

Supplemental information

Impact of a playful booklet about diabetes and obesity on High School students in Campinas, Brazil

Gabriela M. Soares, Lucas Zangerolamo, Lucas R. O. Rosa, Renato C. S. Branco,
Everardo M. Carneiro, Helena C. Barbosa-Sampaio

1) Consent term

University of Campinas - UNICAMP

CONSENT TERM

You are being invited to participate of a research conducted by the OCRC - Obesity and Comorbidities Research Center. This research aims to evaluate the knowledge of high school students about Obesity and Diabetes.

The participation in this study consists in answering a questionnaire whose objective is to collect information from the students' knowledge regarding Obesity and Diabetes.

Having been advised of the content of the questionnaire and understood the nature and purpose of the study, I _____, **ID:** _____, **responsible for the student** _____,

ID: _____, authorize the participation in the research mentioned above, being fully aware that there is no economic value, receivable or payable, for participation.

Comments,

- The student's privacy will be respected; in other words, his/her name or any other data or element that may, somehow, identify him/her, will be kept confidential.

Prof Dr Helena Cristina de Lima Barbosa Sampaio
OCRC – Obesity and Comorbidities Research Center

Street Carl Von Linaeus, Campinas - SP, Zip Code: 13083-864.

2) Quiz

1) Diabetes is a disease characterized by:

- a) Increased blood glucose levels
- b) Increased blood insulin levels
- c) Decreased blood glucose levels
- d) Increased blood adrenalin levels

2) Which hormone is involved with diabetes development and how?

- a) Adrenalin – Excess of adrenalin favors the development of diabetes.
- b) Insulin – Excess of insulin favors the development of diabetes.
- c) Insulin – Low levels of insulin or deficiency on the action of this hormone, favors the development of diabetes.
- d) ADH (Anti-diuretic hormone) – Excess of ADH favors the development of diabetes.

3) Regarding blood glucose (fasting glycemia), choose the correct alternative:

- a) An individual with glycemia of 50 mg/dl is in normal condition.
- b) An individual with glycemia of 110 mg/dl is diabetic.
- c) An individual with glycemia of 115 mg/dl is in normal condition.
- d) An individual with glycemia of 135 mg/dl is diabetic.

4) Which factor(s) favors the development of obesity?

- a) Bad eating habits.
- b) Sedentary lifestyle.
- c) Genetic predisposition.
- d) All alternatives above.

5) Which organ produces the hormone insulin?

- a) Liver.
- b) Intestine.
- c) Pancreas.
- d) Stomach.

6) Regarding the difference between type 1 and type 2 diabetes, choose the correct answer:

- a) The development of type 2 diabetes occurs when there is no insulin production.
- b) The development of type 1 diabetes occurs when the organism presents resistance to insulin's action.
- c) The development of type 1 diabetes occurs when there is no insulin production.
- d) The development of type 2 diabetes occurs when there is excess in insulin production.

7) About insulin's actions in the organism, choose the correct alternative:

- a) Insulin acts on pancreatic beta-cells stimulating them to produce glucose.
- b) Insulin acts on adipose tissue stimulating fats breakdown.
- c) Insulin acts on hypothalamus stimulating glucose synthesis.
- d) Insulin acts on liver cells stimulating them to store glucose.

8) Insulin acts upon an organ, producing satiety sensation. What is this organ?

- a) Hypothalamus (located in the brain).
- b) Skeletal Muscle.
- c) Liver.
- d) Intestine.


9) Is obesity a disease?

- a) Yes, obesity is a chronic disease that culminates on metabolic alteration of multiple organs, including the brain.
- b) No, obesity is only a condition of excessive adipose tissue (fat).
- c) Yes, obesity is a chronic disease caused only by genetic factors.
- d) No, because obesity doesn't disturb the function of any organs.

10) What are hormones and what do they do?

