

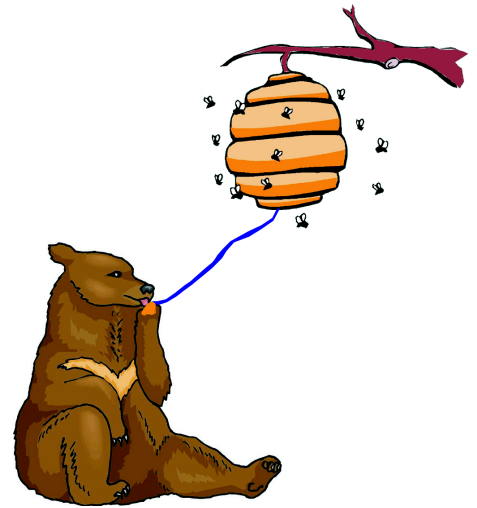
Diabetes

Diabetes: a variable disorder of carbohydrate metabolism caused by a combination of hereditary and environmental factors and usually characterized by inadequate secretion or utilization of insulin, by excessive urine production, by excessive amounts of sugar in the blood and urine, and by thirst, hunger, and loss of weight

What is diabetes?

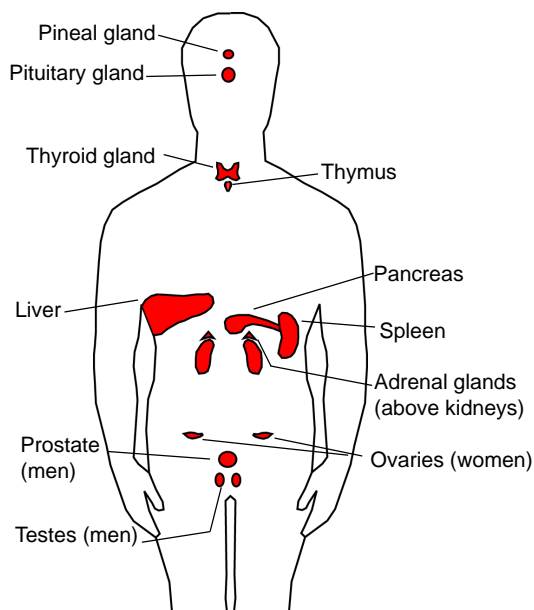
The complete name for diabetes is Diabetes Mellitus, a term from Greek and Latin which literally means “siphon honey.”

*Latin names are usually pretty descriptive.
Can you think what siphon honey might be describing?*



From a medical perspective, diabetes is a disease of the endocrine system, a collection of glands that produce the hormones necessary for normal body function. Hormones regulate metabolism, growth and sexual development. They are released from the glands directly into the bloodstream, where they are transported to organs and tissues throughout the entire body. When a person is healthy, the endocrine system and all the body's other systems work together in balance and harmony.

The Endocrine System



What is the name of the hormone needed by people with diabetes?

More specifically, diabetes is a disease of the pancreas. The pancreas is a long tapered gland which lies across and behind the stomach. It secretes digestive juices which break down fats, carbohydrates, proteins and acids. Special cells in the pancreas, called beta cells, produce a hormone, called insulin, which helps the body regulate its sugar levels. Diabetes occurs when a person's pancreas either produces no insulin or not enough insulin. It can also occur when the pancreas produces insulin but the body doesn't use it properly. Diseases, like diabetes, tell us there is a serious imbalance at play and that our body's systems are not working together as they should.

Carbohydrates: The simple and the complex

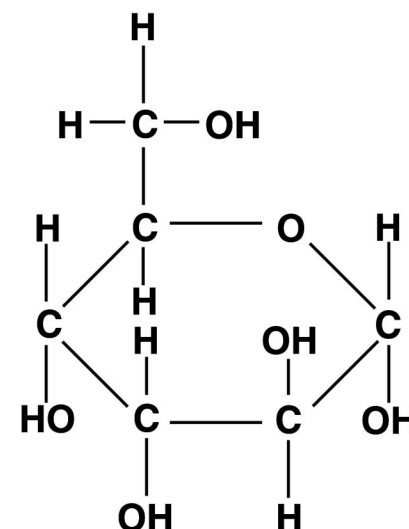
Carbohydrates are molecules made from carbon and water. For something that sounds pretty simple, carbohydrates play a very important role in our lives; they are the source of the energy which keeps us going. Carbohydrates, in the form of glucose ($C_6H_{12}O_6$), supply 70-80% of our bodies' energy needs, and 100% of energy needed by the brain.

