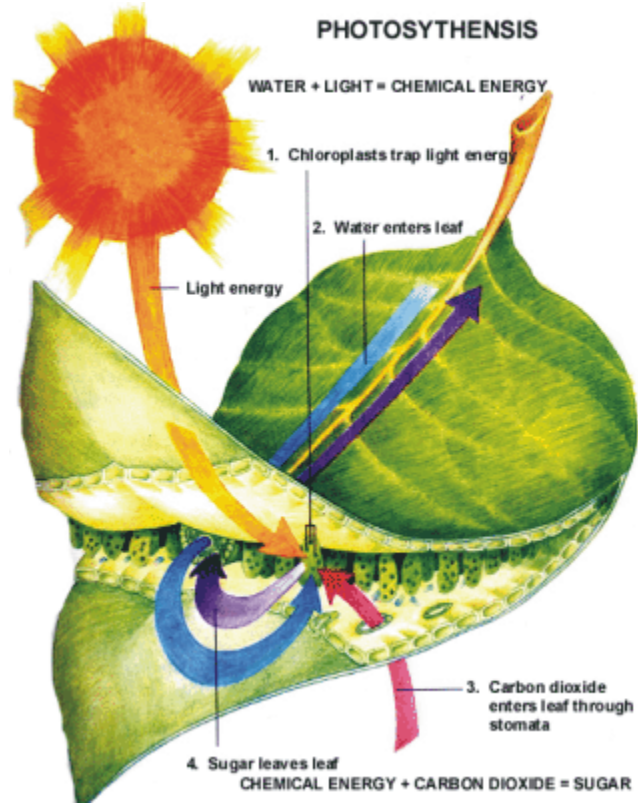
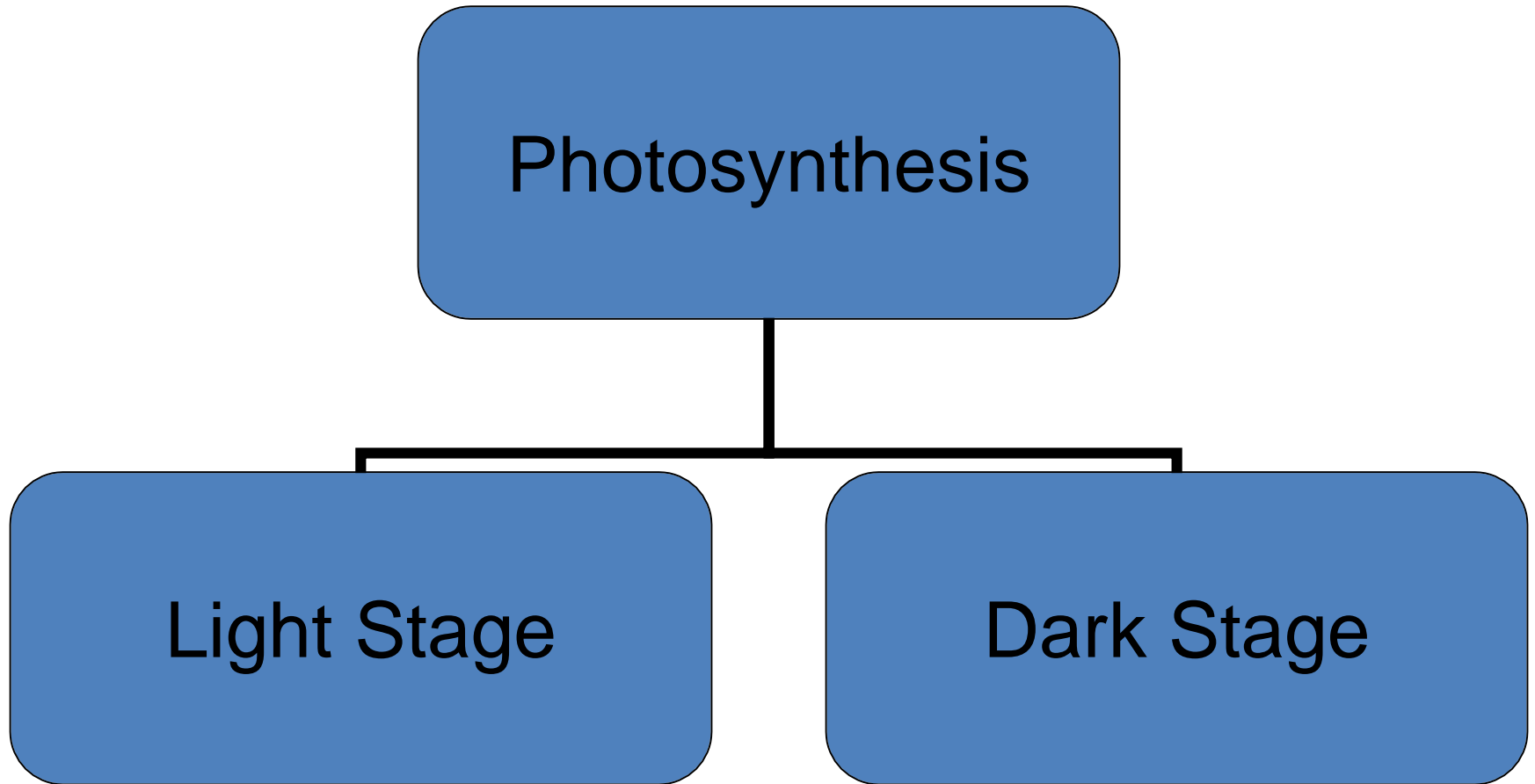


