

An Introduction to Cells

Dr Simon Williams

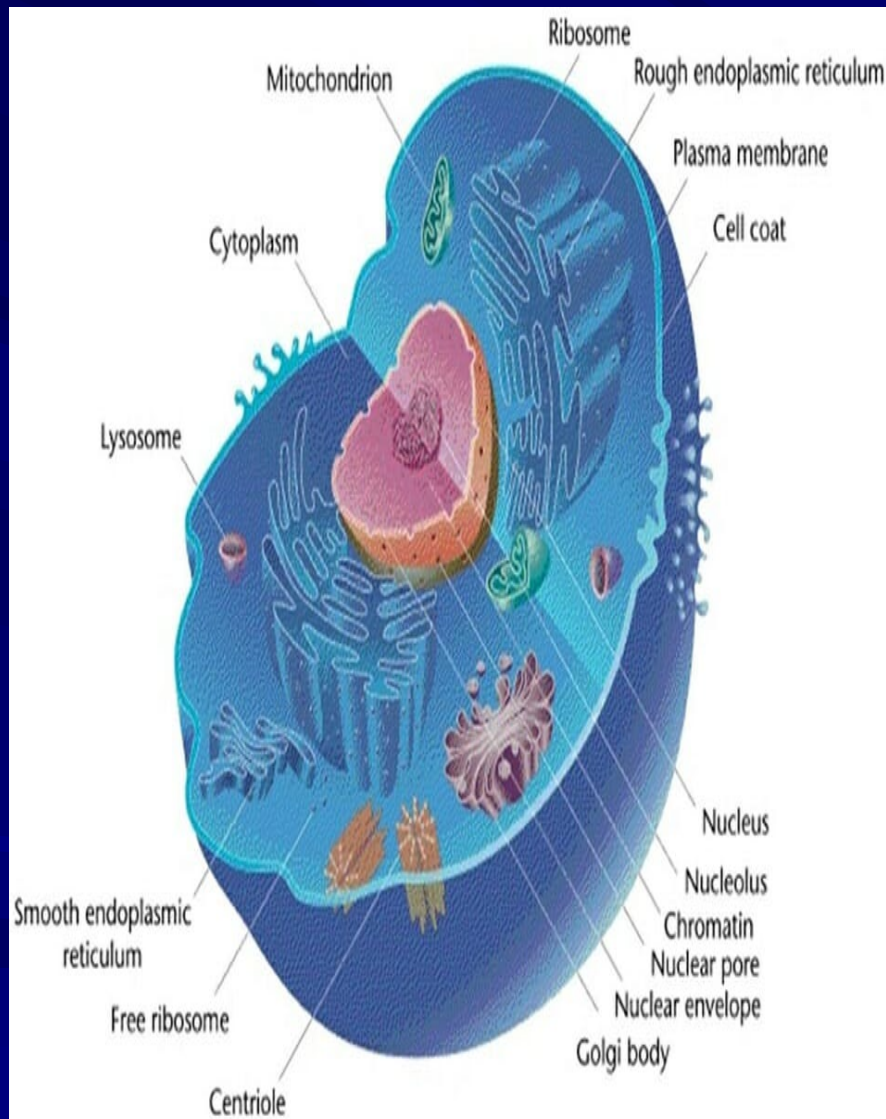
Date	Topic	Staff
1 st October	Cell Physiology and Genetics 1	Simon Williams
8 th October	Cell Physiology and Genetics 2	Simon Williams
15 th October	Muscular System	Dan Martin
22 nd October	Skeletal System	Dan Martin
29 th October	Respiratory System	Geraint Forster
5 th November	Cardiovascular System	Geraint Forster
12 th November	Nervous System	Simon Williams
19 th November	Endocrine System	Simon Williams
26 th November	Gastrointestinal System	Simon Williams
3 rd December	Lymphatic System	Dan Martin
10 th December	Excretory System	Geraint Forster

Aims

After this lecture you should be able to...

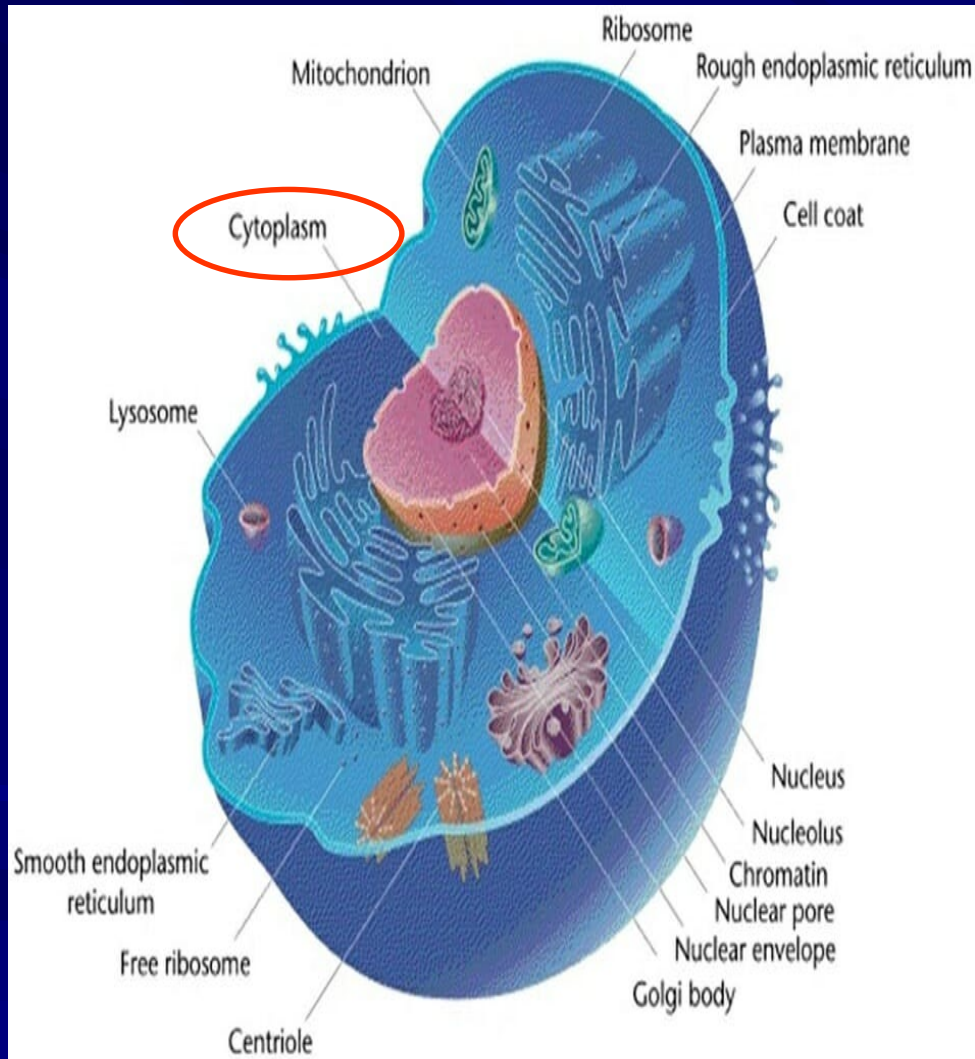
- Describe the basic structure and function of a human cell.
- Describe the function of the adipocyte
- Describe the basic structure and function of the cell membrane, including different transport mechanisms