Where else have you heard about glucose?

There are two kinds of carbohydrates, simple and complex.

Simple carbohydrates are made of one or two molecules, they are also known as sugars. Simple sugars come in many forms: dextrose, sucrose, fructose, maltose, glucose, corn syrup, maple syrup, honey, brown sugar, powdered sugar etc.

Do you know or can you guess the sources for the above simple carbohydrates?



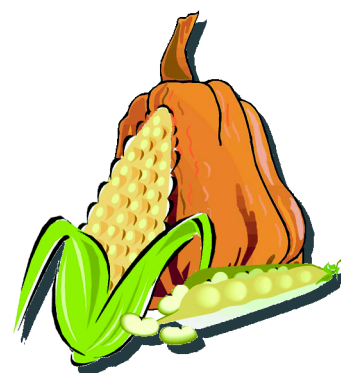
A glucose molecule is made up of 6 carbon atoms, 12 hydrogen atoms and 6 oxygen atoms.



Candy and soda pop contain lots of simple carbohydrates.

Sugars are found in candy, soda pop, and even fruit. They taste really good, but don't really provide the body with much nutritional value. In fact, when you eat too much of them your body doesn't get enough vitamins and minerals. (They also cause cavities in the teeth.)

Complex carbohydrates are long chains of thousands of molecules. They are broken into two groups - fibre and starch. Starches are found in plants including tubers (potatoes, yams), fruit, seeds, nuts, cereals (wheat, bran, barley, rice), legumes (peas, beans) and other vegetables (corn and squash). Complex carbohydrates have much more nutritional value than simple carbohydrates.



Corn, beans and squash - the three sisters - contain complex carbohydrates.

Where is starch found in the traditional foods of your nation?



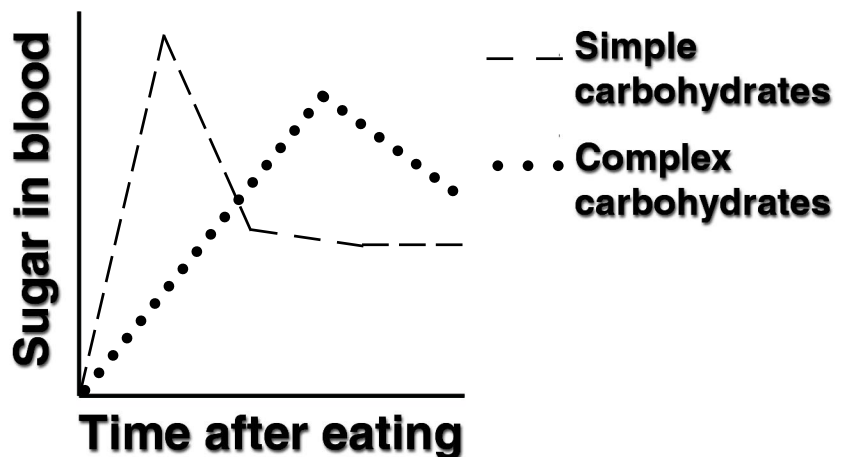
Our bodies use enzymes produced in the saliva, the stomach, the small intestine and the pancreas to break down both simple and complex carbohydrates into glucose.

Which do you think is easier to break down, simple or complex carbohydrates?

Because they only contain a few molecules, simple carbohydrates are much easier to break down than complex carbohydrates. If you have ever had a can of soda pop or a chocolate bar in the middle of the afternoon, you have probably felt the resulting “rush;” a burst of energy that doesn’t last very long. Eating large amounts of sugar (such as those found in a chocolate bar or can of soda pop) causes a spike in blood sugar levels and a rush of insulin from the pancreas. In a very short period of time, your body converts a lot of sugar into energy.

On the other hand, complex carbohydrates break down over a much longer period of time, allowing insulin to more easily maintain balanced blood sugar and energy levels.