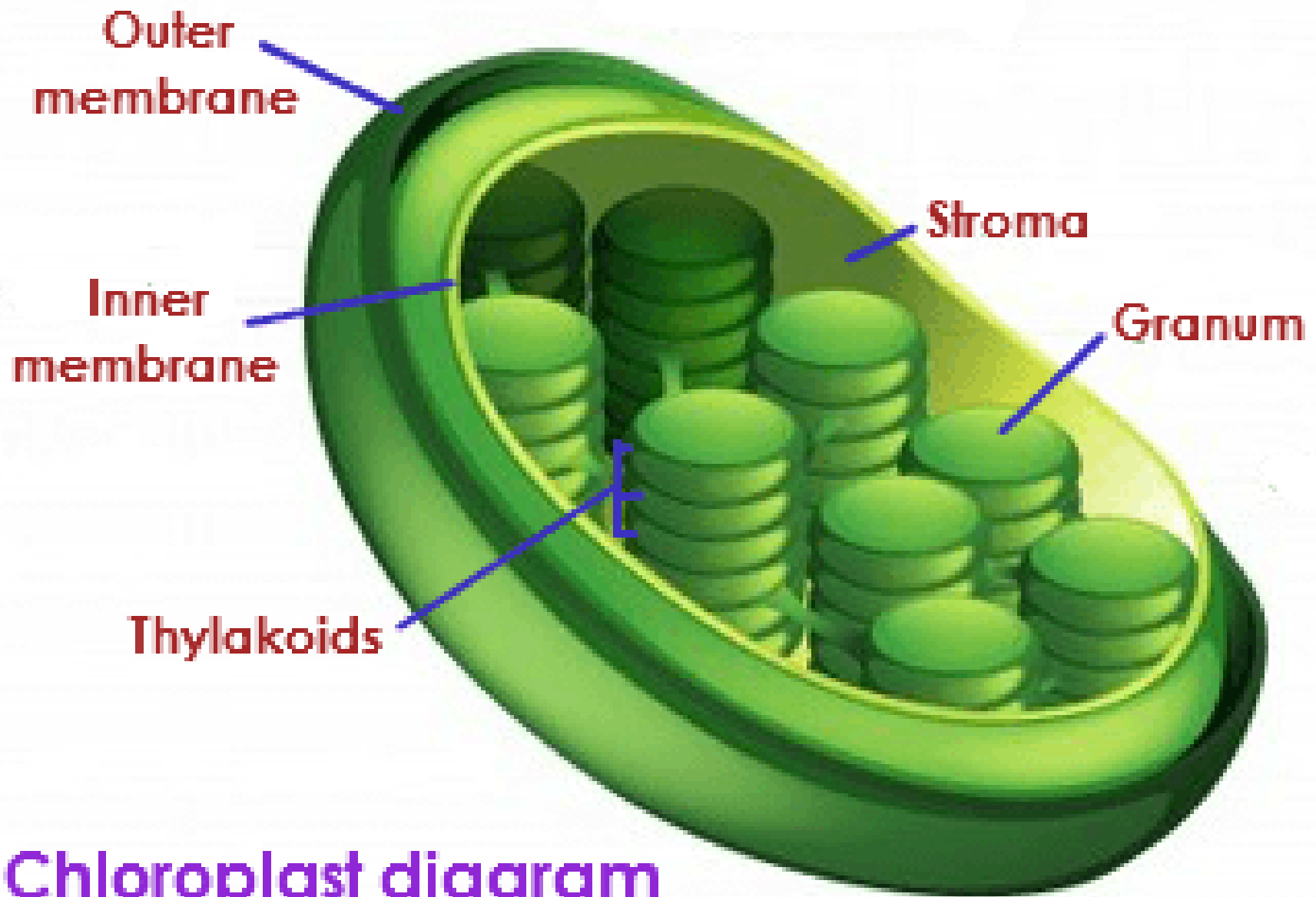


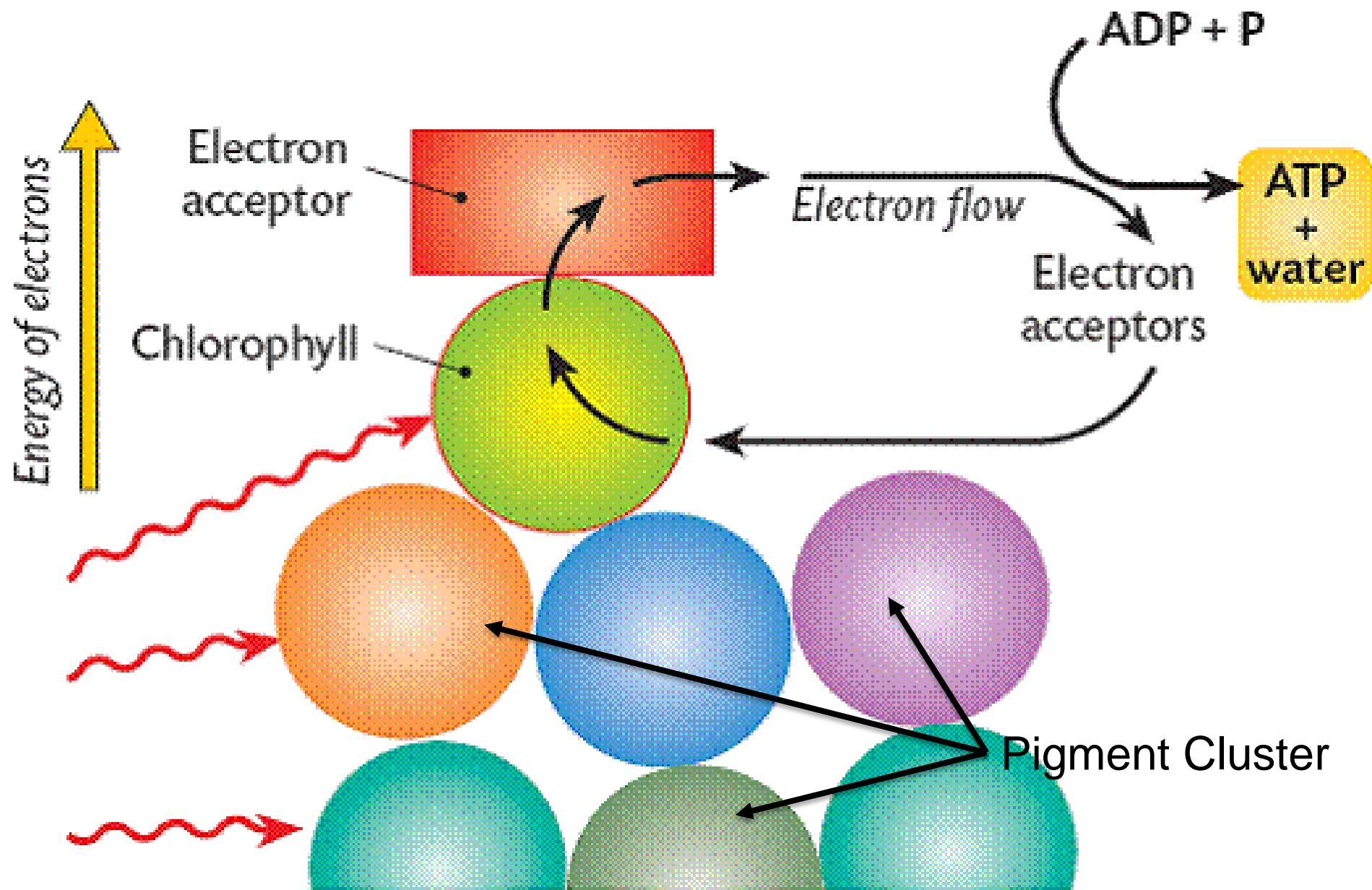
Photosynthesis Extended Study



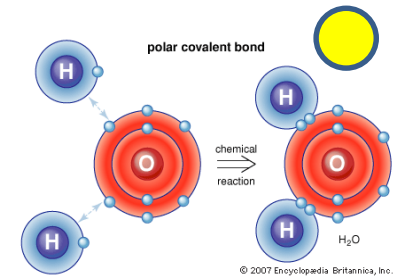
2 stages of Photosynthesis (HL)