Eukaryotic Cell Structure



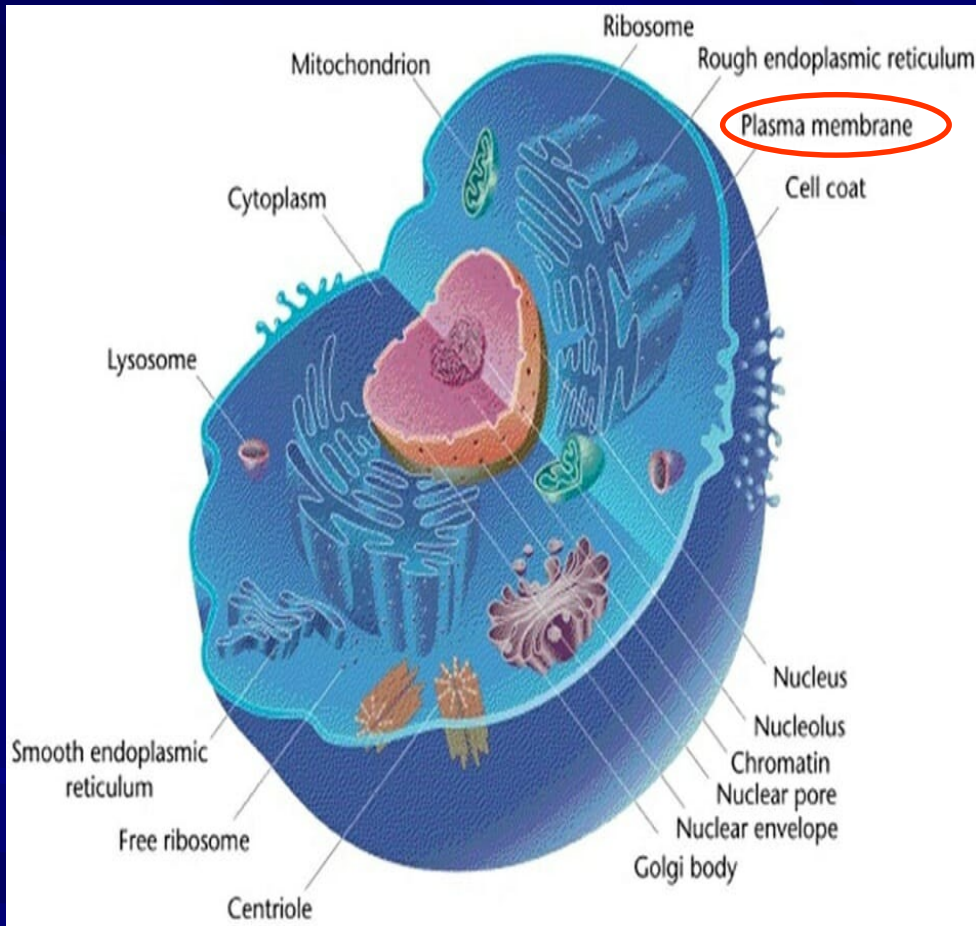
- Basic structure of a eukaryotic cell – a cell with a nucleus – and the organelles
- Cells have specialized functions
 - Skeletal muscle cells
 - Cardiac muscle cells
 - Adipocytes
 - Parietal stomach cells
 - Pancreatic beta-cells

Eukaryotic Cell Structure



- Structures inside a cell are called organelles
- Cell is a single living unit – so the organelles can be considered as the equivalent of the organs
- Cytoplasm, all of the material inside the cell, enclosed by the cell membrane, but not the nucleus.