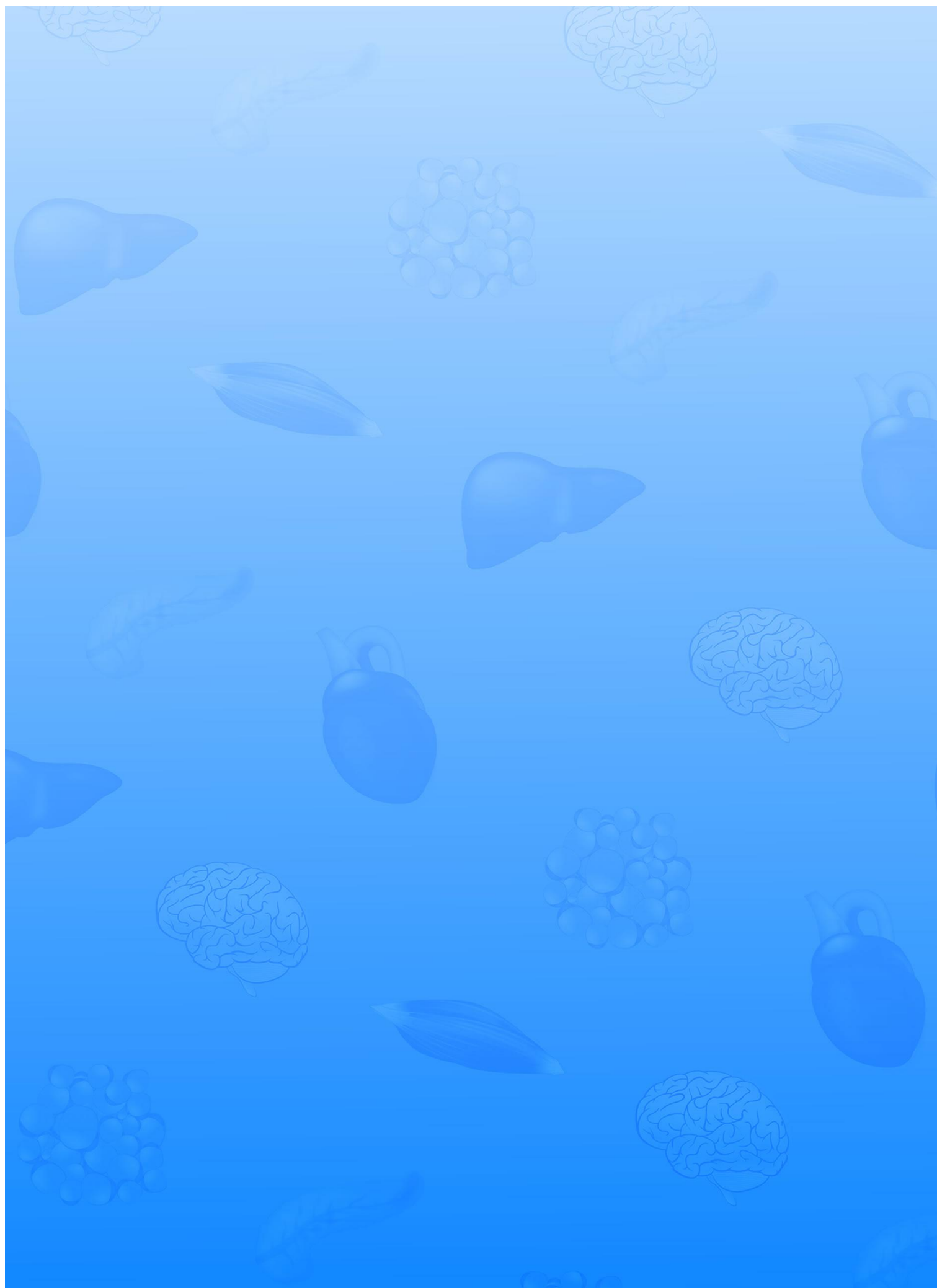
- a) Hormones are molecules that serve as energy source.
- b) Hormones are molecules that increase muscle's contraction strength in stress situations.
- c) Hormones are molecules produced in the heart that act in multiple organs.
- d) Hormones are molecules produced by glands that help control many processes in the organism.

3) *Booklet*

An illustration of a female scientist with long brown hair and blue eyes, wearing a white lab coat over a green shirt. She is holding a large white sign with a blue border. The background is a laboratory setting with shelves containing various glassware like flasks and beakers with colored liquids. Above her head are three blue circles connected by lines, resembling a molecular structure or a network diagram. The floor is made of light brown wooden planks.

WHY TO KNOW ABOUT OBESITY AND DIABETES?





Do you know what obesity and type 2 diabetes are? So, let's go!

In this booklet we will get to know a little more about these diseases that become more prevalent every day in the world.

Here you will learn about them through interactive games. The proposed activities will help you to understand more about these subjects

WANNA JOIN US!?



OBESITY

Obesity is a chronic disease characterized by excessive body fat accumulation. This situation occurs when there is an unbalance between calories uptake and expenditure, in other words, when we eat too much and don't waste energy with our daily activities.

Obesity development is related with many factors, including genetic factors (predisposition), social factors, bad eating habits, sedentary lifestyle and hormonal disturbs. In this context, modern lifestyle induces us to have bad eating habits by opting for industrialized and fast foods. Besides, practices of physical activities have decreased in the last decades, which in association with unhealthy eating contribute to increase of obesity levels in the whole world.