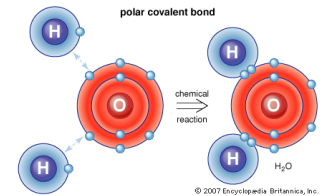
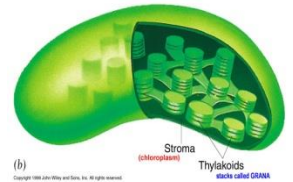
Light Stage (HL)



- This light energy is transferred to the electron that has been passed to the chlorophyll
- This chlorophyll is in the pigment cluster and is strategically placed near an electron acceptor
- The pigment cluster absorbs as much light energy as possible and passes it to the chlorophyll which passes it to the electron
- The energised electron is passed to the electron acceptor which can then send it on one of two pathways

Learning Check

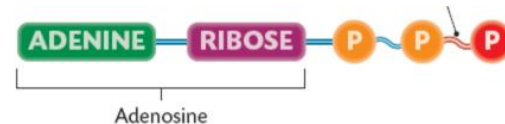
- Where does the light stage occur?
- Why is it called the light stage?
- Where do the electrons supplied to the chlorophyll come from?
- What absorbs the light energy?
- What is the chlorophyll strategically placed near?
- How many possible pathways can the electron be passed on?



Electron Flow Pathway 1 (HL) or Photosystem 1



- In pathway 1 the electrons pass from the first electron acceptor to a series of other electron acceptors and back again to the chlorophyll
- As the electrons are passed around they lose energy
- This energy is used to join a phosphate to ADP to form high energy ATP
- Water is also formed in this process



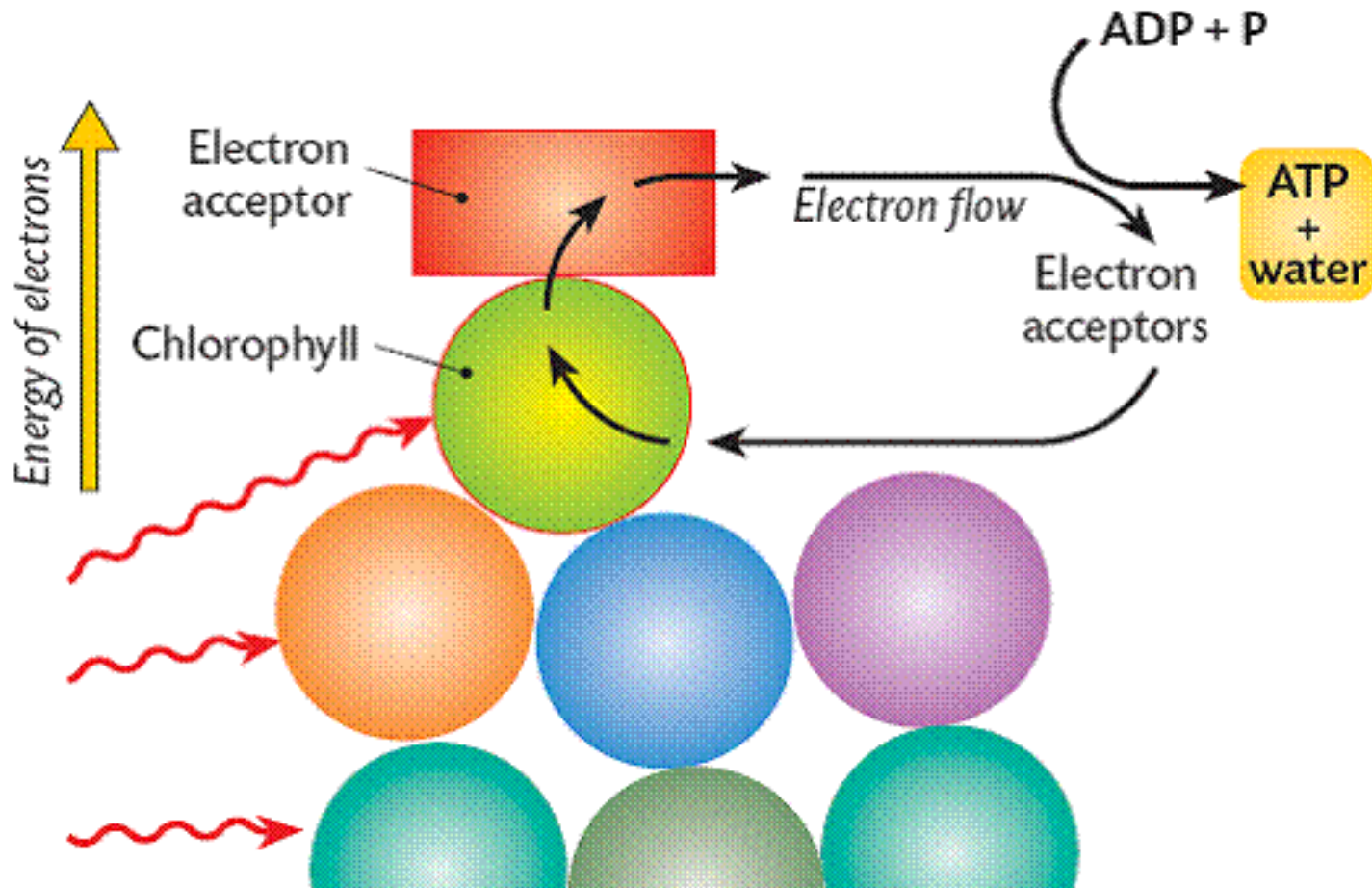


Pathway 1 (HL)



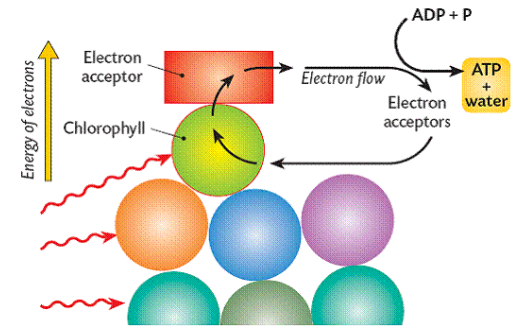
- The addition of phosphate to ADP is called **phosphorylation**
- Because the electron travel in a cycle and returns to its original chlorophyll this process is called **Cyclic Phosphorylation**

Electron Pathway 1 (HL)



Learning Check

- Where does the electron go to from the chlorophyll in pathway 1?
- What happens to the electron as it is moved around?
- What is phosphorylation?
- Why is this pathway called cyclic phosphorylation?
- What are the end products of pathway 1?