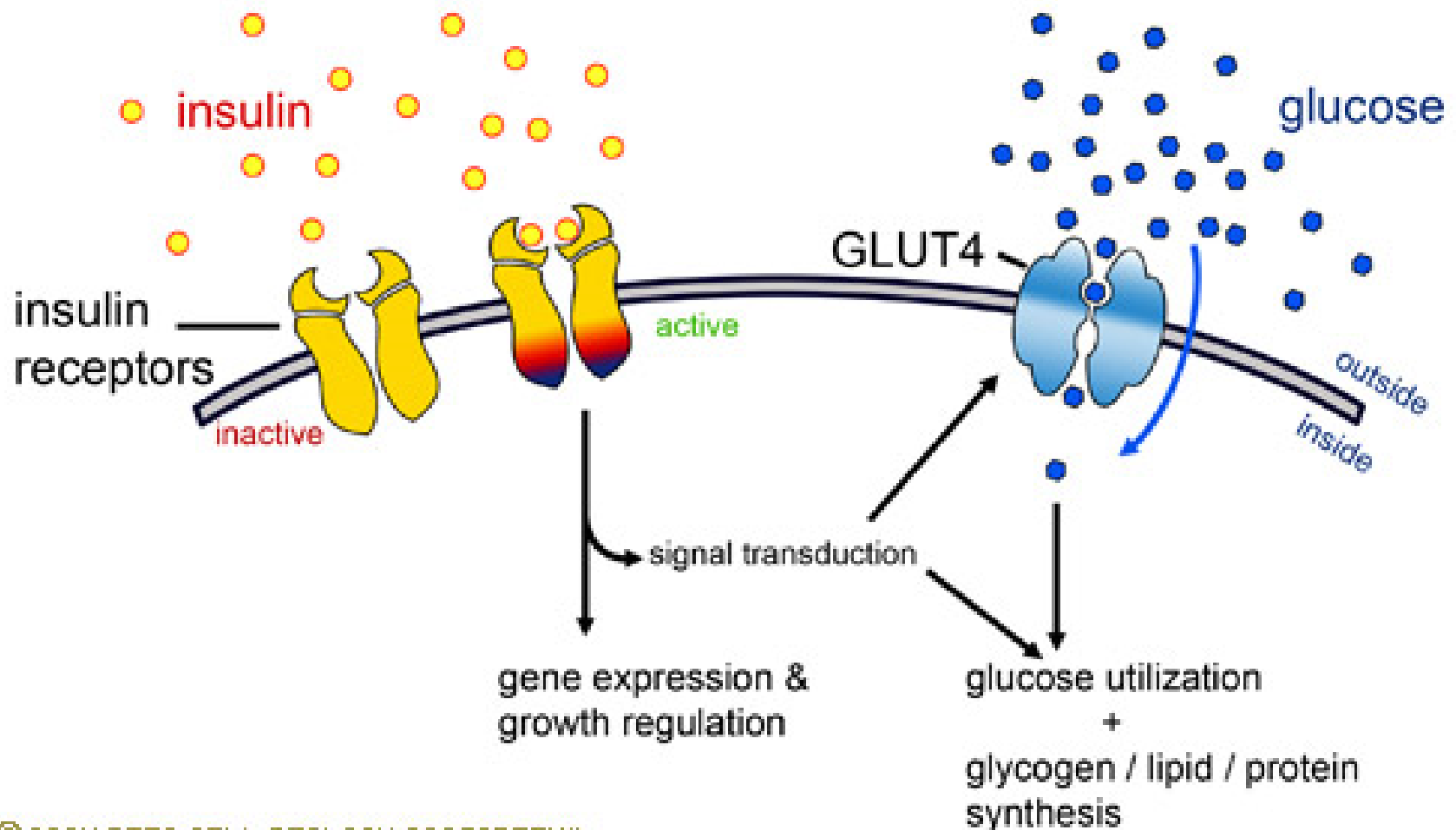
Eukaryotic Cell Structure



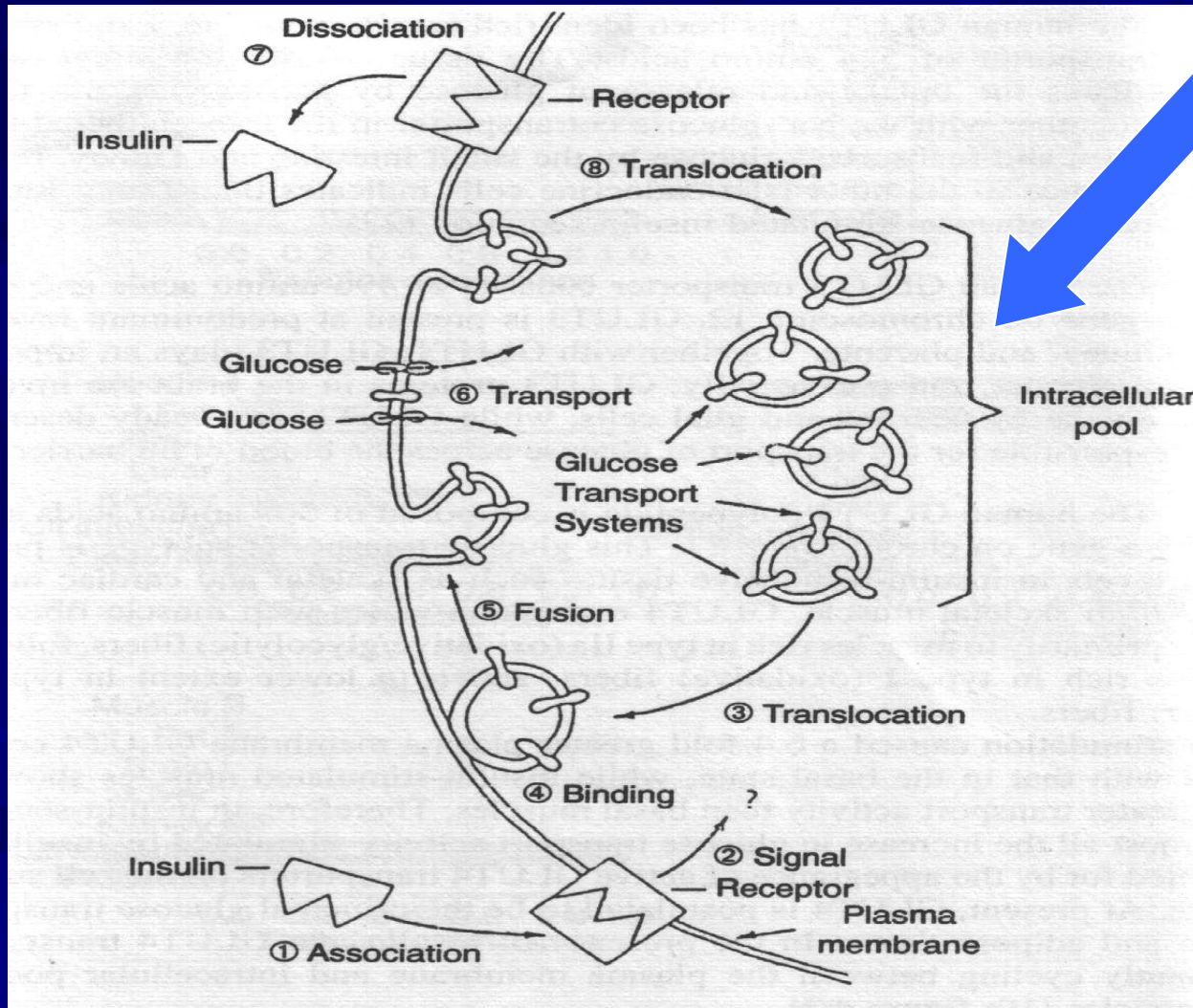
■ Plasma membrane

- Regulates movement of substances into and out of the cell.
- Regulates the response of a cell to a variety of signals (e.g. hormones like insulin)

Glucose transport (GLUT 4 – the ‘insulin sensitive glucose transporter’)



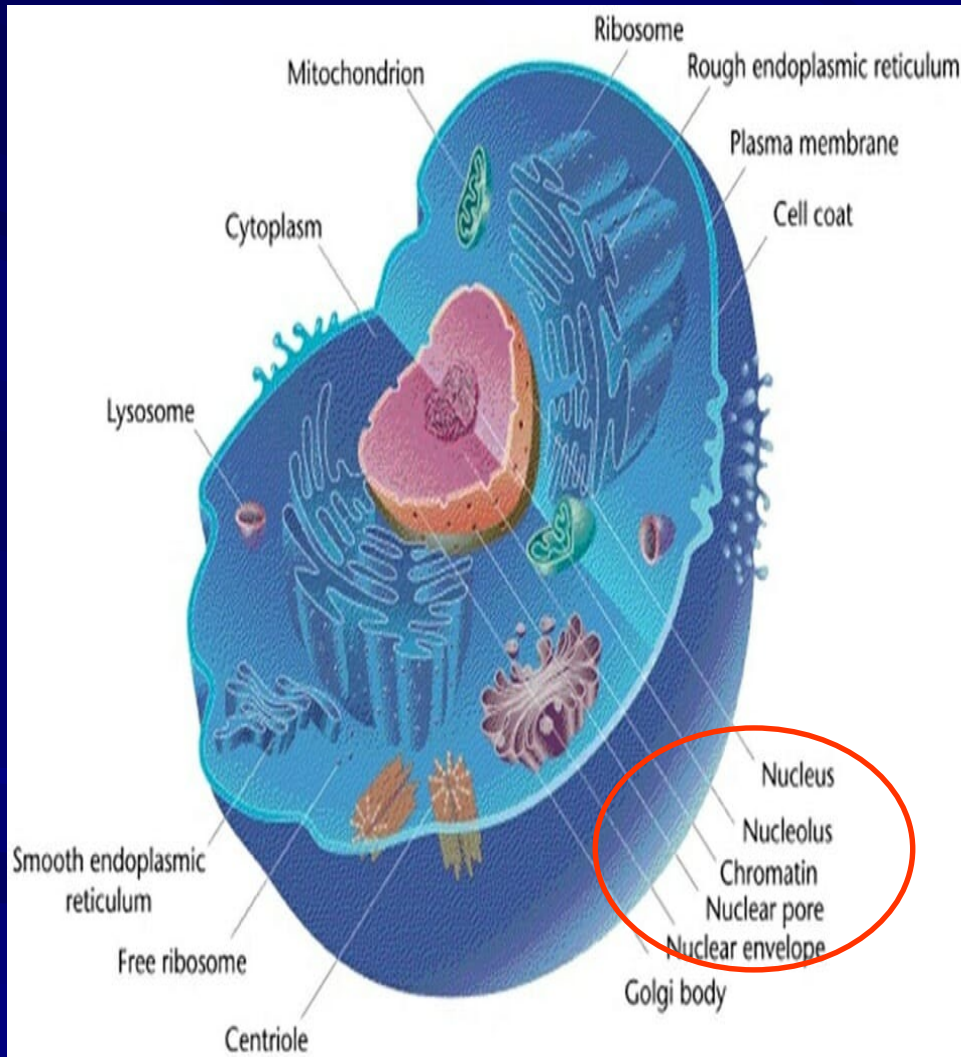
Glucose Transport, GLUT 4 activity and Insulin Sensitivity



