IN A LAB HIGH ATOP A MOUNTAIN...

Hmmm....

THEY ARE LATE.

I'LL GET THE EXPERIMENT READY FOR THEM.
EASY...

KEEP THE BALL STEADY

HEY, ISN'T DR. UPR EXPECTING US BACK AT THE LAB?

AWW MAN... I FORGOT!

MYYYYAAAIII!!!

PASS THE BALL, RITA!!! STAY WITH ALEX!!!
OH MAN!!!

HER NAME IS ALEXANDRA. HER MOM CALLS HER "ALEX"...

HUH...

...WATER

...BIN! AHHHRR!

I CAN MAKE IT... I CAN MAKE IT

YEAH!

I FEEL SO TIRED ALL OF A SUDDEN...

AMAZING!

HEY! SOMETHING'S WRONG WITH HER!
Hey! Alex!

Manuel, go get the first aid kit. Somebody get her some water!

I told her those new contact lenses wouldn't help!

Right away!

Rick, go check Rita!

Ummm... sure thing...

Come on Rita, Alex just fainted.

Dr. UPR, one of the girls from Maggie's soccer team fainted...

Tell him that my daughter has been diagnosed with juvenile type 1 diabetes.

She's been having trouble taking her insulin...

She has high what?

High glucose, sugar, duh!

Don't worry ma'am. We'll run a few tests to see what's going on.

Confirming diabetes.
...A NEW CELL IMPLANTATION TECHNIQUE USING THE MICRO-MACRO CONVERTER (MMC).

THIS IS A CHRONIC CONDITION. I WAS GRANTED PERMISSION BY THE MOTHER TO TRY.

AH, DO YOU REMEMBER WHAT HAPPENED LAST TIME?

I ALMOST GOT EATEN BY A MACROPHAGE...

SO WHAT’S THE PLAN THIS TIME?

AND NOW IT’S GOING TO BE CRAWLING WITH VERY AGGRESSIVE CD4 LYMPHOCYTES...

AHHH!!

YOU WILL BE INJECTED DIRECTLY INTO THE PATIENT’S PANCREAS VIA A TRUNCOR NEEDLE. THEN, YOU WILL PLANT NEW BETA-CELLS INSIDE THE PATIENT’S PANCREAS WITH THE HELP OF NANOBOTS.

IF THAT’S A NANOBOT, HOW COME IT’S SO HUGE?

THAT’S BECAUSE IT’S AN ENLARGED ONE.

HEY DOC, WHERE DID YOU GET THE BETA-CELLS FROM?
**Diabetes Mellitus**

Diabetes mellitus is a group of diseases characterized by high levels of blood glucose resulting from defects in insulin production, insulin action, or both. Glucose is a simple sugar that provides energy to all of the cells in your body. The glucose in the blood comes from the food that you eat. The cells take in glucose from the blood and break it down for energy.

There are 2 types of diabetes. Type 1 diabetes occurs when the body does not make a hormone called insulin. Insulin helps the body use sugar (also called glucose) for energy. People with type 2 diabetes either do not have enough insulin or their cells ignore the insulin they have. Nearly 95% of people with diabetes have type 2.

You are at higher risk for diabetes if it runs in your family, you are overweight, do not exercise, and eat an unhealthy diet. By addressing these risk factors (i.e. losing weight, exercising, and eating healthy foods) you can delay or prevent the development of diabetes.

**Clinical Studies**

Clinical studies are research studies in which people help doctors find ways to improve health care. Each study tries to answer scientific questions and to find better ways to prevent, diagnose, or treat a disease.

Extensive preclinical or laboratory research (in animal and human cells) has to be conducted before a drug or treatment is tested in humans. Only if this stage of testing is successful, the Food and Drug Administration (FDA) will approve the testing of the drug or treatment in humans.

The patient's rights and safety are protected in two important ways. First, any doctor awarded research funds to conduct a clinical study must obtain approval by an Institutional Review Board. The review board is usually composed of doctors and lay people. The group examines the study's protocol to ensure that the patient's rights are protected, and that the study does not present an unnecessary risk to the patient. Second, any person participating in a clinical study in the United States and Puerto Rico is required to sign an "informed consent" form. This form details the nature of the study, the risks involved, and what may happen to a patient in the study. The informed consent tells patients that they have a right to leave the study at any time.