Electron Pathway 2 (HL)

- 2 high energy electrons at a time are passed from chlorophyll to the electron acceptor and then along another series of electron acceptors
- The electrons do not return to the original chlorophyll
- They lose energy as they pass from electron acceptor to electron acceptor and this energy is used to make more ATP



Electron Pathway 2 (HL)

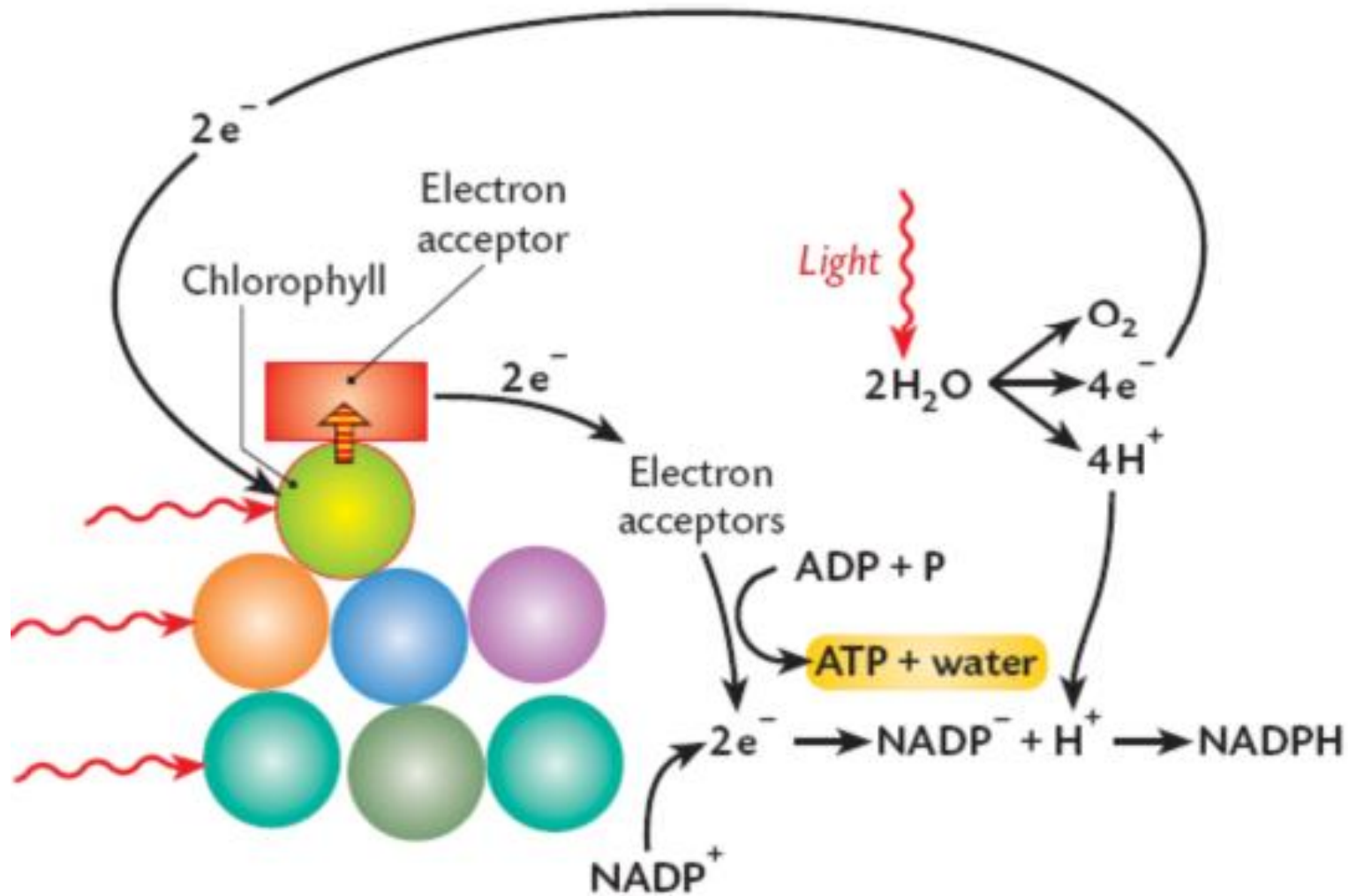
- Eventually the 2 electrons are passed to combine with **NADP⁺** to form **NADP⁻**
- The chlorophyll molecule is now short of electrons and gains more from the splitting of water
- The splitting of water using light energy is called **Photolysis**



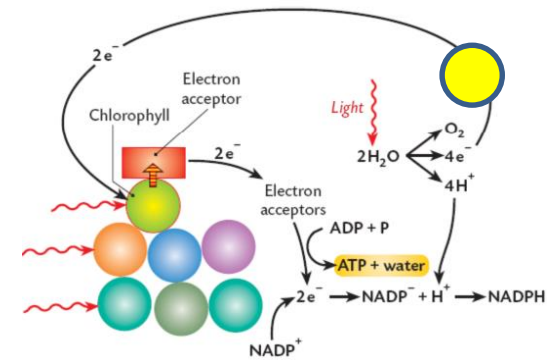
(HL)

- The protons that were stored in the proton pool are attracted to NADP⁻ and combine with it to form **NADPH**
- Because the electrons start at a chlorophyll and finish at NADPH and form ATP on their way this pathway is known as **Non cyclic photophosphorylation**

Electron Pathway 2 (HL)