*Exercise
also activates
GLUT 4*

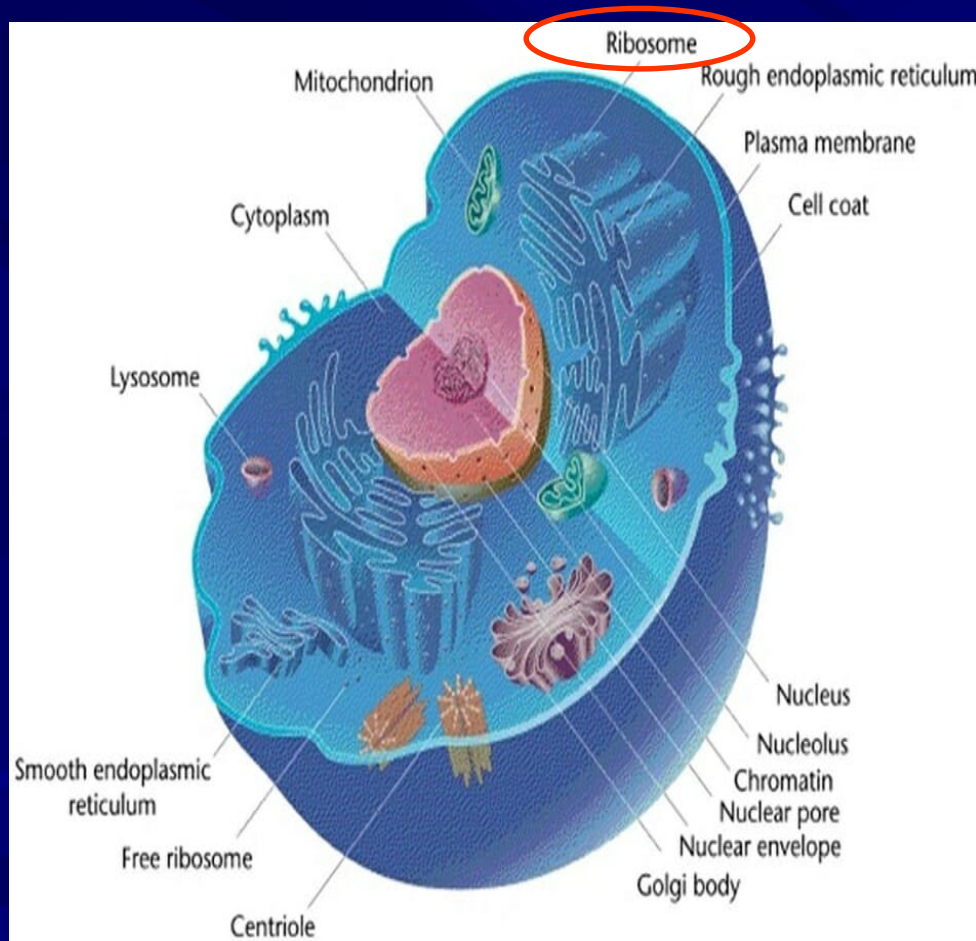
- Distinct GLUT 4 pool
- Responsive to exercise in 'normal' and diabetic subjects

Eukaryotic Cell Structure



- Nucleus, nucleolus, chromatin, nuclear pore, nuclear envelope
 - Nucleus contains the DNA (deoxyribonucleic acid) which combines with proteins called histones to form chromatin
 - This is the genetic material of the cell
 - Nucleolus manufactures ribosomes

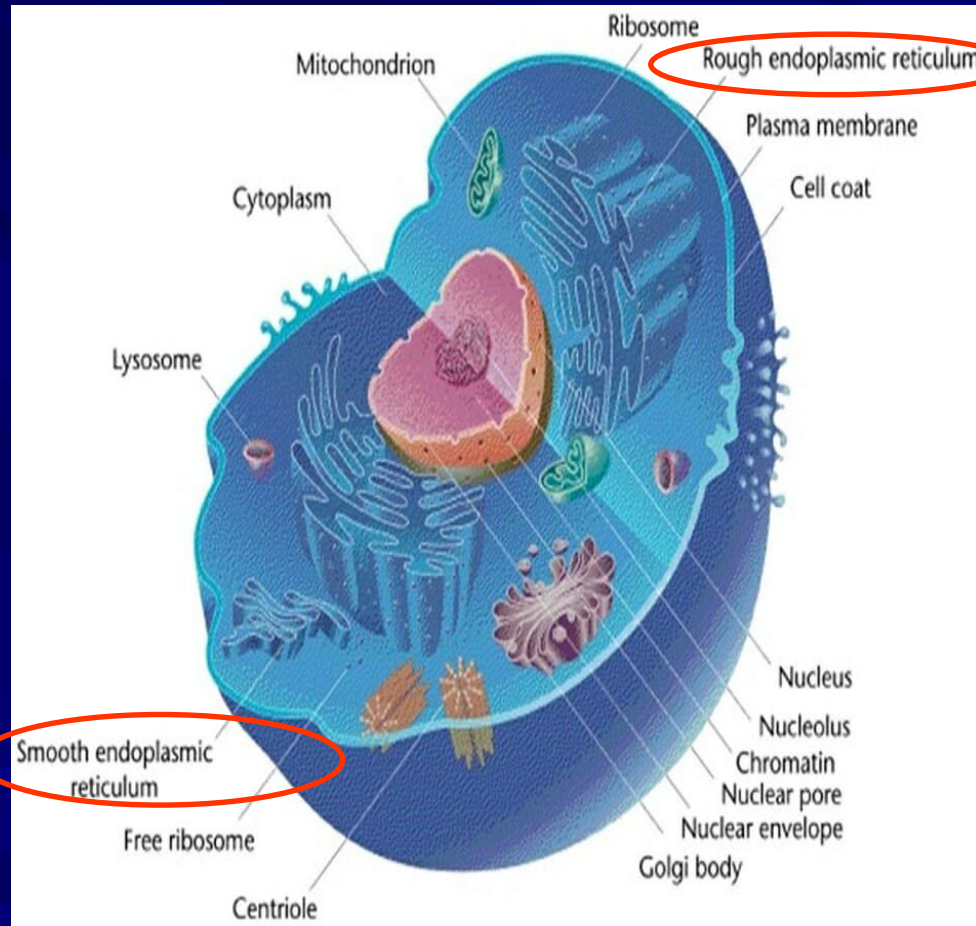
Eukaryotic Cell Structure



■ Ribosomes

- Involved in the production of new proteins (e.g. enzymes, some hormones, membrane proteins)

