* Breaking down glucose – glycolysis – catabolic
* Functions of carbohydrates
  + Store and generate energy – sugars used by our cell to store and generate energy for muscle contraction, neural activities etc – glycogen and starch are polymers of sugars
  + Immune recognition – if look at spike protein of sarscov2 – full of sugars – so sugars are important for immune recognition
  + Cellular protection – polysaccharide cell wall
  + Cell adhesion – proteins on cells that recognise sugars – e.g. lactase that recongises sugar
  + Biological lubrication – eg. glycosaminoglcans for joints
  + Building and maintain biological structure – eg. cellulose in plants
* Carbohydrate terminology
  + Monosaccharide – 1 unit of sugar
  + Oligosaccharide
  + Polysaccharide – long chain of saccharides
  + Glycan – basic term of oligosaccharide
* Glucose – in close form is a circle
  + Maltose is disaccharide – contain 2 glucoses
  + Polysaccharide –
* Carbohydrates because they have carbon and water but carbohydrates can be substituted with phosphate and sulphur
  + Aldehyde infirst carbon and others have hydroxyl group
* Simplest carbohydrate in nature contains 3 carbon – glyceraldehyde – called trioses cause 3 carbons
* Difference between glyceraldehyde and dihydroxyacetone – left has aldehyde group so called aldose – right have ketone so called ketoses
* The carbon in star is chiral but in ketose no chiral
* Chiral carbon can create two enantiomers – two formulas that are mirror images of each other – for sugars called D and L – if we have polarised light – if the plane of the light goes right called dextrose – if go to left called left
  + The hydroxyl group furthest from the aldehyde is on the left of D and vice versa
* Aldotetroses – 4 carbons – D-Erythrose – because the OH from the aldehyde is on the left but have 2 chiral carbonds
* D-Ribose is very important for RNA
* Glucose is aldose because have aldehyde
* Ketoses have ketone
* Hexose and pentose are monosaccharides – they are cyclise – can form circle – glucose is aldose with 6 C – the OH at C5 to C1 – now we have chiral C1
  + Beta – when OH goes above the ring
  + Alpha – when OH goes below the ring
  + Anomer
  + Slide 12 – alpha because OH below – pyranose because it forms 6 carbon ring – D because OH on left – gluco because it is glucose
* Maltose is disaccharide – slide 13 – 1 to 4 because C1 link to C4 of next sugar
* Fructose – 5 carbon rings
* Lactose – found in milk – disaccharide – connect C1 of galactose to C4 of glucose
* We don’t have enzyme to cleave cellulose bond – slide 14 – alpha and beta different from maltose
* Galactose and glucose form lactose and lose water – unfavourable thermodynamically
* Polysaccharides that sore energy
  + Glycogen granules in liver
  + Figure 9.17 – all glucose units – alpha linkage 1 to 4C – however we can have branches of another chain of glucoses linking to it
  + N stands for non-reducing end – the start
  + R stands for reducing end – the end
* Cellulose
  + We cannot use it because we don’t have the enzyme to cleave it
* D-sugars are what nature chose for us – almost all sugars we have belong to D – most aa are Ls – there are exceptions if change D to L the receptor can’t recognise so we can’t sense the taste
* Glycolysis
  + Catabolic process in which we take glucose 6C and convert to pyruvate
  + Pyruvate is 3C
  + So 1 glucose to 2 pyruvate
  + Does not require oxygen
  + Oxygen will be needed in the mitochondria but NOT in glycolysis
* Phases of glycolysis
  + Has 10 reactions – can be divided to 2 phases
  + Need some energy to break glucose down
  + And then generate some energy later
  + First phase – need 2 ATP
  + Generate 4 ATP
  + Gain 2 energy
  + Generate 2 NADH
  + Energy investment phase and energy generation phase
  + First benefit in the glycolytic pathway – generate energy – the 2 pyruvate can go into citric cycle and generate more energy
* Energy investment phase – 5 reactions
  + Hexokinase
  + First phosphorylation needs 1 ATP
  + Go from glucose-6-phosphate to fructose-6-phosphate
  + Slide 22
  + Phosphofructokinase
  + Aldolase cleaves fructose….and get 2 trioses (3C)
* Energy generation phase – 5 reactions
  + Everything is multiplied by 2
  + From aldehyde to carboxylic acid
  + NADH is the reducing agent
  + Stage 7 - generate energy by turning ADP to ATP
  + Generate 4 ATP – 2 were invested – net gain is 2 ATPs
  + Need to know that there are 10 reactions and the 2 phases
* Isoenzymes I, II, III have low Km
* Reaction 1 is thermodynamically unfavourable – add ATP – favourable
* Reaction 2 – delta G almost equilibrium
* Reaction 3 – favourable
* Reaction 6 – beginning of energy generation
  + Generate BPG – highly energETic than ATP – can transfer phosphate to ADP to generate ATP
* NADH will be seen a lot in the electron transportation in the mitochondria – oxygen accepts electron