For example, in 2016, over 650 million people in the world were obese and 1.9 billion were overweight. Obesity is a very dangerous disease due to its relation with development of many complications, such as: diabetes, atherosclerosis (fat accumulation on blood vessels), cardiovascular problems (heart attacks and strokes) and even cancer.

Nowadays, a few drugs or even surgery (in extreme cases) can be used in attempt to combat obesity, however, nutritional reeducation and practice of physical exercises is more adequate to reduce body weight in a natural manner. Therefore, prevention is better than treatment and it can be done through adoption of healthy habits and lifestyle.

A woman with long brown hair and blue eyes, wearing a white lab coat over a green shirt, is holding a large, dark red sphere. The sphere has the word "OBESITY" written on it in white, bold, capital letters. The background is a bright blue gradient with several faint, light blue hexagonal shapes scattered across it.

OBESITY

DIABETES

Diabetes Mellitus is a disease characterized by elevated blood sugar (glucose). This glucose circulating in our vessels come from the food we eat, especially carbohydrates like potatoes and rice. Glucose is very important for our body because it is used as energy source for our cells.

However, to be able to use this glucose as energy source, cells need to capture it from the blood. A hormone, called insulin, produced by the beta cells that are localized in the pancreas, is the responsible for stimulate glucose uptake in muscle cells, adipose cells (fat cells), among others.

Therefore, insulin deficiency can lead to diabetes. This problem can happen in two situations: 1) when the pancreas does not secrete insulin or 2) when the pancreas secretes less insulin and it loses its action upon cells, a phenomenon known as insulin resistance. That is why diabetes is divided between two types: type 1 diabetes and type 2 diabetes. In type 1 diabetes, an immunological defect makes the organism recognize the pancreatic beta cells as invaders and destroy them. Therefore, the pancreas is incapable of secreting the required amount of insulin and that's the reason blood glucose levels rise. In type 2 diabetes, genetics play an important role. However, this type of diabetes is more related to each individual's habits. Risk factors include: obesity and overweightness, sedentary lifestyle, hypertension, excessive alcohol consumption and old age. Therefore, healthy eating and regular physical exercise are a good call in prevention of type 2 diabetes development.

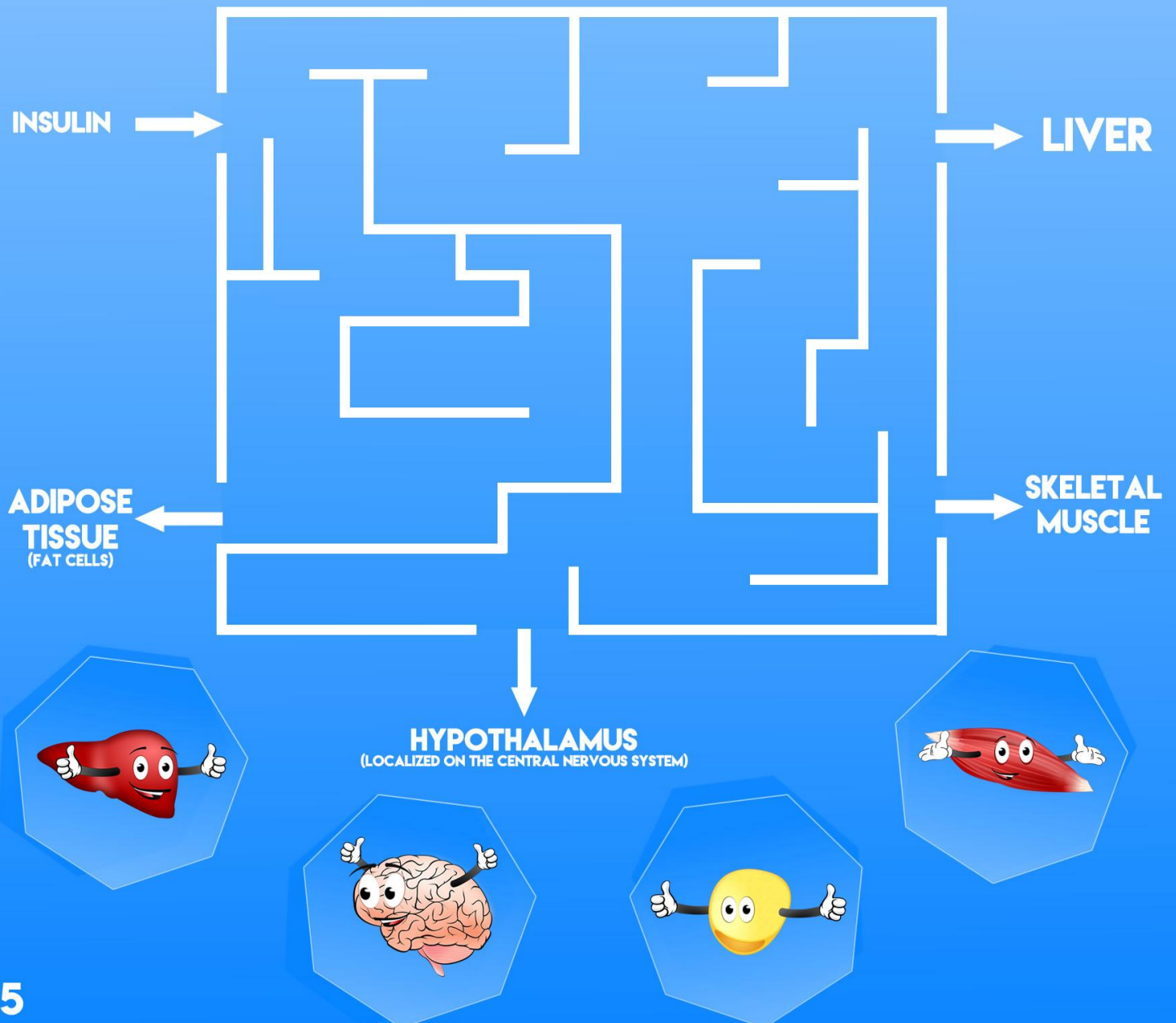
Even there are drugs used to help control blood glucose levels in diabetic patients, after decades of research there is still no cure for diabetes (in other words, there is no way to revert the problems related to defects on insulin production or action completely), as well as the possible damages in multiple organs that come with the disease. Therefore, such as obesity, prevention is the best way to avoid and combat diabetes.