For people with diabetes, glucose doesn’t get converted to energy. Instead, it stays in the blood stream and does not get absorbed into tissue and fat. When high sugars levels are maintained over a long time, it can make a person very sick. If nothing is done to lower sugar levels, a person with diabetes can suffer serious complications, like the loss of a limb, and potentially die.



Three types

As far as we know, there are three types of diabetes.

Type 1

In Type 1 diabetes, the pancreas produces no insulin. People with Type 1 diabetes need to take insulin several times daily, usually by injection, in order to regulate their blood sugar. Type 1 diabetes accounts for about 10% of all diabetes. It is a very rare disease among Aboriginal people.

Type 2

In Type 2 diabetes, the pancreas produces less and less insulin over a period of time, and the body does not properly use the insulin it has available. Just about anyone can get Type 2 diabetes, but some people - including Aboriginal people - are more likely to get it than others. The good news is that Type 2 diabetes can be largely prevented through healthy eating and exercise.

Gestational diabetes

Gestational diabetes is diabetes which occurs in pregnant women. The condition usually disappears about 6 weeks after giving birth. Women, especially Aboriginal women, who have had gestational diabetes are more likely to develop Type 2 diabetes later in life.



Diabetes 3

Why do I need to know about diabetes?

While we are not sure what causes diabetes, we do know that there are clear risk factors that make some people more likely to get diabetes than others. For Type 2 diabetes, one of those risk factors is ethnic background and race.

Until the 1940s, diabetes was virtually unknown in Aboriginal communities. Since that time the infection rate has been increasing at an unbelievable rate. Aboriginal people now suffer from Type 2 Diabetes at 3 to 5 times the rate of people in the non-Native population. Native people also get diabetes at a younger age: Type 2 diabetes usually appears in non-Aboriginal people only after the age of 40, but Aboriginal children and teenagers can develop the disease.



Aboriginal people, African Canadians and Hispanic people have a higher incident of type 2 diabetes than the rest of the population.

What do you think might have contributed to the rise in Type 2 diabetes among Aboriginal peoples?

While diabetes is a disease that can be controlled, it has many associated risks and complications, especially over long periods of time. There are things you can do to prevent or at least lower the odds of getting Type 2 diabetes.

What are the risk factors for Type 2 diabetes?

Besides race, there are a number of other factors that make some people more likely to develop Type 2 diabetes:

- A family history of diabetes
- Age
- Previous signs that your body is not processing sugar properly
- Excess weight
- Physical inactivity

Look at the risk factors for Type 2 diabetes. Which ones can you do something about?

Prevention

Prevention of Type 2 diabetes is based on getting exercise and eating a balanced diet.



What kind of activities did your parents and grandparents take part in when they were your age?

Very few people these days are as active as their grandparents were as kids and teenagers. Television, video games, instant messaging, and even really great sound systems; many of the things we enjoy doing don't require a lot of physical activity. Our bodies, however, need activity and exercise to stay healthy, and while it can take a little getting used to, you don't need to try too hard to be active. You can help prevent diabetes by walking to school, playing hockey or lacrosse, or dancing wildly to your favourite CD. Many traditional activities like drumming, dancing, snowshoeing, hunting or just spending time on the land, are also really good for getting the heart going and exercising the body. The bonus of these activities is that you get to spend time with friends and family, and learn about things you can pass along to your own children.

Photo: Health Canada
<http://www.hc-sc.gc.ca/english/media/photos/index.html>



Inuit hunters prepare whale meat.

Diet is also very important in preventing diabetes. You don't have to stop eating things you love, but you should consider what and how much of any food you do eat. Fast food and many processed foods can be very high in fat and sugar. We actually need both fat and sugar for survival, but only in limited amounts. Some foods are better for us than others. If you can go hunting or have access to traditional foods you should try and include them in at least some of your meals. Traditional foods like deer, moose, fish, fresh berries, caribou and goose tend to be:

- lower in calories than processed foods, making them helpful for weight control;
- lower in saturated fat than processed foods, making them healthier for your heart;
- higher in mineral and vitamin content than processed food, providing more of the substances your body needs to stay healthy.

Unfortunately, even with prevention, some people will still develop diabetes, so it's important to know the signs and symptoms of the disease.