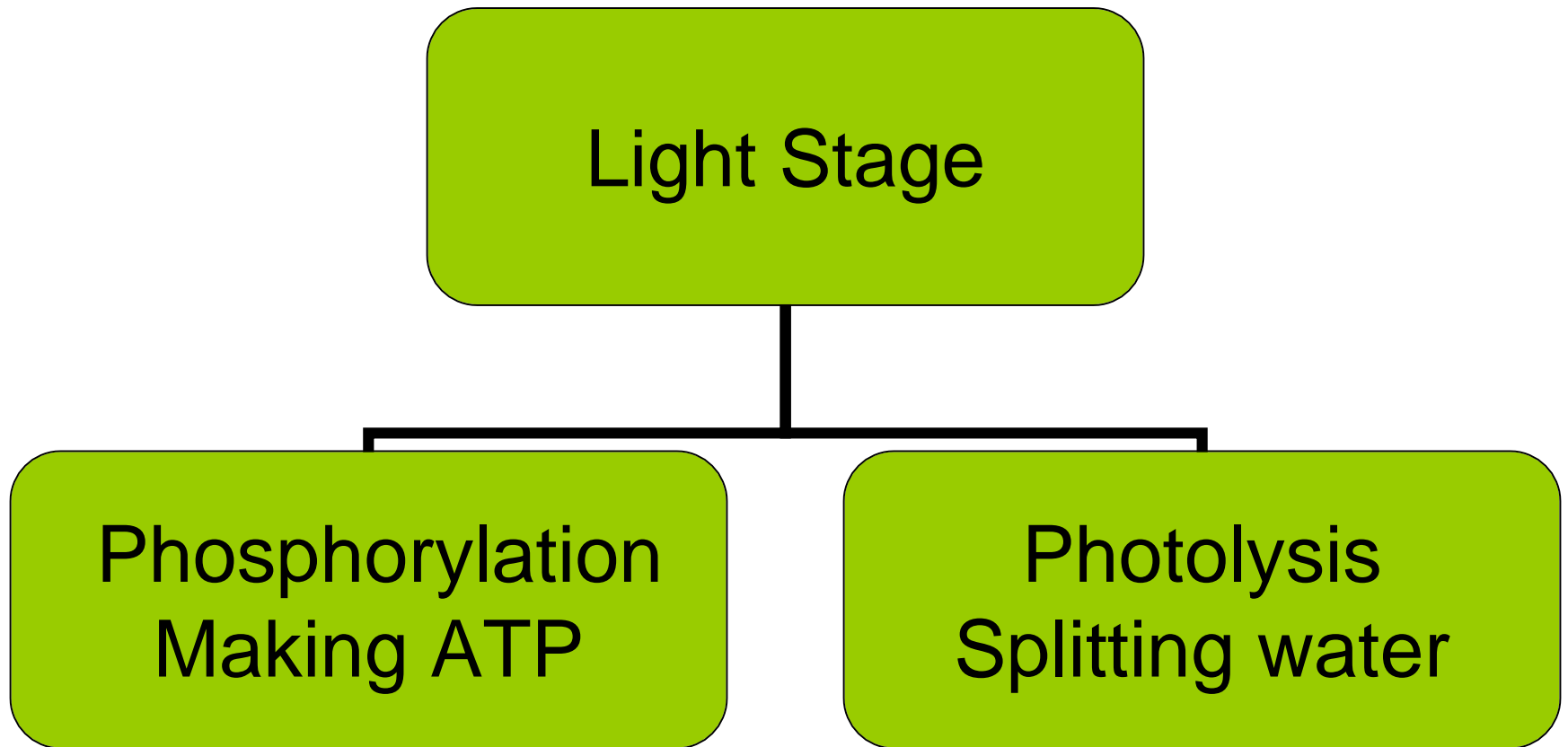
Learning Check



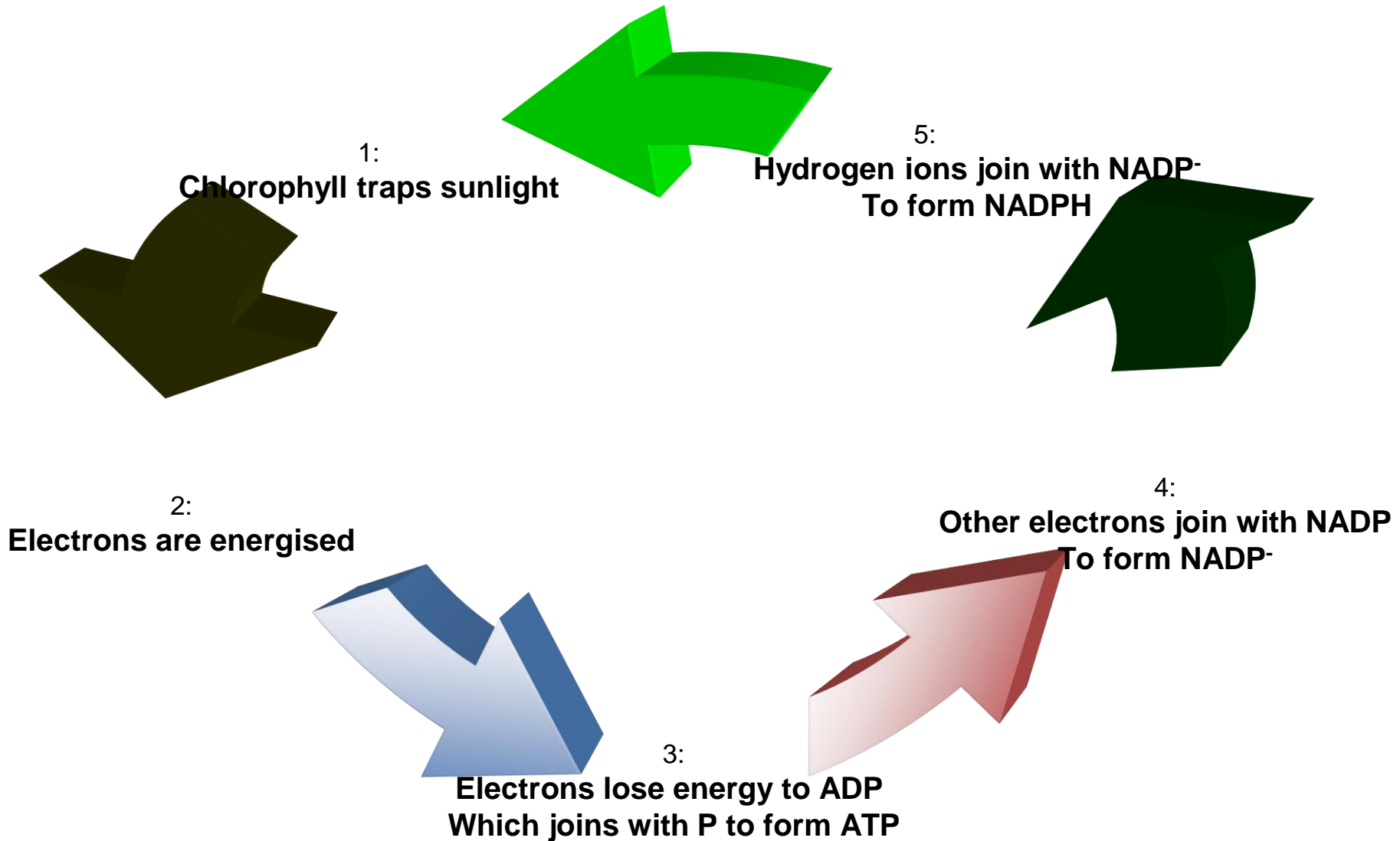
- Where do the electrons move to from the chlorophyll in pathway 2?
- What happens to the electrons as they are moved around?
- What is the final destination of the electrons and what does this form?
- What is attracted to $NADP^-$?
- What was the original source of these substances?
- What is photolysis?