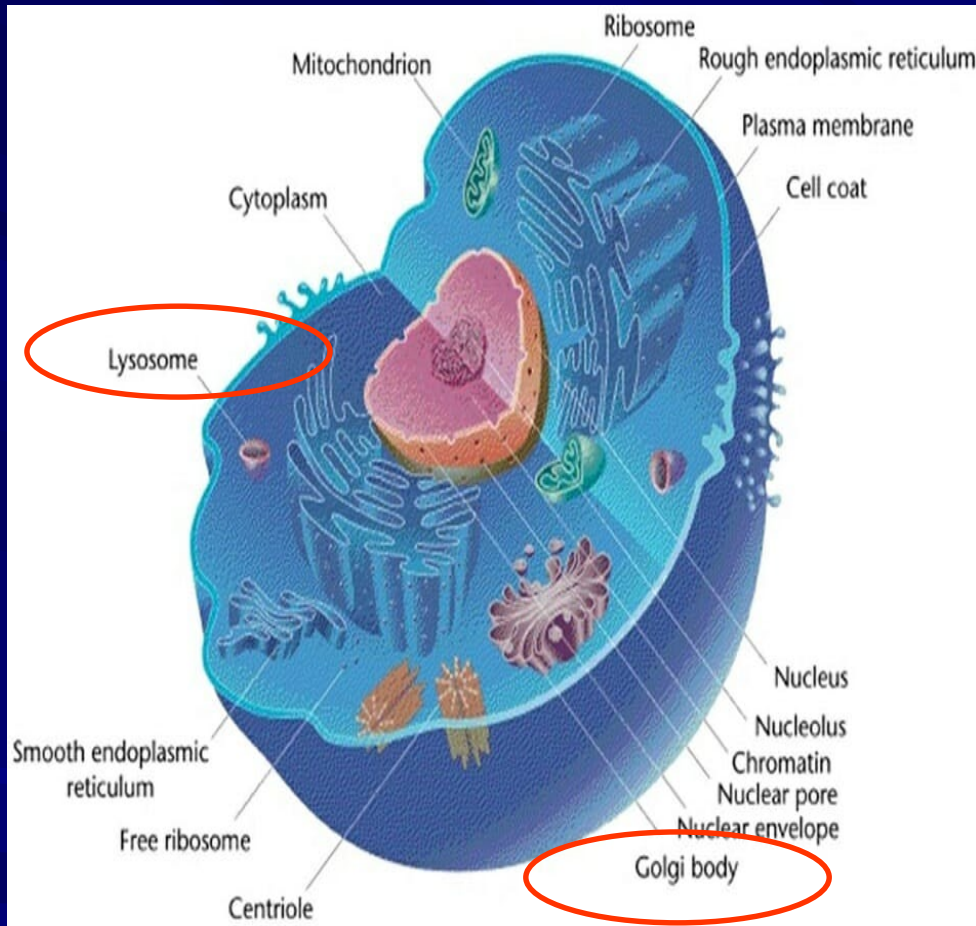
Eukaryotic Cell Structure



■ Rough and smooth endoplasmic reticulum

- A system of membranes that extends throughout the cytoplasm
- Multiple functions (e.g. protein and lipid synthesis, calcium accumulation)
- Initiation of skeletal muscle contraction (sarcoplasmic reticulum)

Eukaryotic Cell Structure



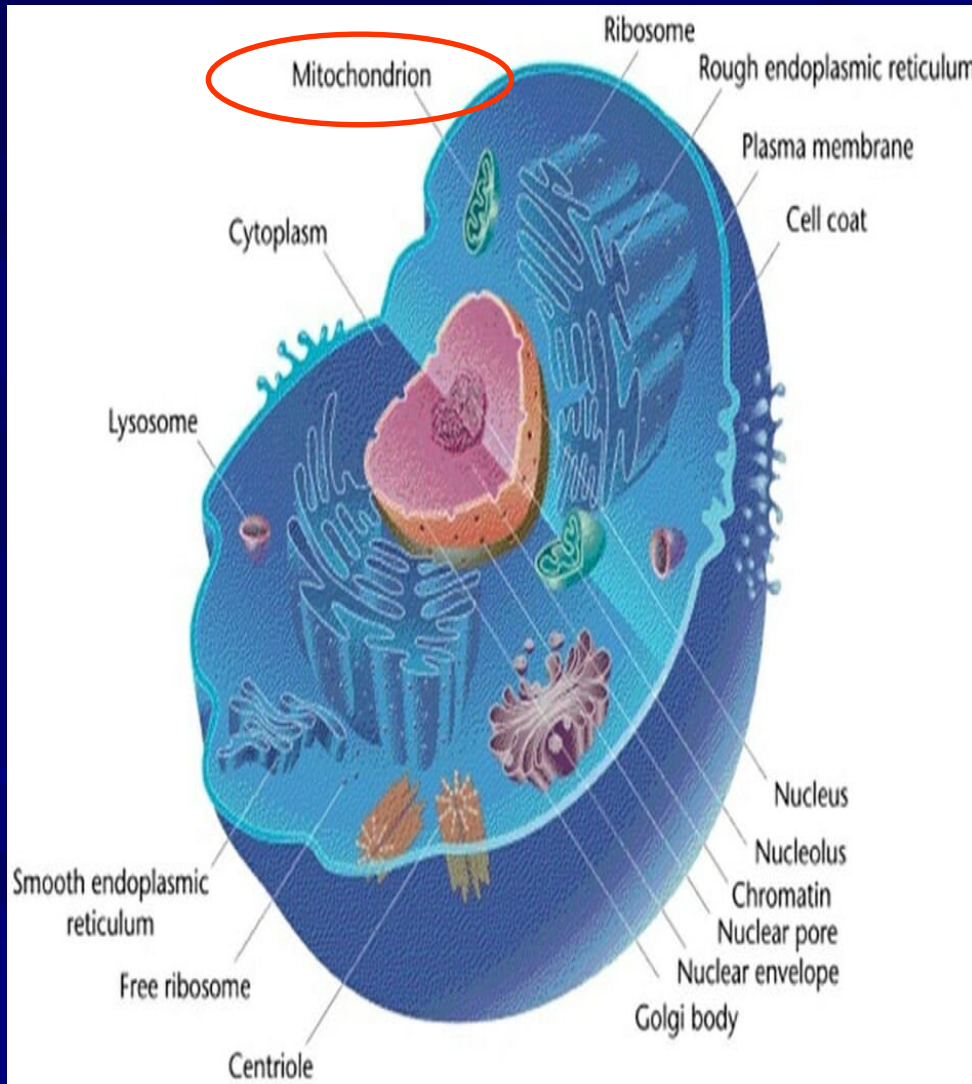
■ Golgi body or apparatus

- The cells 'post office'
- Stores, modifies and packages proteins for secretion or use by the cell

■ Lysosome

- Act as the waste disposal unit of the cell by digesting obsolete or unused material in the cytoplasm

