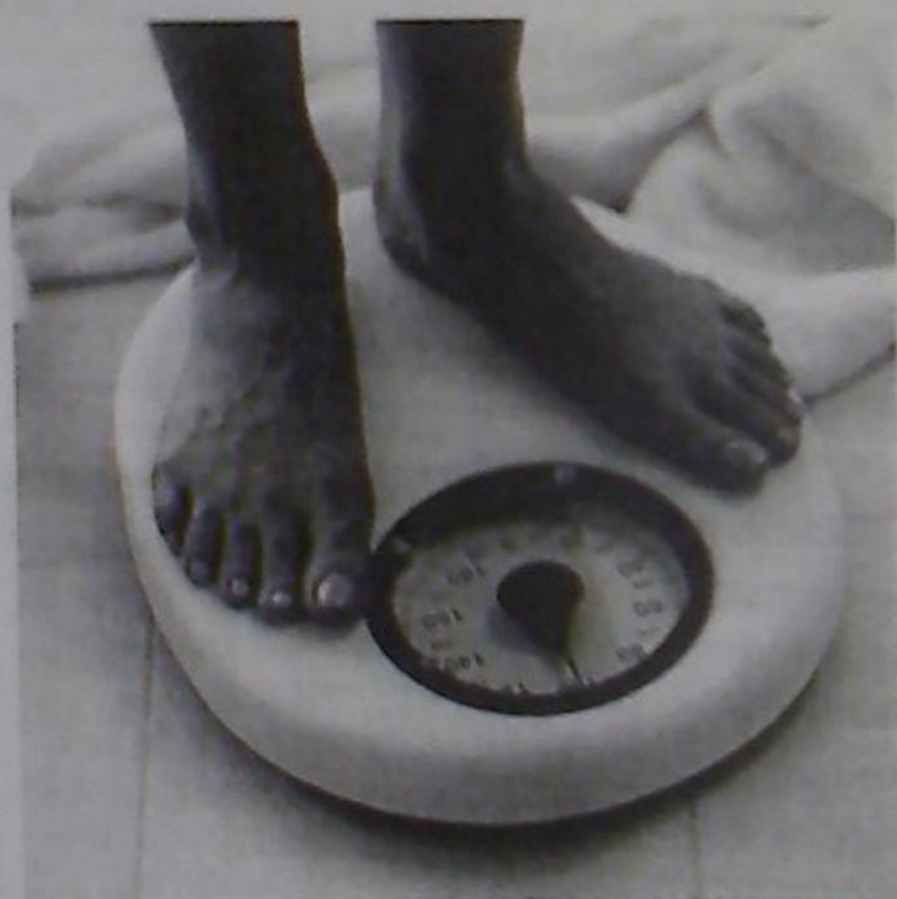
Life Science Case Study: The Diabetes Generation

Fat Experiment Results

The rats who had no fat removed had lots of sugar in their blood the whole time. These results meant they responded slowly to insulin. The rats who had the fat from under the skin taken out also responded slowly. But the rats who had their gut fat removed responded twice as fast to insulin as the other rats. Getting rid of visceral fat also got rid of the insulin resistance, so the researchers concluded that visceral fat causes insulin resistance in young rats.

Fat and Insulin Resistance in Children

But does the same happen in children? Scientists at the University of Southern California (USC) in Los Angeles hypothesized that visceral fat in people might be contributing to insulin resistance in children in the same way that visceral fat does in rats. But scientists can't trim the fat from people like they can from rats. Instead, they predicted that kids with more fat in their gut would have more trouble using insulin.



Researchers at the University of Southern California measured the weights of 32 children between the ages of 8 and 13.

To investigate this possibility, USC researchers Michael Goran, Martha Cruz and Richard Bergman enlisted the help of 32 children between the ages of 8 and 13. The researchers gathered a variety of data: They weighed each child. They measured the different kinds of fat on the children's bodies. They also measured how well their bodies responded to insulin. Weighing is easy to do, but how did the researchers collect the other data?

Fat is a Problem for Insulin

When people eat, their stomachs break down carbohydrates in food into a simple sugar called glucose—the same as table sugar—that tissues can use for fuel. But tissues need insulin to enable sugar to get inside cells, where the sugar is put to use.

In diabetics, muscle and some other tissues don't allow blood sugar to enter cells easily, even though insulin abounds. Some people who aren't diabetic still have trouble using sugar—these people are insulin resistant. Some scientists think a certain kind of fat prevents insulin from storing sugar, sending people with that kind of fat down the road to diabetes.

