* Basic of biochemical signalling
* Hormones as main of signalling molecules
* Receptors that bind hormones – RTK – receptor tyrosine kinases
* Think of cells as city – the cell membrane is the wall – need to communicate external changes
* Internal communication – communicate what is happening in the cell to the outside
* Cancer cell has no communication – no immune response
* Signals to tell that it has too much of something and need to store it
* Slide 4 is very important
* Reception - Need receptor protein that specifically binds a hormone or other ligand
* Signal transduction – mechanism to transmit the ligand-binding event to the cell interior
* Response – series of intercellular responses – activating new gene or enzyme or whatever
* Usually involve enzyme cascade, in which a succession of events amplify the signals
* In reality, the cell is very packed – even cytoplasm – getting signals to go from outside to the inside – say particular portion of the nucleus or gene – is very complex – need receptor – enzyme cascade has to be good enough
* Signal transduction cascades
  + Signal release – release sth
  + Reception – signal binds to receptor
  + Transduction – transmitting or amplification to have a rapid effect
  + Response
  + Switching off – turn off what it is supposed to do
* Homeostasis – need multiple stop mechanisms
* Consequences of signalling cascades – changes in metabolic activity, gene expression, target protein
* It is about the signal and the amount of the signal too to let the cells differentiate – gradient of signal going from one direction to another – amount of particular molecule in the cell will determine what the cells become – in embryogenesis
* Can have different responses from the same signal – in heart pacemaker cell, acetylcholine makes the heart fires slower but lead to more secretion in salivary gland and lead to contraction in skeletal muscle cell
* Hormones are universal – secrete in one part of the body and affect multiple parts of the body
* Hormones are tiny – not proteins – effective because they are small so can travel through blood
* Endocrine hormones – glucagon and insulin work against each other – to maintain certain glucose level in the bloodstream
* Insulin is not big enough to be protein – short – polypeptide
* Eat – blood sugar rises – simulate glycogen formation – want to convert glucose to glycogen – insulin spikes – reducing amount of free glucose in blood – once glucose level significantly low – stimulate release of glucagon – glucagon generally store in liver – glycogen converted to glucose – glucose is the only source of fuel for brain
* Norepinephrine and epinephrine – fight or flight response – need quick source of energy when fleeing – need a lot of glucagon for sugar
* Hormone:
  + Homeostasis – very important – everything is in equilibrium – eg. steady temperature so that enzyme not denatured
  + Provide rapid response to external and internal factors
  + Regulate cyclic and developmental programs
* Environment can meal internal and external
* Signalling molecules bind to the receptors
* Epinephrine analogs
  + Agonists – act similar to normal system
  + Antagonists – block the action of the normal hormone
  + We want to stimulate (agonise) or antagonise when we make drugs
  + Caffeine is agonist – enhance the effect of the receptors
* 2 main classes of hormone receptors:
  + G-protein-linked receptors (GPCRs) – when a ligand binds, it activated G protein which activates other enzyme along the cascade
  + Enzyme-linked receptors – effect and concentrate that they work are fascinating – form dimer and bring two ligands together – catalytic domain that activate catalytic domain on the other side
* Binding to phosphate activates an enzyme
* Membrane spanning molecule such as epidermal growth factor that has tyrosine kinase domain and have binding ligand domain that binds to the responsible ligand
* Ligand binds to the receptor
* Activation of Epidermal Growth Factor (EGP) receptor- EGP once binds active extracellular domain and dimerise – change the activator and phosphorylation – open phosphorylation site – autophosphorylation site undergone in both domains
* Insulin binds to tyrosine kinase and lead to phosphorylation
* Kinase cascades activate the signalling cascade that go all the way down to gene expression – go all the way to the nucleus