Eukaryotic Cell Structure



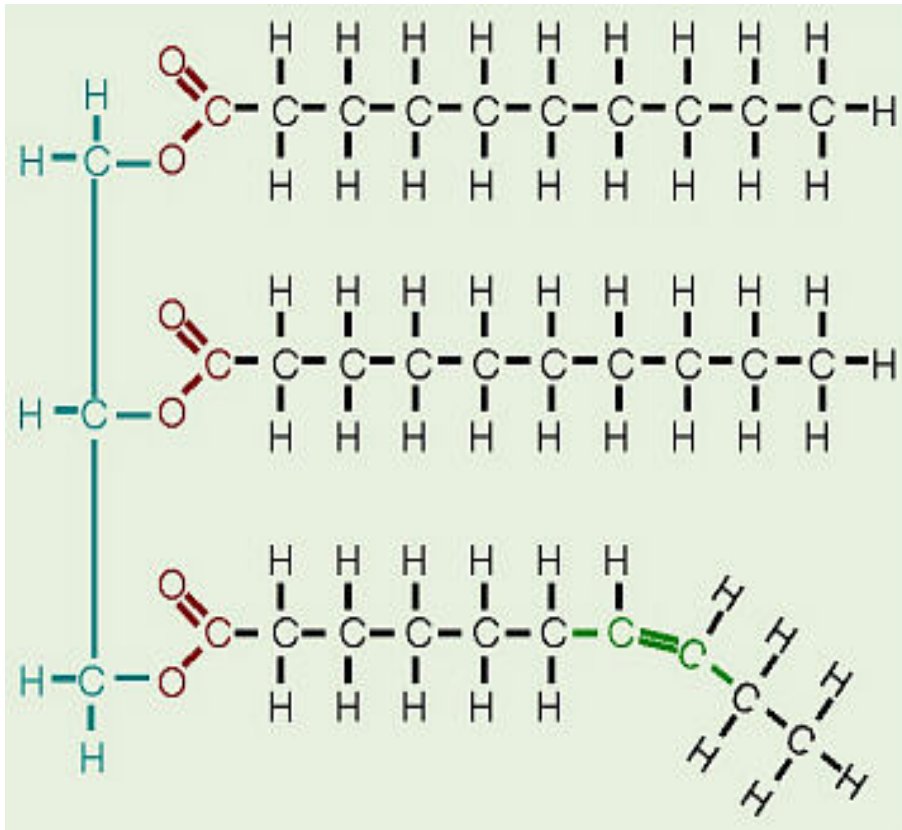
■ Mitochondrion

- The site in the cell where most ATP synthesis occurs via process called **oxidative phosphorylation**
- ATP = **adenosine triphosphate**, the chemical (usable) energy in the cell
- Dietary energy from glucose and fat combining with oxygen to produce ATP

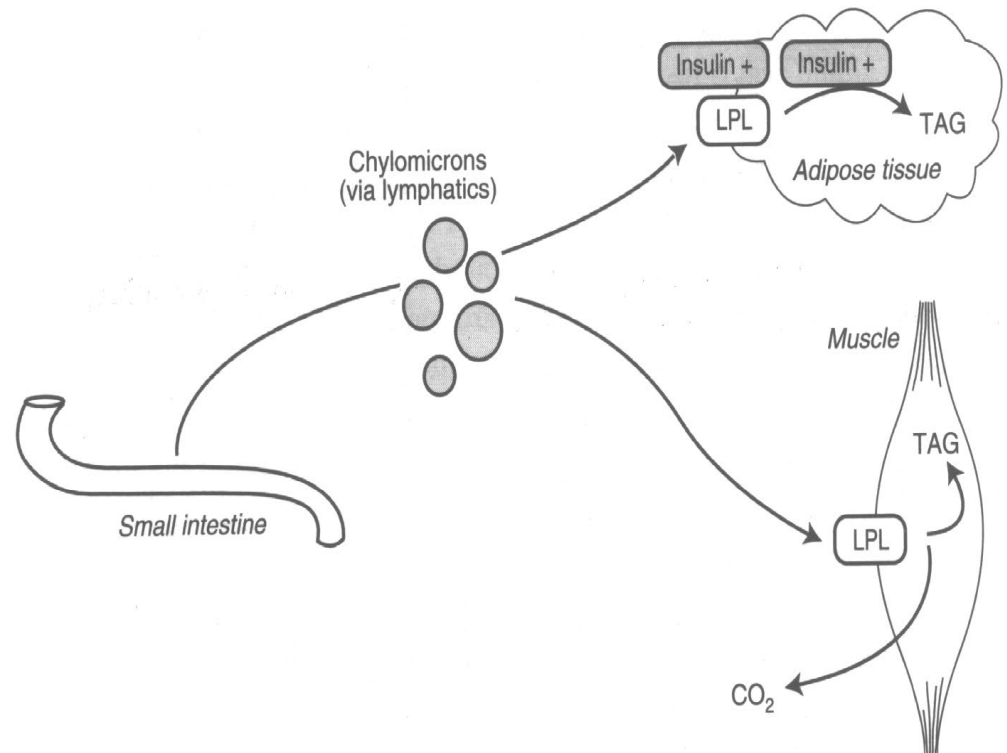
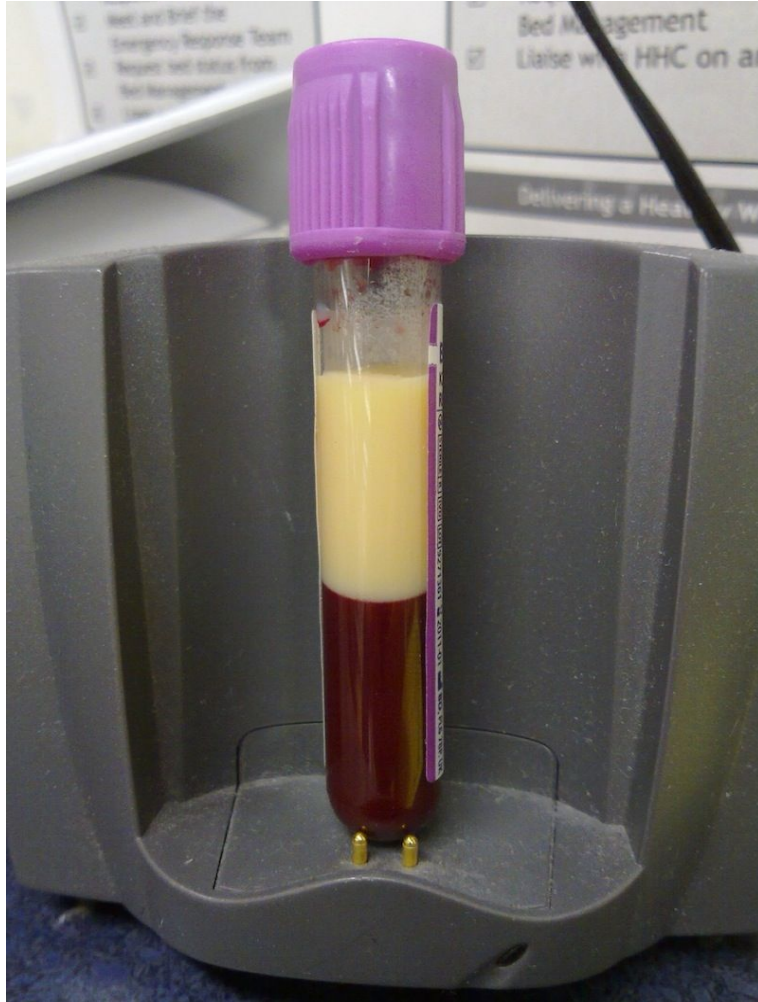
Fat, Body Fat, Adipose Tissue & Fat Cells – What's the Difference?

What is triacylglycerol (triglyceride) and what is its function?