The University of Puerto Rico, Medical Sciences Campus houses a clinical research center, sponsored by the National Institutes of Health, which provides an optimal setting for medical investigators to conduct safe, controlled, state-of-the-art, out-patient studies of both children and adults.
**Stem Cells**

Stem cells are cells with the ability to develop into other types of cells. They have two important characteristics that distinguish them from other types of cells. First, they are unspecialized cells that renew themselves for long periods through cell division. The second is that under certain physiologic or experimental conditions, they can be induced to become cells with special functions such as the beating cells of the heart muscle or the insulin-producing cells of the pancreas.

Stem cells are already being used to treat leukemia and repair some joints. For example, a bone-marrow transplant is accomplished by injecting stem cells from a donor into the bloodstream of the patient. Stem cells from bone marrow can produce new blood cells and also have the ability to repair the liver. Eventually, stem cells may also be used to regenerate organs, reducing the need for organ transplants and related surgeries. Scientists primarily work with two kinds of stem cells from animals and humans: embryonic stem cells and adult stem cells, which have different functions and characteristics. Because stem cells can become bone, muscle, cartilage and other specialized types of cells, they have the potential to treat many diseases, including diabetes.

**Nanotechnology**

Nanotechnology refers to the creation of materials and devices through the control of matter at the atomic and molecular level, where completely new properties exist. Thus, one of the basic goals of nanotechnology research is to control individual atoms. Carbon, hydrogen, oxygen, and other types of atoms are the building blocks of the universe. They make up galaxies, stars, planets, rocks, water, people, trees, CDs, and the cells of our bodies.

The word nanotechnology is derived from the word “nano”, dwarf. A nanometer (nm) is a measurement equaling one-billionth of a meter. A human hair is about 80,000 nanometers wide. Small structures can be used for stronger materials, better medicine, and faster computers. Scientists are also alert to the effects that these new materials may pose to our health.

Nanotechnology has an impact on a diverse collection of fields, touching on biology, medicine, materials, computers, manufacturing, physics, and several others. At the University of Puerto Rico we have scientists (physicists, chemists and engineers) working in the nanotechnology area at both, the Río Piedras and Mayaguez Campus.

... AND NOW BACK TO OUR STORY!
I grew them from adult stem-cells, I obtained from NIH. They will enable the pancreas to produce insulin for the body. Now let's go see the nanobots.

**Pancreas**

**Islet of Langerhans**

---

The gardener-bots plant the new beta cells, while the builder-bots build a cage out of carbon fiber that protects them from the body's immune system. The defender-bots fend off attacking cells while the implant is being done. Manuel, you will oversee the nano-bots with the new software in your inner-space suit's computer.

---

Now the team enters the MMC chamber to be shrunk down.

---

I hate this part of my job.

---

Ok guys, suit up so we can shrink you down using the MMC machine and inject you inside the patient.
EVERYTHING IS READY AND ALEX SHOULD BE OUT SOON.

I KNOW EVERYTHING WILL BE FINE WITH MY DAUGHTER.

OK MARGARITA, IS THE PATIENT PREPARED?

YES DOCTOR, EVERYTHING IS READY. YOU CAN INJECT THE TEAM AND THE NANOBOTS INSIDE THE PATIENT'S PANCREAS.

VERY WELL, LET US BEGIN.

INSIDE ALEX'S PANCREAS

HEY MANNY, WILL YOU GET YOUR LEG OFF OF ME?

THAT'S NOT MANNY THAT'S ME!

OWWW!

WHHHOO OOO-AAA AAHHH!!!
THAT SURE WAS A ROUGH RIDE!

LET'S DO THAT AGAIN... I'M CALLING DR. UPR

I BUMPED MY HEAD... OUCH...

NO!

PHASE 1 HAS BEEN COMPLETED. THE TEAM IS INSIDE, NOW WE WILL PROCEED TO PHASE 2, NANO-BOT DEPLOYMENT.

OK GUYS, WE ARE ABOUT TO RELEASE THE NANO-BOTS.

HEY! I DON'T SEE ANYTHING COMING OUT.

WHOA!

INSIDE THE PANCREAS THE NANO-BOTS ARE BEING DEPLOYED

GET OUT OF THE WAY!

COOOOOLL!
MAN, THIS IS JUST CRAZY!

WE HAVE A LITTLE GIRL TO SAVE.

I'M GOING BACK UP THAT NEEDLE!