DIABETES

LABYRINTH GAME

As we have seen, PANCREAS is responsible for producing INSULIN. Insulin travels through the blood in order to reach other organs. Help it reach the respective tissues below:



SYMBOL ALPHABET GAME

To know a little more about diabetes, discover the answers by using the symbols

A



E



I



O



U



C



G



H



L



M



N



P



R



S



T



Y



1) INSULIN ACTS ON A GLAND AND PROMOTES SATIETY. THIS GLAND IS:

ANSWER:



A

2) WHERE ARE BETA CELLS LOCATED?

ANSWER:



A

3) A TYPE 2 DIABETIC PATIENT HAS A NUTRIENT ELEVATED IN THE BLOOD. THIS NUTRIENT IS:

ANSWER:



A

WORD HUNT

A sedentary lifestyle and nutritional disturbs are the current main factors that lead to obesity. Practice of physical exercises is recommended to obese individuals, because it provides calories waste and weight loss. Besides, physical activity can also help regulate sugar levels circulating on the blood.

Other benefits of sports practice for obese patients includes: improved self-esteem and concentration, maintenance of muscle tonus, improved metabolism and blood circulation, reduced appetite and stress, in addition to prevention of problems related to high blood pressure and high cholesterol.



INFORMATION

Find the words in bold in the previous page in the box below. The letters are spread randomly and the word may be found vertically, horizontally or reversed.

H	S	R	I	R	A	M	S	I	L	O	B	A	T	E	M	V	D	X	Q	E	L	J
V	S	E	D	E	N	T	A	R	Y	L	I	F	E	S	T	Y	L	E	X	D	V	F
E	N	G	D	A	F	Q	I	U	W	O	B	E	S	I	T	Y	Q	G	O	P	Z	X
I	P	U	M	H	H	Q	Y	O	N	C	A	S	E	I	R	O	L	A	C	N	X	J
W	O	L	V	S	O	S	K	U	Q	Q	U	Z	B	I	N	K	Y	F	D	R	K	Z
Q	P	A	V	S	W	R	H	E	C	Y	D	Q	H	F	R	Z	J	L	Y	S	T	Z
Q	I	T	V	J	T	K	V	U	T	L	T	Q	O	E	Z	H	J	W	X	C	B	H
C	Q	E	M	F	S	E	S	I	C	R	E	X	E	L	A	C	I	S	Y	H	P	H
Z	Y	L	M	L	L	Q	W	X	Y	I	H	V	D	X	R	C	O	B	B	H	W	B
K	A	T	U	S	E	L	U	Q	D	C	H	O	L	E	S	T	E	R	O	L	C	Q
F	J	O	S	W	W	F	V	Z	O	M	Y	N	X	U	H	K	B	P	S	F	T	K
I	Q	G	C	W	M	D	V	G	O	O	R	Z	I	K	E	E	W	M	S	I	A	N
V	T	Y	L	X	U	S	K	O	L	N	A	P	P	E	T	I	T	E	F	S	Q	M
J	A	Q	E	G	B	N	R	T	B	M	Y	B	V	H	H	Z	B	C	R	H	Z	F
T	U	N	C	W	X	D	K	A	Y	J	W	L	C	I	L	W	O	G	A	O	I	H
G	G	Y	A	R	K	C	B	K	X	B	Z	A	C	A	T	B	Q	J	B	E	P	I

"WHAT GLAND AM I?" GAME

In this game you will have to find out which gland is the right answer by following the clues below:

1

I'm a twelve letters word, I'm known as the "master" gland in the organism. I'm a little organ and found inside the skull. What gland am I?