A triglyceride molecule

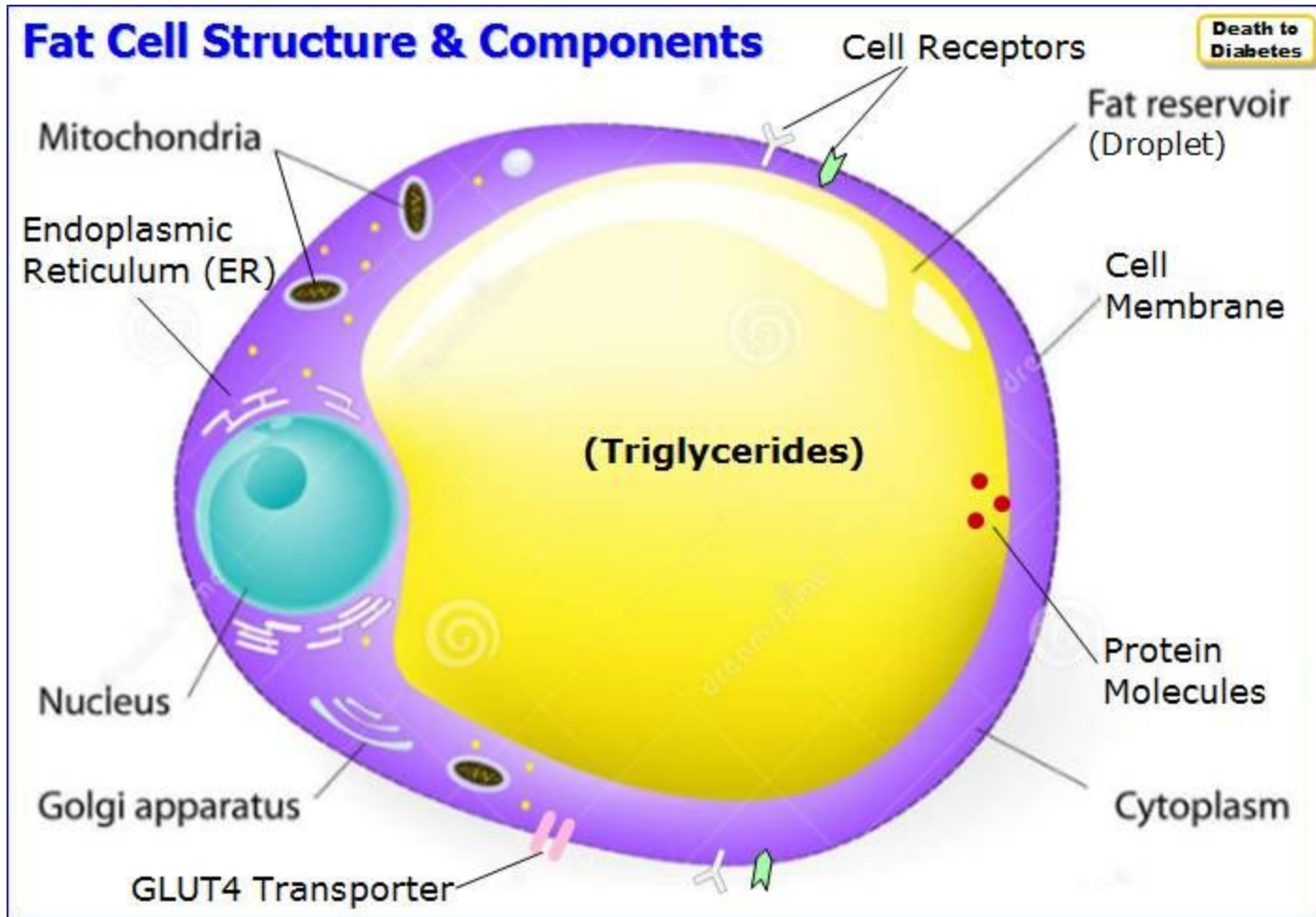


Dietary Fat Appears in the Bloodstream after a Fatty Meal

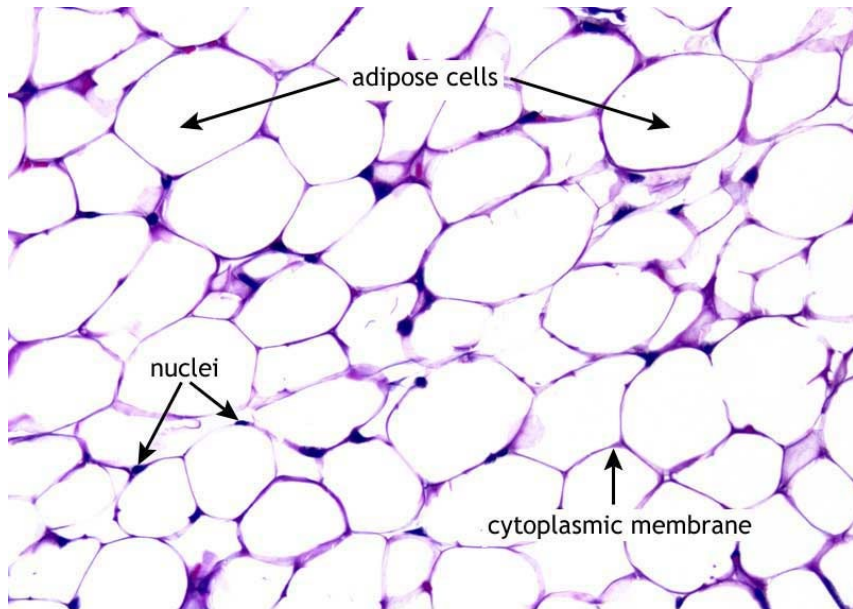


The pattern of plasma triacylglycerol metabolism after a breakfast containing both fat and carbohydrate

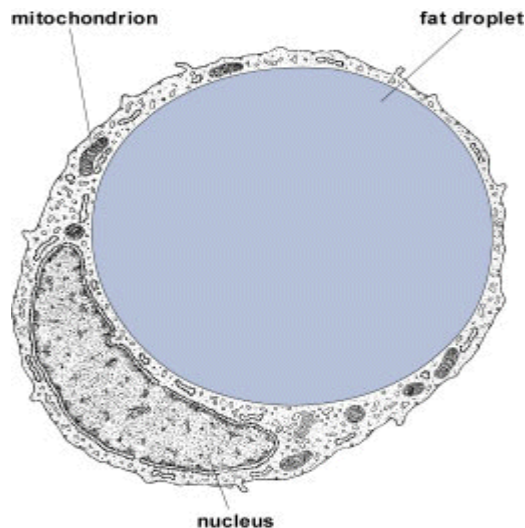
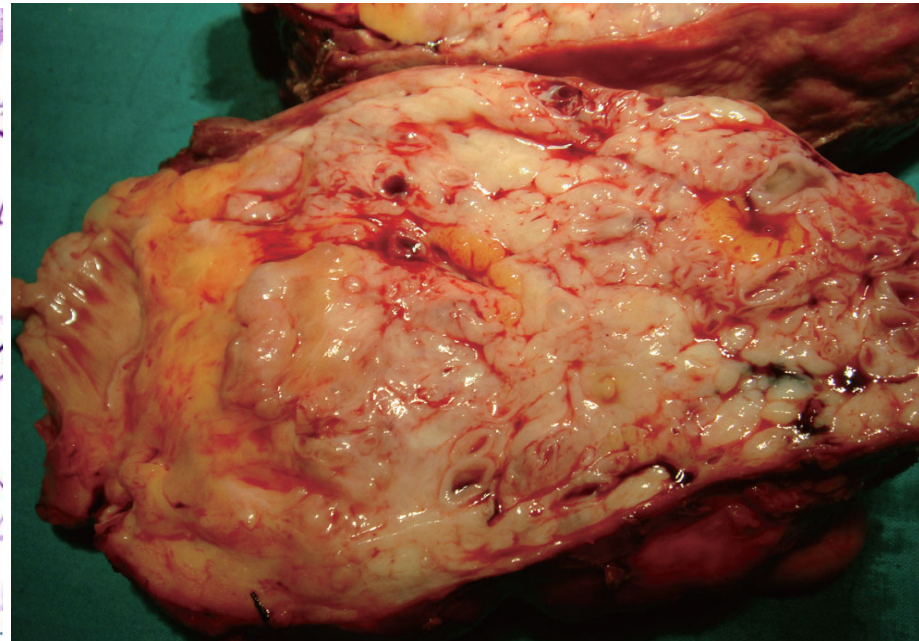
The Adipocyte or Fat Cell is a Specialised Eukaryotic Cell for Storing Fat



White Adipose Tissue



© Deltagen Inc.