OH, ALRIGHT.

HOLD ON RICK!

THE GARDENER-BOTS DO NOT HESITATE AND START PLANTING NEW BETA-CELLS, WITHIN THE PANCREAS ISLETS OF LANGERHANS.

CD4 CELLS DETECT THE NEW BETA-CELLS AS THEY ARE EXPOSED...

THE BODY'S IMMUNE SYSTEM STARTS ATTACKING
The defender-bots give the attacking cells an electric shock, chasing them away unharmed...

...the builder-bots weave a carbon fiber cage around the beta-cells being planted...

...protecting them from being attacked.

As the islets of Langherans are restored...

So are the functions of the pancreas...
Gotta get this pancreas to start producing insulin again.

Gotta help as much as I can!

There we go.

Huh!

Hey Rick, stop picking on Rita!

...And Manny, stop slacking off!

Hey Rita! Cover up that cell before it gets attacked.

I'm your boss, now move!

May I ask what are you doing?

I'm supervising.
HMMM... THIS IS STRANGE.

WHAT IS IT, MAGGIE?

THE COMPUTER DOESN'T SEEM TO BE RESPONDING WELL.

SEBASTIAN! SO IT WAS YOU.
QUICK, CONTACT MANUEL!

OOO-OUUUCH!

HEY WHAT'S GOING ON HERE?

DON'T WORRY RITA, I GOT THEM.

HHHYYYY-AAAHHHH-HHH!!

HEEY... WHERE'S RICK?

Oof! THAT WAS CLOSE...

RIIICK!!!

HEEY! AHHHHHH!!!
WHAT DO YOU THINK YOU'RE DOING YOU CRAZY BOT!

MANUEL CAN YOU HEAR ME?

JUST WAIT UNTIL I GET OUT OF HERE. YOU'RE GOING TO THE DUMPSTER!

RICK HOLD ON, SOMETHING'S WRONG HERE!

OH WILL YOU BE QUIET! MANUEL WILL GET US OUT OF THIS...

... RIGHT MANNY?

MANUEL, SEBASTIAN CHEWED ON THE POWER-CABLE OF THE MAIN CONTROL UNIT FOR THE NANO-BOTS. USE YOUR COMPUTER TO OVERRIDE THE MAIN SYSTEM CONTROL.

I NEED THE SYSTEM SECURITY CODE!

I'LL SEND IT TO YOU.

GREAT!

MANNY, I NEED SOME HELP HERE.
I'M COMING RITAAA!

IT'S ABOUT TIME! NOW, WILL YOU TELL THIS ROBOT THAT I'M THE BOSS.

MANUEL, WE HAVE TO PROTECT THE BETA-CELLS FROM BEING ATTACKED!

WHOA!

HMMPH!

HYYYYAHHHH!

WITH THE NANOBOTS NOT FUNCTIONING RIGHT...

THE BODY'S IMMUNE SYSTEM STARTS ATTACKING...

...DESTROYING ANY EXPOSED BETA-CELLS.

YEAH I'M WORKING ON IT.
Hey! I got the code!

Great. So when are you going to pull me out of this thing?

Got it!

Rita, you control the Gardener-Bots.

Ah! Ahhhhh! Aahhhhh! Aahhhhh! Aahhhhaa! Hahahah! Ahhhhh! Aahhhhh!

Rick, yelling does not help.

Rick, you control the Builder-Bots.

I'm gonna have fun now!

I'll control the Guard-Bots. Use the computer's on your wrists.
THE NANO-BOTS SEEM TO BE BACK ONLINE AND THE PATIENT'S STATUS HAS STABILIZED.

GREAT! MANUEL DID IT!

I THINK WE'RE ALMOST DONE RESTORING THE INSULIN PRODUCING CELLS IN THE PANCREAS.

OK, I'LL TELL THE DOCTOR TO RETRIEVE YOU GUYS.

HURRY UP YOU LAZY BOT! I'M IN CHARGED NOW!

WELL GUYS, I GUESS THINGS ARE THE WAY THEY SHOULD BE. THE BETA-CELLS ARE STARTING TO PRODUCE INSULIN.

AND NOW THEY CAN'T BE ATTACKED BECAUSE OF THE CARBON-FIBER NETS THE NANO-BOTS BUILT AROUND THEM.
OH ... ummmm....I WAS JUST TESTING SOME OF THESE NANOBOT FEATURES. YOU KNOW, THEY COULD BE OF USE LATER.