A _____

2

I'm a large gland, located in the abdomen, behind the stomach; I secrete an important hormone related to diabetes. What gland am I?

A _____

HMMM!?
**GUESS I
KNOW
THOSE ONES!**



ANAGRAM

Solve the anagrams and find out some of the effects of insulin in the following tissues:

1

HYPOTHALAMUS
Induction of:
YSIEATT

A

2

LIVER
Synthesis of:
LNOYGECG

A

3

ADIPOSE
TISSUE
Uptake of:
OGLCESU

A

4

Skeletal
Muscle
Synthesis of:
TPIONRE

A

BESIO,
YT..
OBESITY!



QUESTION GAME

MARIANA



Mariana was studying the food compositions and observed that all the sugar we consume is composed by a “sweet” substance. Speaking with her professor, she found out that one of the characteristics of type 2 diabetes is to affect how the body utilizes _____.

A

CAMILA

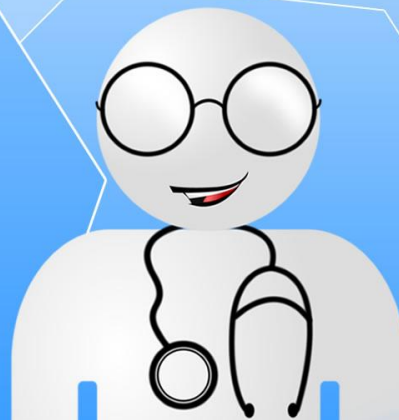


Camila went to the doctor to show some exams she ran. The doctor prescribed her a medication capable of preventing diabetes. One of the most common anti-diabetogenic medication is _____.

A

RENATO

Renato is a doctor and a university professor. In one of his lectures, teaching the endocrine system, he said: "When beta cells fail to produce the sufficient amount of insulin, the person can develop diabetes". What is the name of the gland in which beta cells are located? _____.



A

JEAN

Jean is a very active boy; he is always playing around at home. One day, he asked to his teacher what happens with the food we eat, since he eats very well but also spends a lot of energy. Then she explained to him, that inside our body there are many molecules that control the distribution and the use of the ingested nutrients.

What are the names of these molecules that help control organism functioning? _____



A

COMPLETE THE TEXT GAME

COMPLETE THE
TEXT WITH THE
FOLLOWING
WORDS:

WORDS

Type 2 diabetes – adipose –
sedentary lifestyle –
nutritional – fat –
hypercholesterolemia –
obesity – hypertension –
disturbs – disease

TEXT

_____ is a _____ characterized by
excessive _____ accumulation in
_____ tissue. Its main causes are
_____ and _____. The
absence of treatment can lead to
other diseases like _____,
_____, _____ among others, and
in extreme cases it can even lead to
death.

N

O

I

T

I

N

U

T

R

COLUMN ASSOCIATION GAME

A

HORMONE WHOSE DEFICIENCY CAN LEAD TO DIABETES

B

DISTURB CHARACTERIZED BY EXCESSIVE FAT
ACCUMULATION

C

FASTING BLOOD GLUCOSE LEVELS IN A HEALTHY
PERSON

D

FASTING BLOOD GLUCOSE LEVELS IN A DIABETIC
PATIENT

E

THE NAME OF PANCREATIC CELLS RESPONSIBLE
FOR INSULIN PRODUCTION

F

INSULIN'S ACTION UPON HYPOTHALAMUS

OBESITY

BLOOD GLUCOSE: 70 TO
100 MG/DL

SATIETY

INSULIN

BLOOD GLUCOSE: >
THAN 126 MG/DL

BETA



CROSSWORD PUZZLE

1) GLUCOSE PRODUCTION IN THE LIVER FROM DIFFERENT SUBSTRATES IS A PROCESS CALLED...

2) WHAT'S THE NAME OF THE HORMONE RESPONSIBLE FOR STIMULATE GLUCOSE UPTAKE FROM BLOOD INTO TISSUES, LIKE SKELETAL MUSCLE AND ADIPOCYTES?