Light stage (HL)



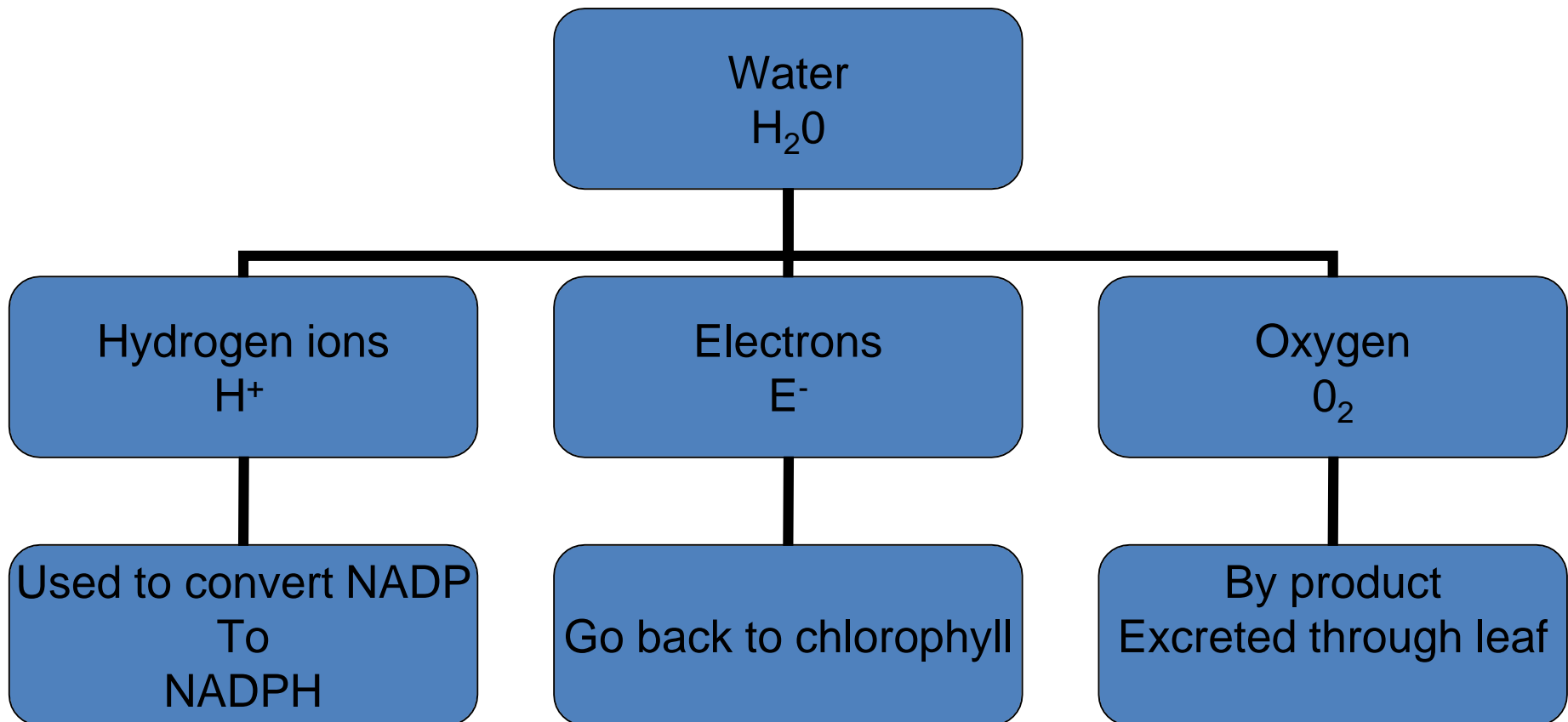
Phosphorylation (HL)





Photolysis (HL)

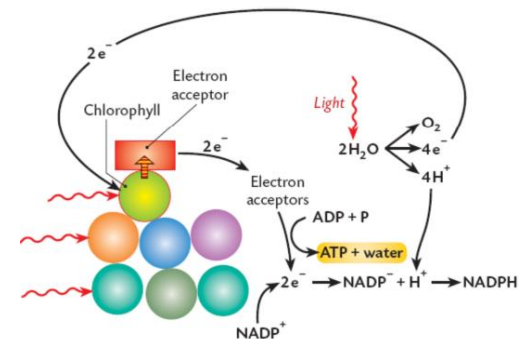
The splitting of water



End Products of the Light Stage (HL)

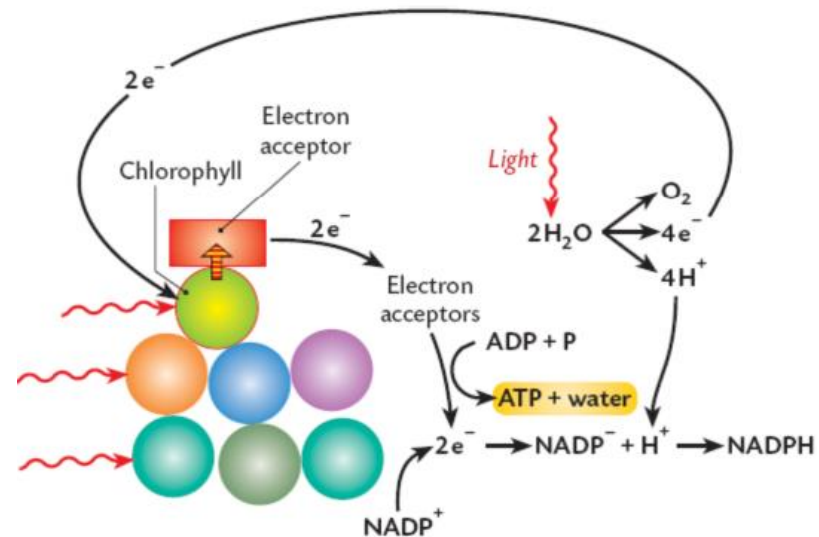


- There are 3 end products of the light stage
 1. ATP this will provide energy for the dark stage
 2. NADPH this will provide protons + energised electrons for the dark stage
 3. Oxygen is made when water is split



Learning Check

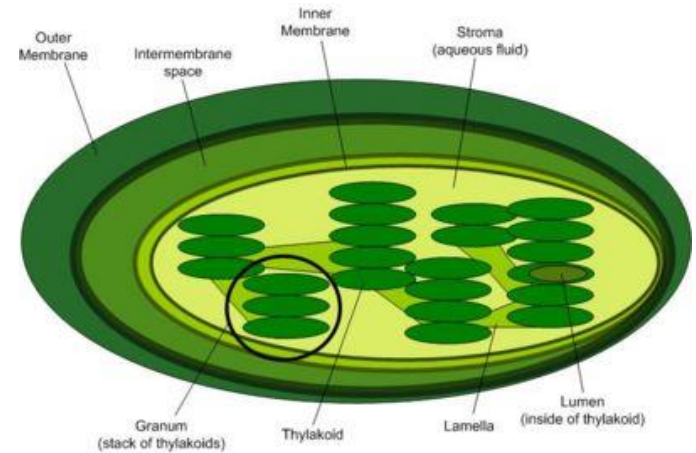
- What are the 3 end products of the light stage?
- Where do each of these products come from?
- What will happen to each of these products?