JUST WHAT ARE YOU DOING?

UHMM... RICK?

OK TEAM, THE NEEDLE IS IN PLACE, START BOARDING PROCEDURES AND LET'S BRING THE NANOBOTS HOME.

SURE RICK, STOP TORTURING THEM ALREADY!

RIGHT ON DOC!

HEY THERE'S THE NEEDLE WHOOPYYYY!!!

TWO WEEKS LATER

GOOD JOB TEAM. ALEX SEEMS ALL RIGHT.
RITA SEEMS TO BE HANDLING HERSELF VERY WELL ON THE PLAYING FIELD.

Ah, greetings "Doña Rosa".

I just hope I don't have to drag Rita back to the lab like last time.

Hello Dr. UPR.

The cell implants in Alex's pancreas should last for a long time with this procedure.

Yes, my daughter is looking really well. Thank you so much.

Hey, I'm open...

Oh no...
“SIGH”

GET HER!!!
GO, GO, GOOOO!!

BAM! BAAAM!

HEEY, COACH MAGGIE?

YEEAH?

OK, GUY’S, LET’S WRAP IT UP...

NOT AS LONG AS YOU FOLLOW DR.UPR’S INSTRUCTIONS, EXERCISE A LOT AND TEST YOUR GLUCOSE LEVEL BEFORE EVERY MEAL.

I DON’T HAVE TO STOP PLAYING SOCCER, DO I?

AAAALLEEEX!!?

BY THE WAY, GOOD GAME!

MOM!
COACH MAGGIE, MY MOM'S CALLING ME.

SO I GUESS EVERYTHING ENDED WELL...

SEE YOU NEXT WEEK, ALEX!

ONCE AGAIN, WITH THE HELP OF BIOMEDICAL RESEARCH, OUR HEROES HAVE MADE ONE LITTLE GIRL HEALTHY AND HAPPY AGAIN.
**Beta Cells** - one type of cell in the islets of Langerhans in the pancreas; they make and release insulin, a hormone that controls the level of glucose (sugar) in the blood

**Carbon Fiber** - threadlike strands of pure carbon that are extremely strong and flexible

**CD4 Lymphocytes** - cells that when activated secrete cytokines that regulate other lymphocytes; they are one of the targets of HIV infection

**Clinical Trial** - a carefully designed investigation of the effects of a drug, medical treatment, or device on a group of human subjects

**Diabetes** - chronic disorder of glucose (sugar) metabolism caused by inadequate production or use of insulin

**Glucose** - the principal circulating sugar in the blood and the major energy source of the body

**Implant** - an organ, tissue, or mechanical device surgically inserted and left in the body

**Insulin** - a peptide hormone secreted by the islets of Langerhans of the pancreas that regulates the level of sugar in the blood; insulin permits cells to use glucose for energy

**Islet of Langerhans** - irregular clusters of endocrine cells scattered throughout the tissue of the pancreas that secrete insulin and glucagon; there are about one million islet cells in a healthy adult human

**Lymphocytes** - white blood cells involved in the body's immune system; B-lymphocytes mature into cells which produce antibodies; T-lymphocytes help to protect against infections and they are divided into helper cells, suppressor cells and cytotoxic cells; natural killer (NK) lymphocytes destroy infected cells.

**Micron** - measurement unit that is equal to one millionth of a meter, $10^{-6}$ meter, represented by the symbol "µ"

**Nanobot** - is a microscopic machine made up of nano-sized elements that is a mechanical or electromechanical device whose dimensions are measured in nanometres (millionths of a millimeter, or units of $10^{-9}$ meter)

**Nanometer** - measurement unit that is equal to one billionth of a meter, $10^{-9}$ meter, represented by the letter "n"

**Nanotechnology** - The creation of materials and devices through the control of matter at the atomic and molecular level

**Pancreas** - a spongy fish-shaped grayish-pink organ about 6 inches (15 cm) long that is located behind the stomach; the pancreas makes insulin, as well as other hormones and enzymes

**Pancreatic Duct** - part of a system of ducts in the pancreas; pancreatic juices containing digestive enzymes are released into these ducts and flow into the small intestine

**Pro Insulin** - a single-chain polypeptide that is the precursor of insulin and converted into insulin by enzymatic action

**Stem Cells** - cells that can transform into other types of cells; they are produced both during embryonic development and in the adult body; many embryonic stem cells have the ability to become any cell type, such as blood, skin, muscle or nerve cells
CONNECT THE DOTS TO SEE WHAT A PANCREAS LOOKS LIKE!