Main features:

Poor vascularisation

Large single lipid droplet

Low oxygen consumption

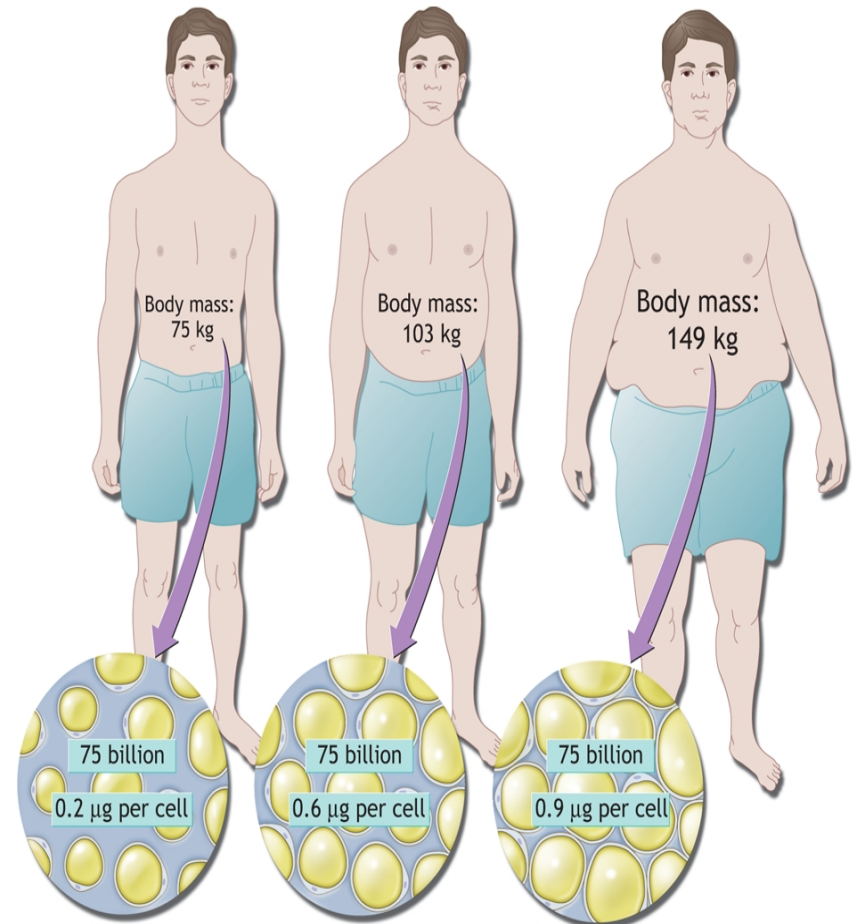
Responds to insulin and other hormones

Yellow in colour

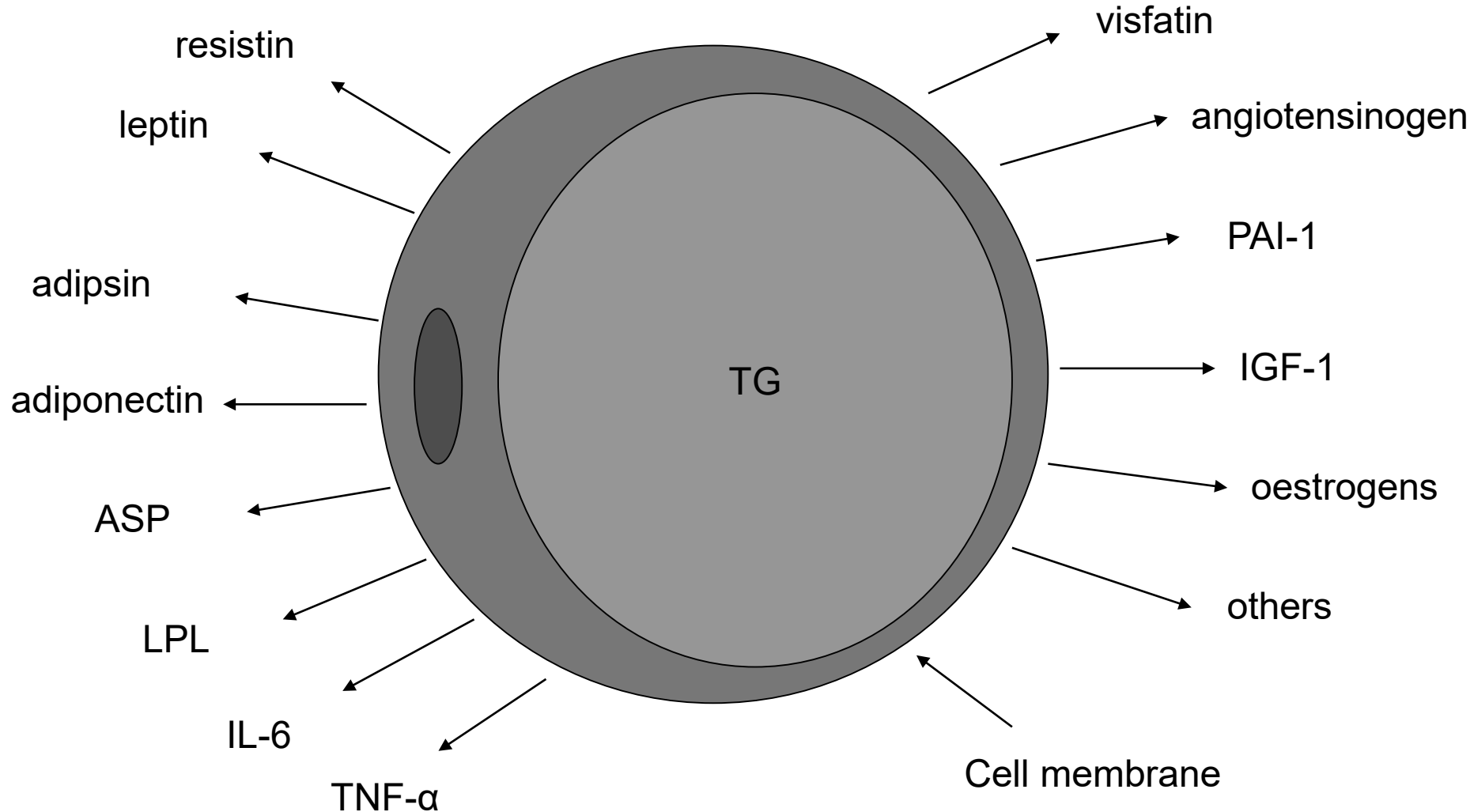
Adipose Tissue Cellularity and Obesity

Fat cell hypertrophy or fat cell hyperplasia?

- An adult with 'normal' body composition has about 25 to 75 billion fat cells. In the case of severe obesity, fat cells can number as high as 250 to 300 billion.
- In adults, fat gain generally occurs as a result of hypertrophy and then hyperplasia.
- There are regional differences in fat cell size and density (i.e. number of cells per unit mass).
- Gluteo-femoral fat cells seem to increase in number more than abdominal.



Overview of the adipocyte as a secretory cell



In Summary

- Mammalian eukaryotic cells are highly specialized cells that also share many similar characteristics.
- The cell contains the genetic material that codes for the production of many different proteins and, coupled with the environment in which we live and grow up in, these genes make us who we are.
- As exercise specialists we should be familiar with the characteristics of particular specialized cells