3) EGGS, MILK AND MEAT ARE FOODS RICH IN _____

4) WHAT'S THE NAME OF THE MOLECULES RELEASED FROM GLANDS AND SOME ORGANS RESPONSIBLE TO CONTROL OUR METABOLISM?

5) WHICH ORGAN PRODUCES INSULIN?

6) HORMONES ARE SECRETED INTO AND TRANSPORTED BY THE _____

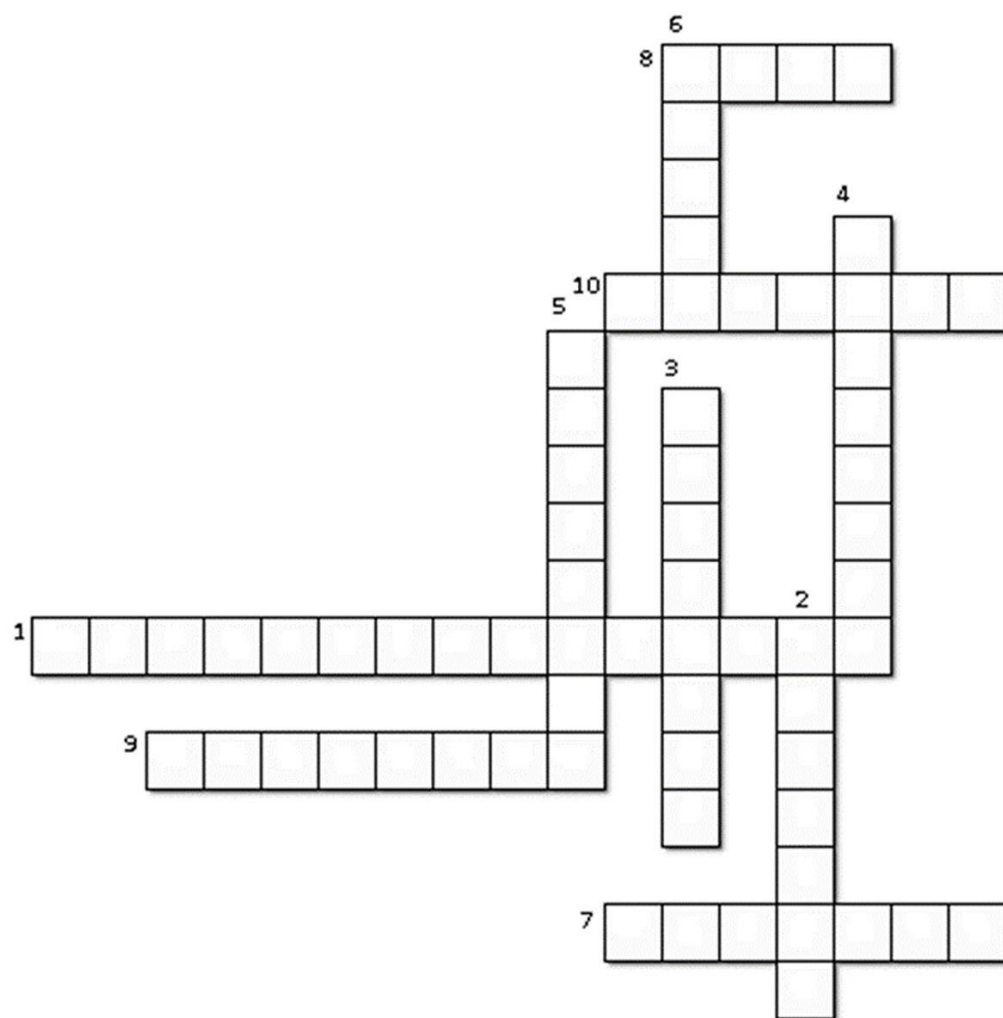
7) WHAT'S THE EFFECT OF INSULIN ON THE HYPOTHALAMUS?

8) WHICH CELLS ARE RESPONSIBLE FOR INSULIN PRODUCTION?

9) DIABETES _____ IS A DISEASE CHARACTERIZED BY DEFICIENCY ON INSULIN SECRETION AND/OR ACTION.

10) OBESITY IS CHARACTERIZED BY THE INCREASE OF WHICH TYPE OF TISSUE?