Testing a Fat Hypothesis

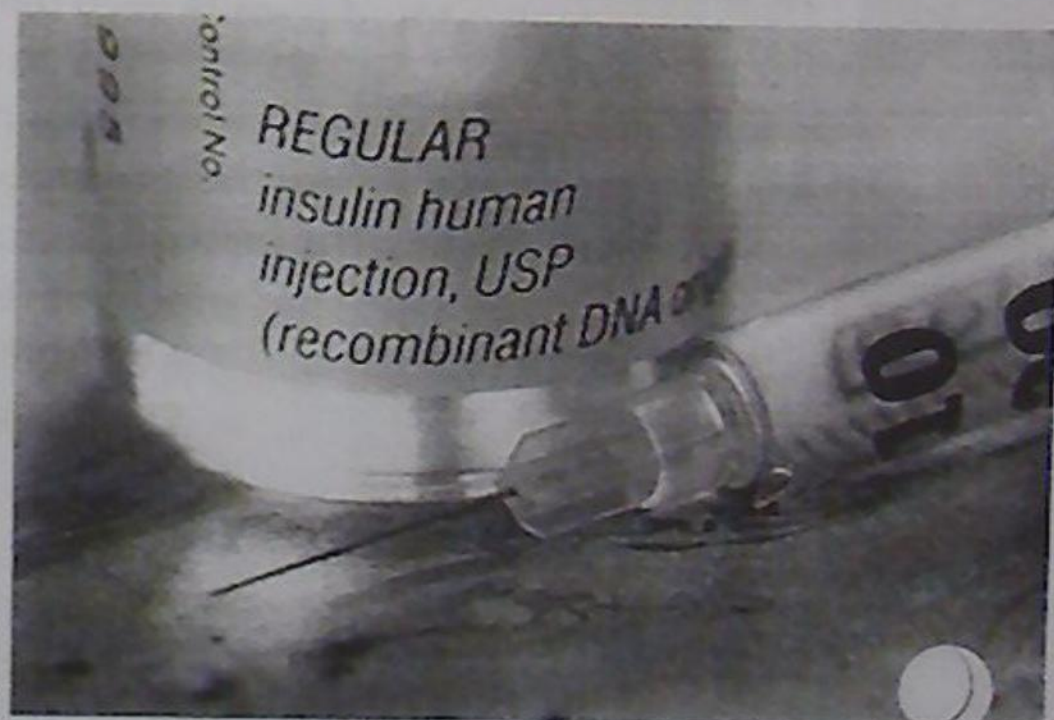
To test the hypothesis that one kind of fat might make someone more prone to diabetes than another kind of fat, a group of researchers first experimented with young adult rats. Nir Barzilai, who works at the Albert Einstein College of Medicine in New York City, and his colleagues tested what kinds of fats might cause diabetes by removing fat from rats and seeing if the animals could use insulin any better.

The researchers performed surgery on three groups of rats. They trimmed fat from the abdomen of one group. This kind of fat is also called visceral fat. They removed an equal amount of fat from just under the skin of another group of rats. In the third group, the researchers pretended to perform surgery and wiggled fat around, but didn't remove any fat. Then the researchers let the rats recover for a few weeks.

In the next part of the experiment, the researchers had to figure out how sensitive the rats were to insulin. Healthy rats and people continually trickle sugar into their blood between meals. The sugar feeds all the tissues and gives people energy even when they're not eating. But if the amount of insulin in the blood rises suddenly, for example, if someone injected insulin into his blood, the body takes this as a sign that plenty of sugar is already coursing through the blood, and quickly stops trickling out sugar. Diabetics don't stop making sugar even when they have lots of insulin in their blood.

People and animals who are insulin resistant react to insulin in slow motion. When the rats healed up, the researchers tested how quickly the rats' responded to insulin. The team injected insulin into the blood of rats. Then they took a sample of blood every few minutes for 2 hours. In a laboratory, scientists measured the amount of sugar in the samples.

Nir Barzilai and his colleagues learned about the relationship between visceral fat and insulin resistance by measuring how quickly rats with visceral fat and rats without visceral fat responded to injections of insulin.



The History of Diabetes

Diabetes mellitus is Greek, roughly meaning “water running through that is sweet.” Diabetics are exceedingly thirsty and have to urinate a lot. Hence the “running through.” And the urine passed by ancient diabetics attracted a lot of flies and ants, suggesting the urine contained something bugs like to eat—*mellitus* is Latin for honey.

Diabetic Dogs

Although the disease goes back to ancient times, only in the last century have scientists found out how to treat diabetes. Dogs who lacked an organ called a pancreas suffered from the disease. Frederick Banting and Charles Best hypothesized that diabetes damaged a particular area of the pancreas.

The Discovery of Insulin

To investigate this idea, the scientists removed the fluid from certain cells in the pancreatic organs of healthy dogs. Then they injected the fluid into diabetic dogs. The sick dogs that got the shots recovered from their disease. But if the scientists stopped giving the fluid to the recovering animals, the diabetes came back. The scientists concluded that whatever the dogs needed to fix the disease could be found in those pancreas cells.

Eventually, the team of scientists discovered a substance made by the pancreas that helped people use their blood sugar properly. Called insulin, this substance could be easily extracted from cows and given to diabetics to reduce the amount of sugar in their blood. The finding so improved the health of people with diabetes that Dr. Banting received the Nobel Prize in Medicine for the discovery.



Scientists Frederick Banting and Charles Best studied diabetic dogs. Their research ultimately led to the discovery of insulin. Insulin is now used to treat diabetes in humans.