What are the signs and symptoms of Type 2 diabetes?

Type 2 diabetes is one of the most under-diagnosed diseases in the world. Unlike other diseases, the signs and symptoms of Type 2 diabetes can go unnoticed for a long time, sometimes even years, so many people have Type 2 diabetes and don't know it. At the same time, some people with Type 2 diabetes do get physical indications that something is out of balance with their bodies.



If you suspect you have Type 2 diabetes, or any other health problem, you should always see a doctor, or a community nurse along with any healer in the community.

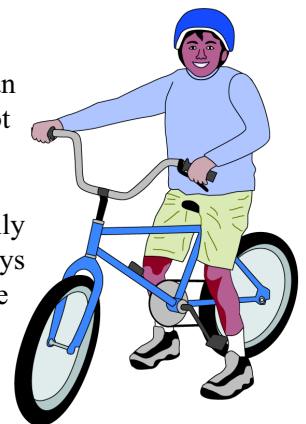
You might have Type 2 diabetes if:

- You need to go to the bathroom all the time
- You are often very thirsty
- You get extremely hungry, even after eating
- You lose a lot of weight without trying
- You are very tired all the time
- You are moody
- Your sight becomes blurry
- You feel sick to your stomach and vomit often
- Your breath smells sweet
- You often get infections in cuts and scrapes, or in the gums, bladder, or skin
- Your cuts and bruises take a long time to heal
- You have tingling or numbness in your hands and/or feet.

How do people live with Type 2 diabetes?

People live with diabetes by learning to rebalance their lives in new ways. This rebalancing can be difficult, but with the help and support of family, friends and community members, it is not impossible.

The key to managing Type 2 Diabetes is exercise and meal planning. This approach works really well for people who catch the disease in its early stages. Exercise helps, because exercise always helps. Planning meals allows people to control the level of glucose in their blood over the course of the day. They have to watch not only the amount of simple carbohydrates (sugar) they take in, but also the amount complex carbohydrates (starch) they get from foods like bananas, tomatoes, squash, cereals and grains (and therefore bread and pasta), potatoes and rice.



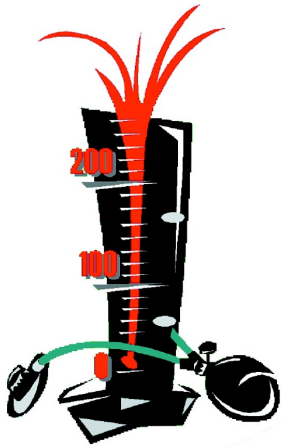
Why do you suppose people with diabetes have to monitor their total carbohydrate intake?

Most people with Type 2 diabetes will monitor their blood sugar levels. This usually involves taking a small blood sample a few times a day, and measuring its glucose content in a machine called a glucose meter. By keeping a record of their sugar levels, people can see how their bodies are responding to the food they eat over a period of time and make adjustments in diet.

Some people with Type 2 diabetes also take medicines to help control glucose levels, or to manage complications related to high blood sugar, however, most people with Type 2 diabetes do not require daily insulin injections.



A community nurse can help people learn to track glucose levels with the help of a glucose monitor.



Complications

About 40% of people with diabetes will develop complications related to the disease.

These include:

- Impairment or loss of vision
- Nerve damage and circulatory problems
- High blood pressure
- Heart disease
- Infections

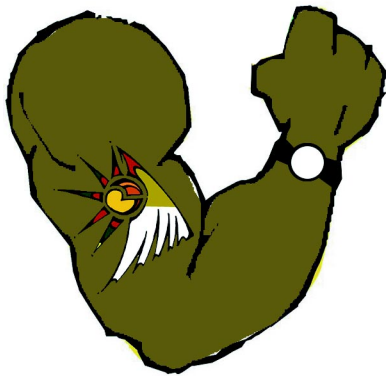
Early diagnosis, glucose monitoring, diet and exercise are the best known ways to prevent or delay complications.

So what does engineering have to do with Type 2 Diabetes?