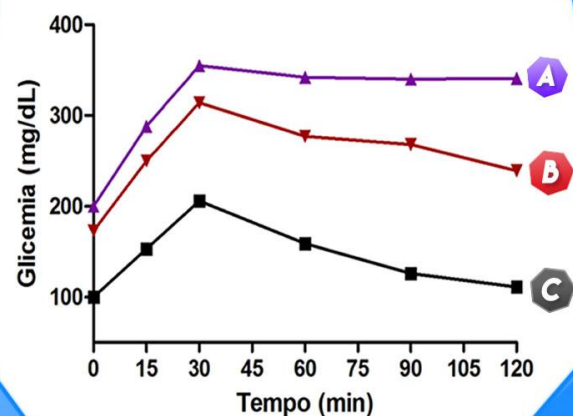
FILL THE BOXES



GLYCEMIC CURVE

The glycemic curve (or glucose tolerance test) indicates blood glucose levels measured over the time. The result of the test depends on the amount of insulin secreted by the pancreatic beta cells and/or the efficiency of insulin action on tissues. It can be easily measured through a device called "glucometer". The method is very simple: you just need to place a drop of blood in a strip in the glucometer. Then, the reader will display blood glucose levels.

Through this test, it is possible to detect if the person is diabetic by creating the glycemic curve, which is measured by the amount of blood glucose after sugar ingestion. Analyze the graph below and identify which individual is the healthy one, the type 1 diabetic and the type 2 diabetic.



A

B

C

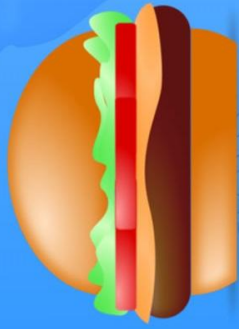
HYPERGLYCEMIA

Hyperglycemia is a state in which blood glucose levels are elevated, even during fasting periods, which may be a sign of diabetes. On the other hand, hypoglycemia is a state in which blood glucose levels are very low, which may happen due to failures on maintenance of a basal glycemic level between meals.



Values in mg/dL	
Hypoglycemia	< 60
Normal	60 - 110
Reduced glucose tolerance	110 - 126
Possible Diabetes Mellitus	> 126