Dark Stage (HL)



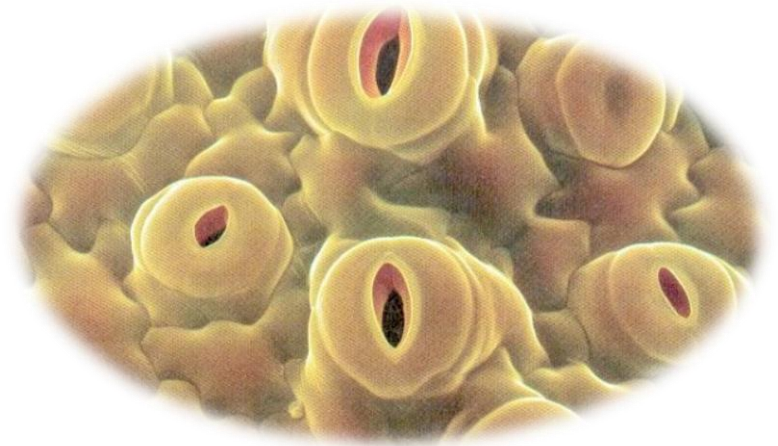
- This may also be called the **light independent stage** as it can occur in the light but does not need to use it
- It takes place in the **stroma** of the chloroplast
- It is controlled by enzymes and therefore can be affected by temperature



Dark Stage (HL)



- Carbon dioxide from the air enters the chloroplast where they combine with protons + electrons to form glucose
- This needs energy and protons + electrons



Dark Stage (HL)