Pancreas: A fish-shaped spongy grayish-pink organ about 6 inches long that stretches across the back of the abdomen, behind the stomach. The head of the pancreas is on the right side of the abdomen and is connected to the duodenum (the first section of the small intestine). The narrow end of the pancreas, called the tail, extends to the left side of the body. Insulin is produced in this organ.

PANCREAS
Dr. Liliam González de Pijem
Pediatric University Hospital
Director, Pediatric Endocrinology
Professor
University of Puerto Rico
Medical Sciences Campus

Rick: When did you become interested in science?

Dr. González: Since my childhood, I was interested in the disease process, most of all in how to cure them. When my dolls got “sick” I was always the “doctor” who attended them. My uncle was the town doctor and I was always fascinated with his work, especially when I visited his office and saw his work instruments and the medical laboratory next door.

Rick: What did you study?

Dr. González: I obtained a Bachelors Degree in Biology and Chemistry and did an internship in Medical Technology before studying medicine. Once I graduated from medicine, it was natural for me to specialize in pediatric endocrinology since this field has all the elements of science and pediatrics that I enjoy.

Rick: What do you do in your work?

Dr. González: I treat children and adolescents with endocrine problems such as; diabetes, developmental problems, growth problems, problems with the thyroid, etc. As part of my job I must stay informed (updated) regarding new medications in the market and the latest treatment modalities to educate not only the patients with regards to their illness but also to educate medical residents who will be our future pediatricians. We also work closely with the pharmaceutical companies when a new medication is introduced in the market by evaluating the benefits and assuring that they do not adversely affect our children and adolescents.

Rick: What do you like best about your job?

Dr. González: Helping a patient who comes to me with problems due to diabetes, growth or another endocrinological disorder and I help them conquer the disease.

Rick: What type of person makes a good clinical scientist?

Dr. González: In order to be a good clinical scientist, the person should be dedicated, as well as have the desire and disposition to help patients. In addition, they should always have an open mind to evaluate and accept new treatment modalities which could help a patient.

Rick: Do you have some suggestions for the BioMed Battle Team?

Dr. González: They should continue their mission of educating and providing services to patients with endocrinological diseases without forgetting to evaluate the benefits and adverse reactions of the medicines that are given to patients.
MATCH THE WORD WITH THE PICTURE.

___ GLUCOMETER - a portable monitor used to measure blood glucose levels
___ NANOBOT - a robot of nanoscopic dimensions, enlarged by the MMC
___ GLUCOSE - a simple sugar (monosaccharide) molecule commonly encountered in the blood; chemical formula is C₆H₁₂O₆
___ PANCREAS - a long irregularly shaped gland lying behind the stomach, that secretes insulin into the bloodstream
___ BETA CELL - insulin producing cell of the islets of Langerhans in the pancreas
___ GLAUCOMA - eye disease that causes elevated pressure in the eye and can lead to partial or complete loss of vision
___ INSULIN - a complicated protein molecule used in the treatment of diabetes; hormone secreted by the pancreas; chemical formula is C₂₁₅H₃₄₁O₂₅N₁₈S₇
___ ANTIBODY - "Y" shaped protein produced by mature B cells called plasma cells, which neutralizes antigens by binding to them
___ LYMPHOCYTE - a type of white blood cell involved in the human body's defenses; there are three categories of lymphocytes: T cells, B cells, and natural killer (NK) cells
___ EXERCISE - activity performed to develop or maintain fitness; physical exercise can be a very helpful health indicator
___ THIRST - sensation indicating the body's need for water
___ KIDNEY - organ that filters wastes from the blood and excretes them as urine

A  B  C  D  E  F  G  H  I  J  K  L
BIOMED BATTLE TEAM™
WHAT'S MISSING?

Find the parts from drawing “A” that are missing in drawing “B”. Circle with a pencil the parts that are missing in drawing “A”. Each drawing has five missing elements! Can you find them?
How many new words can you make using the word Diabetes?

Use the following scoring table to calculate your points for each word and write the number besides the word.

- 3 letter word = 1 point
- 4 letter word = 2 points
- 5 letter word = 3 points

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**My total score**