FOODS THAT
LEAD TO
OBESITY



FOODS THAT
IMPROVE
HEALTH



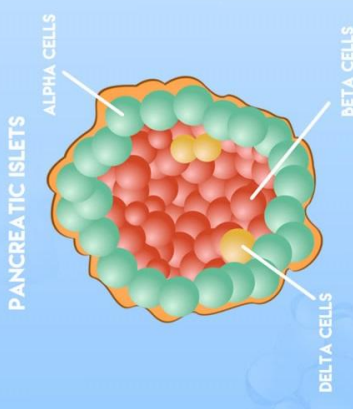
DEVICE USED
TO MEASURE
GLYCEMIA



RECOMENDED
PRACTICE TO
OBES
INDIVIDUALS



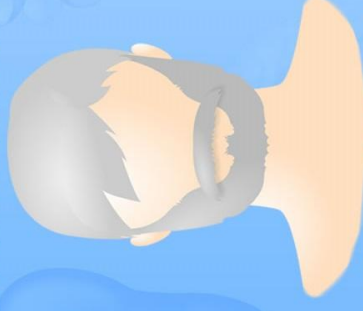
INSULIN-SECRETING
CELLS



ENERGY
ENRICHED
FOOD



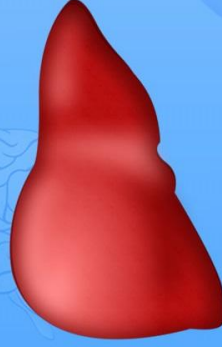
PERIOD OF LIFE
WHEN DIABETES
COMMONLY
APPEARS



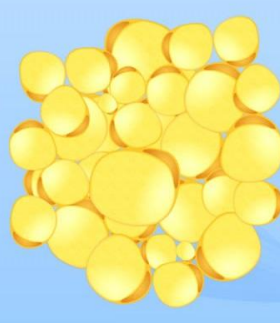
FACTOR THAT
CAN LEAD TO
OBESITY

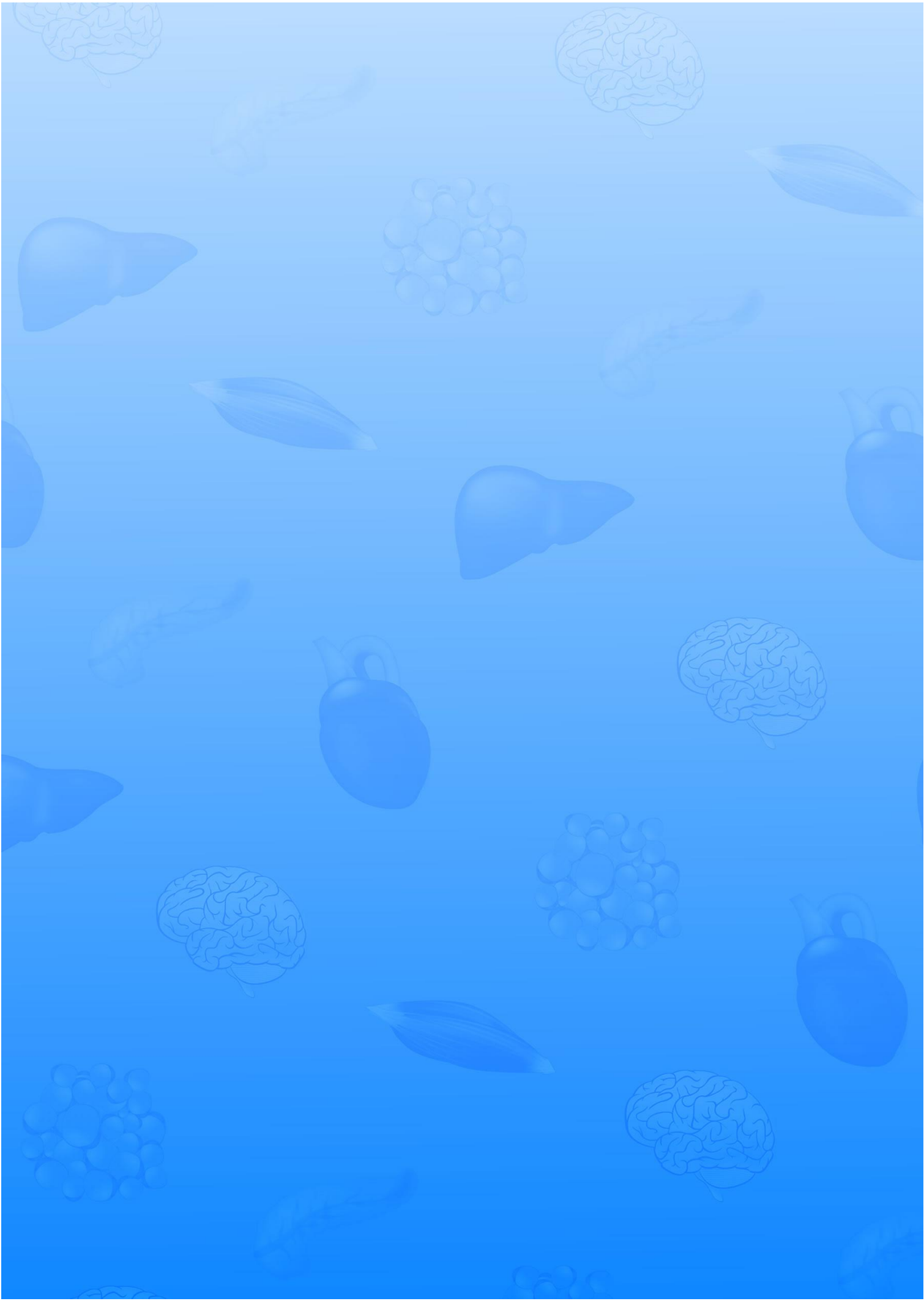


MAIN ORGAN
FOR
GLYCOGEN
STORAGE



CELL
SPECIALIZED
IN FAT
STORAGE





ANSWERS

SYMBOL ALPHABET GAME

- 1 – HYPOTHALAMUS
- 2 – PANCREAS
- 3 – GLUCOSE

“WHAT GLAND AM I?” GAME

- 1 – HYPOTHALAMUS
- 2 – PANCREAS

ANAGRAM GAME

- HYPOTHALAMUS – SATIETY
- LIVER – GLYCOGEN
- ADIPOSE TISSUE – GLUCOSE
- MUSCLE – PROTEIN

QUESTIONS GAME

- GLUCOSE, METFORMIN, PANCREAS, HORMONES

COMPLETE THE TEXT GAME

- OBESITY, DISEASE, FAT, ADIPOSE, SEDENTARY LIFESTYLE, NUTRITIONAL DISTURBS, TYPE 2 DIABETES, HYPERTENSION, HYPERCHOLESTEROLEMIA

COLUMN ASSOCIATION GAME

- B, C, F, A, D, E

CROSSWORD PUZZLE GAME

- 1 – GLUCONEOGENESIS
- 2 – INSULIN
- 3 – PROTEINS
- 4 – HORMONES
- 5 – PANCREAS
- 6 – BLOOD
- 7 – SATIETY
- 8 – BETA
- 9 – MELLITUS
- 10 – ADIPOSE

GLYCEMIC CURVE EXERCISE

- BLACK: HEALTHY INDIVIDUAL 
- RED: TYPE 2 DIABETES 
- PURPLE: TYPE 1 DIABTES 

LEARN MORE ACCESSING

WWW.OCRC.COM.BR

WWW.SOBREPESO.COM.BR

SUPPORT:

PIBIC-EM



UNICAMP