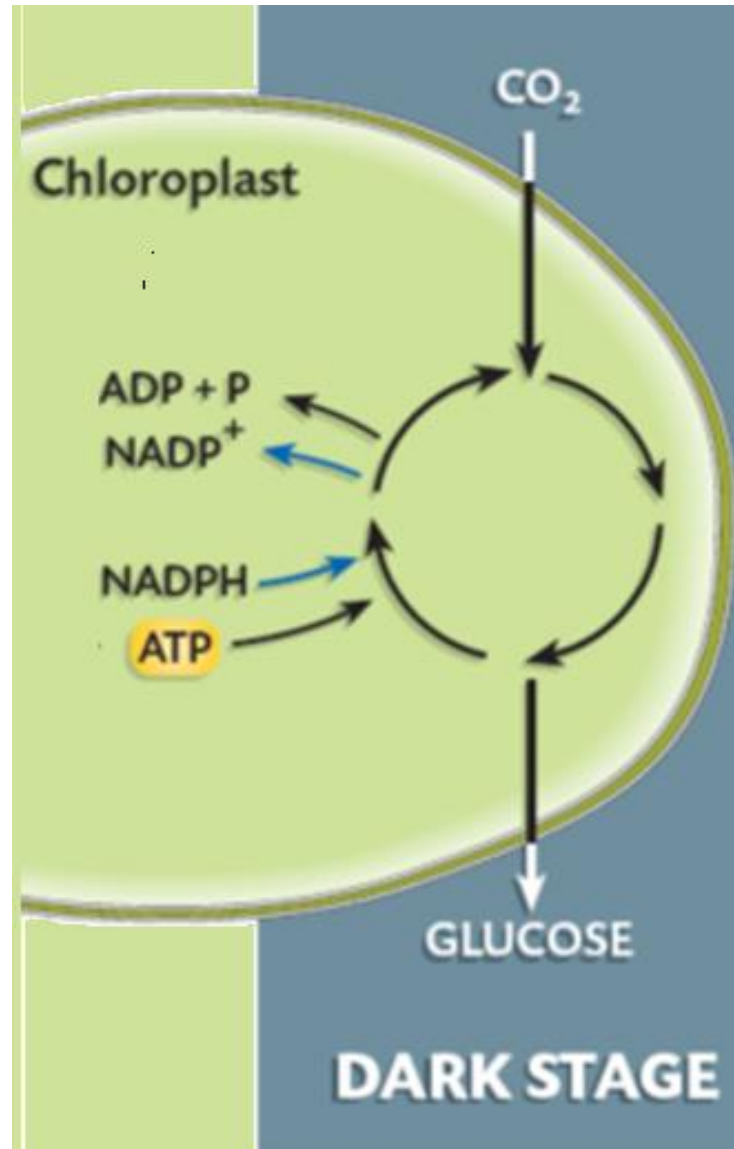
- It uses energy got from breaking down

ATP into ADP + P

- It uses hydrogen ions and electrons got from breaking down

NADPH into NADP^+ + 2 electrons + H^+

Summary of the Dark Stage



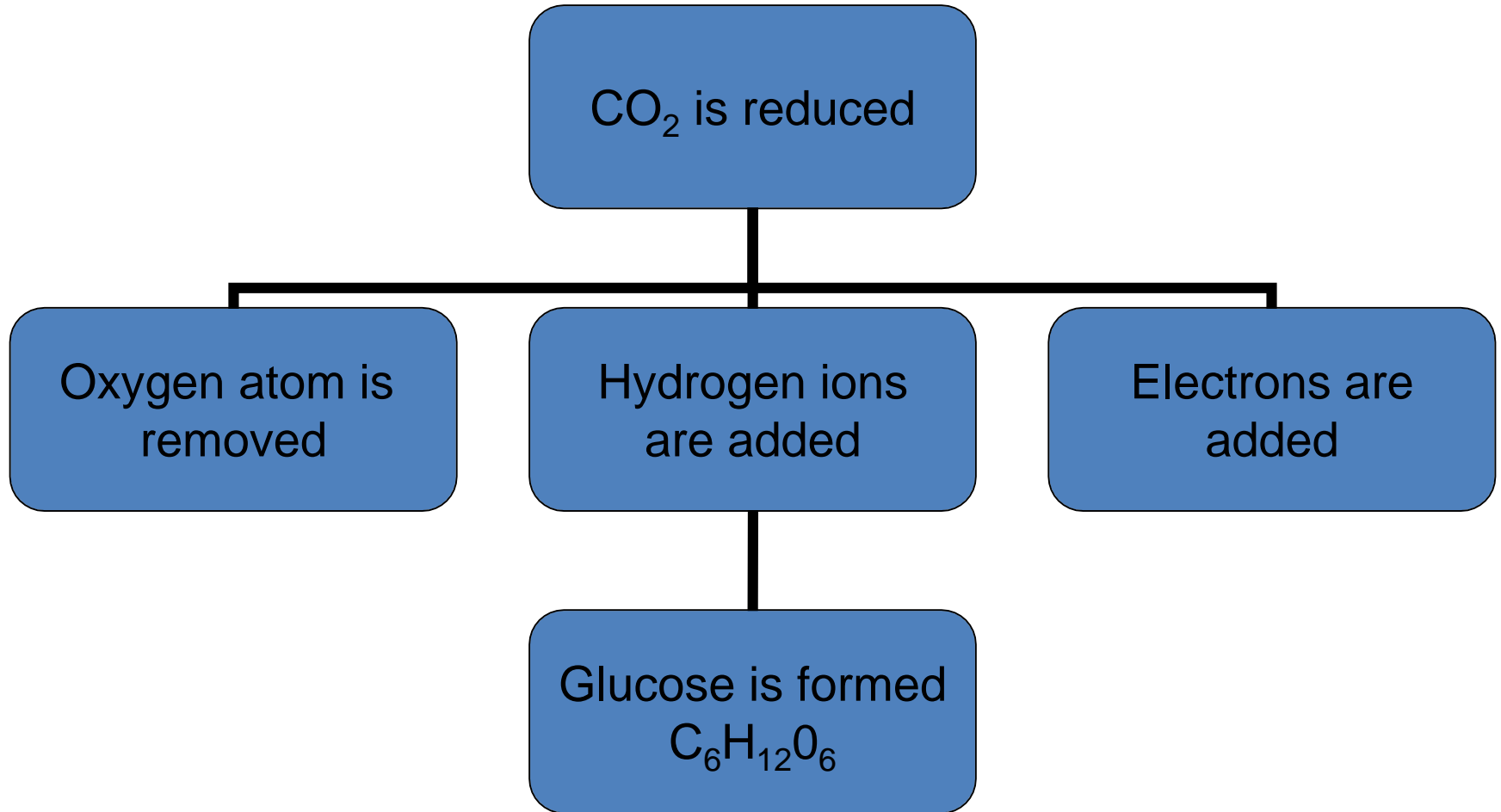


Dark Stage (HL)

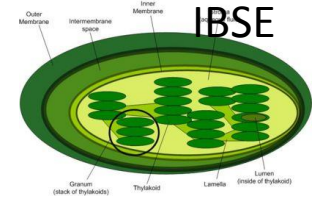
- Remember the addition of electrons to anything is known as reduction
- Carbon Dioxide is **reduced** to glucose



Dark Stage (HL)



Learning Check

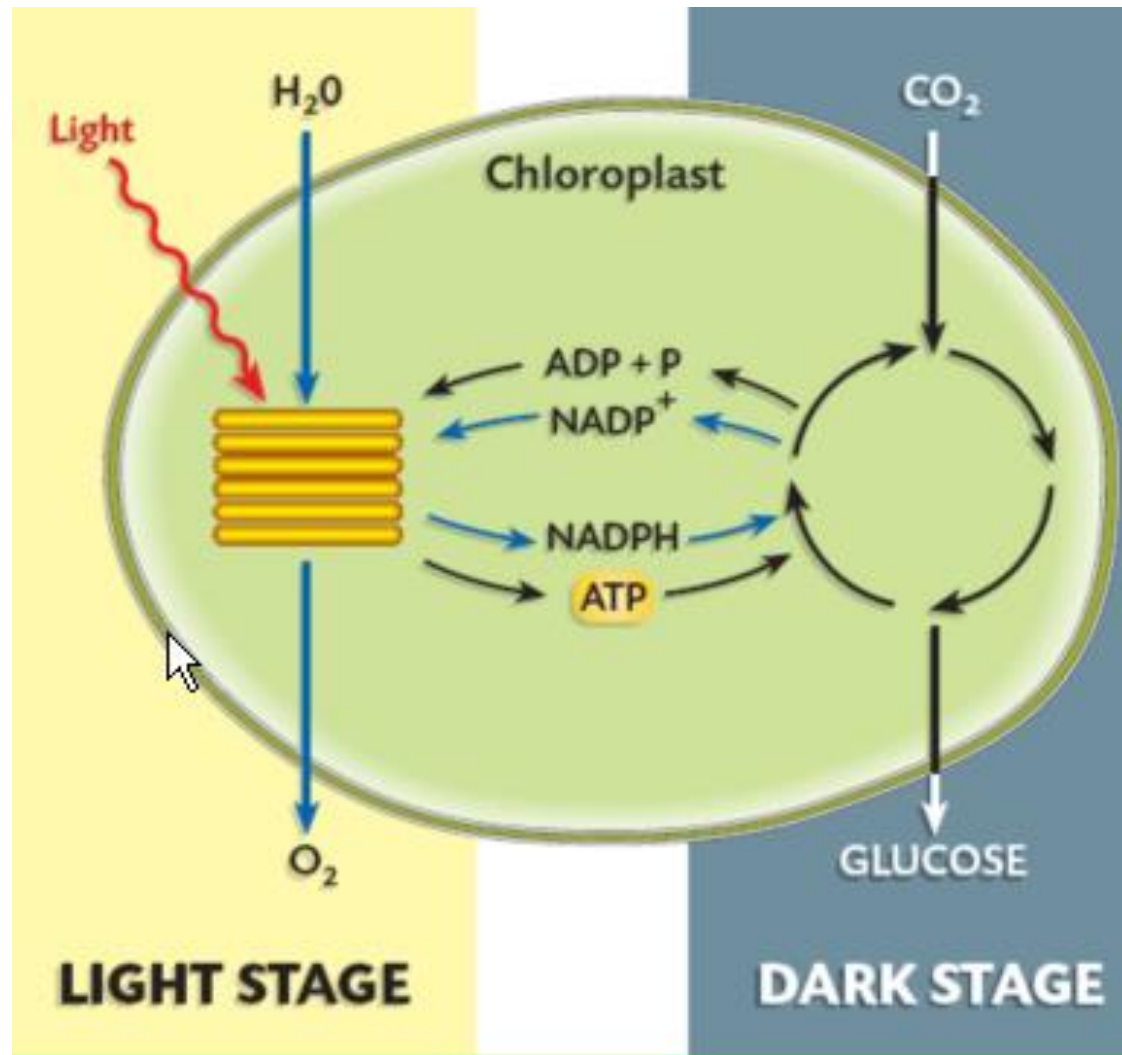


- Why can the dark stage more accurately be called the light independent stage?
- What part of the chloroplast does the dark stage take place in?
- Why is the dark stage affected by temperature?
- What gas is reduced to glucose?
- Where does the energy for this come from?
- What else is needed to reduce the gas? Where do these items come from?

Main events in photosynthesis (HL)

- Light energy is absorbed by chlorophyll
- Water is split
- The electrons are passed to chlorophyll
- The protons are stored in the chloroplasts
- The oxygen is released
- Sunlight transfers energy to electrons
- The high energy electrons, stored protons(the hydrogen ions) and carbon dioxide are used to make glucose

Summary of light and dark stages



Syllabus Can you?.....

- Explain the role of ATP
- Explain the production of ATP from ADP
- Explain the role of NADP⁺ in trapping & transferring electrons & H ions.
- Explain the Light Stage/Dark Stage
- State the two-pathway system of electron carriage.
 1. Direct to chlorophyll
 2. Trapped by NADP⁺