Believe it or not engineers play a role in keeping people healthy. Biomedical engineers look at people's bodies as if they were machines. By combining knowledge in mechanical, electrical and computer engineering with medicine, human anatomy and physiology, biomedical engineers have developed technologies that can help people manage disease and maintain their physical health. In doing so, they contribute to the emotional, intellectual and spiritual well-being of individuals and communities. Biomedical engineers have developed and are developing methods and technologies that help people with diabetes monitor blood sugar and cope with complications of the disease.

Let your brain run wild. What kind of technology do you think would help people with diabetes monitor blood sugar and cope with complications of the disease?

One of the keys to living with diabetes is managing glucose levels. Small, hand-held glucose meters which allow people to keep track of how well their bodies are controlling sugar levels have been in use for quite some time. As electronic components have evolved, these devices have become small handheld computers. Today, many glucose meters store readings on internal memory chips. By hooking the meter to a computer, the readings can be downloaded and viewed at the local nurses' station, and, in communities with no resident doctor, transmitted to a medical practitioner working elsewhere by the Internet. For people in rural and remote communities these developments in telemedicine mean more time with family and friends, and less time travelling for medical care.



Believe it or not, one day tattoos and watch based monitors may help people track their blood sugar levels. (It isn't likely the tattoos will look like this one!)

Engineers are also looking at others ways of helping people monitor and maintain glucose levels. Some are working on the development of an artificial pancreas that could produce insulin within a person's body, but this development is likely many years away. In the meantime, other engineers are trying to take the pain out of glucose monitoring. Right now in order to test blood sugar levels, a person has to prick a finger tip with a sterile pin called a lancet. The process is painful and overtime scars skin on the fingers. A team of chemical engineers in Texas think the solution to this problem may be to give people with diabetes tattoos. The team has developed a fluorescent material that can be inserted under the skin: the lower the body's glucose level the more the material glows. Diabetics would be able to track glucose levels by measuring the glowing tattoo with a watch-like monitor.

One of the most common complications of diabetes is circulatory problems leading to loss of limbs. Biomedical engineers have developed many different kinds of artificial arms and legs which allow people to remain active. Being able to continue normal activities like hunting, fishing or dancing not only helps people remain physically healthy, but also contributes to their emotional, intellectual and spiritual health as well.

Another complication of diabetes is loss of sight. Howard Phillips, an electrical engineer and member of the Choctaw Nation, hopes his engineering expertise will solve this problem. Howard has been very involved in a project designed to bring sight back to the blind. He holds, in partnership with two medical doctors, patent number 5,109,844 called Retinal Microstimulation. It involves the design and development of a microchip, similar to the one found in your computer, which can be implanted in the eye, and used to restore vision to people who are losing their sight. While it might sound like science fiction, it's not. In fact, what Howard and his colleagues propose for the blind, already exists for the deaf. Certain types of deafness can be alleviated through the use of an electronic device called a cochlear implant. This implant uses electrical signals to bypass damaged and non-working neurons involved in hearing and send sound signals directly to the brain. Howard's project would bypass damaged and non-working photoreceptors (elements in the eye which respond to light) and send light signals directly to the brain. While the microcircuit is still being tested, it could one day bring vision back to people who are living in darkness. Howard is using his knowledge in a way which has the potential to directly help his people. If you were to become a biomedical engineer you could do the same.



Dr. Howard Phillips
Choctaw Nation

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Connecting to Math

You are working with an Elder to talk with people in your community about Type 2 diabetes. Together you have figured out what to say about symptoms and prevention. You want to leave something in class rooms and the community centre that shows people why its is important for them to know more about diabetes. You decide to make some posters that show:

1. The number of non-Aboriginal people with Type 2 diabetes living in Canada.
2. The number of Aboriginal people with Type 2 diabetes living in Canada
3. The number of people in your community who probably have Type 2 diabetes.

To make the posters you do some research and find out:

- There are 29,639,035 people living in Canada (2001 Census)
- About 4% of the population are Aboriginal people - First Nations (status and non-status), Inuit and Métis.
- About 4.3% of non-Aboriginal Canadians have Type 2 diabetes.
- Aboriginal people get Type 2 diabetes 3 to 5 more often than non-Aboriginal people.
- There are 1427 people in your community.

Even graphic designers need to know math! Can you use the math you know to figure out the answers to 1, 2, and 3 above? When you're done, use the results to design a poster (or posters) that will catch people's attention.

