

1 – you are THE SUN

- Wear a label that reads “680nm wavelength”
- Hold a flash light
- When prompted, shine your light towards PS II pigment #8
- In a booming voice, say, “let there be light.”

2 – you are an OXYGEN

- Wear a label that reads “Oxygen”
- Initially link arms with hydrogen #3 and #4 to create water
- When the sun shines, break away from the hydrogens then link arms with oxygen #5
- The two of you should leave the chloroplast
- In a sing-songy voice, together say, “I’m out-a here”

3 – you are a HYDROGEN

- Wear a label that reads “hydrogen”
- Hold a ping pong ball representing your electron
- Initially link arms with hydrogen #4 and oxygen #2 to form water
- When the sun shines, break away from the oxygen and move into the lumen of the thylakoid
- When prompted, give your electron to PSII pigment #8
- Flip your label so that it reads “proton H^+ ”
- Slowly move around the lumen as a proton
- IF (and only IF) ATP synthase moves you out of the lumen, act as if this is a huge relief and that you are so glad to be out of there.

4– you are a HYDROGEN

- Wear a label that reads “hydrogen”
- Hold a ping pong ball representing your electron
- Initially link arms with hydrogen #3 and oxygen #2 to form water
- When the sun shines, break away from the oxygen and move into the lumen of the thylakoid
- Slowly move around the lumen as a hydrogen atom

5 – you are an OXYGEN

- Wear a label that reads “Oxygen”
- Initially link arms with hydrogen #6 and #7 to create water
- When the sun shines, break away from the hydrogens and link arms with oxygen #2
- The two of you should leave the chloroplast
- In a sing-songy voice, together say, “I’m out-a here”

6– you are a HYDROGEN

- Wear a label that reads “hydrogen”
- Hold a ping pong ball representing your electron
- Initially link arms with hydrogen #7 and oxygen #5 to form water
- When the sun shines, break away from the oxygen and move into the lumen of the thylakoid
- When prompted, give your electron to PSII pigment #8
- Flip your label so that it reads “proton H⁺”
- Slowly move around the lumen as a proton
- IF (and only IF) ATP synthase moves you out of the lumen, act as if this is a huge relief and that you are so glad to be out of there.

7– you are a HYDROGEN

- Wear a label that reads “hydrogen”
- Hold a ping pong ball representing your electron
- Initially link arm to arm with hydrogen #6 and oxygen #5 to create water
- When the sun shines, break away from the oxygen and move into the lumen of the thylakoid
- Slowly move around the lumen as a hydrogen atom

8– you are PS II Pigment

- Wear a label that reads “PS II pigment”
- When the light from the sun reaches you, accept the ping pong ball electrons from hydrogens #3 and #6
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- Hold the electrons and begin to wiggle in place
- After a moment, pass the electrons to PSII pigment #9
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

9– you are PS II Pigment

- Wear a label that reads “PS II pigment”
- Accept the ping pong ball electrons from PSII pigment #8
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to PSII pigment #10
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

10– you are PS II Reaction Center Pigment

- Wear a label that reads “PS II reaction center pigment”
- Accept the ping pong ball electrons from PSII pigment #9
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to ETC protein #11
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

11– you are ETC Protein

- Wear a label that reads “ETC protein”
- Accept the ping pong ball electrons from PSII pigment #10
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to ETC protein #13
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)
- As you give away the electron, pull proton #12 into the lumen. This requires energy, so make it seem like you are really putting a lot of effort to move the proton.

12– you are proton

- Wear a label that reads “Proton H+”
- Stand outside the desks in the “stroma” of the chloroplast. Stand near ETC protein #11.
- When the time is right, ETC protein #11 is going to move you into the lumen of the thylakoid. Make it seem like you don’t want to go into the lumen, and that the ETC protein is forcing you against your will.
- Once inside the lumen, slowly move around the lumen as a proton
- IF (and only IF) ATP synthase moves you out of the lumen, act as if this is a huge relief and that you are so glad to be out of there.

13– you are ETC Protein

- Wear a label that reads “ETC protein”
- Accept the ping pong ball electrons from ETC protein #11
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to ETC protein #15
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)
- As you give away the electron, pull proton #14 into the lumen. This requires energy, so make it seem like you are really putting a lot of effort to move the proton.

14– you are proton

- Wear a label that reads “Proton H+”
- Stand outside the desks in the “stroma” of the chloroplast. Stand near ETC protein #13.
- When the time is right, ETC protein #13 is going to move you into the lumen of the thylakoid. Make it seem like you don’t want to go into the lumen, and that the ETC protein is forcing you against your will.
- Once inside the lumen, slowly move around the lumen as a proton
- IF (and only IF) ATP synthase moves you out of the lumen, act as if this is a huge relief and that you are so glad to be out of there.

15– you are ETC Protein

- Wear a label that reads “ETC protein”
- Accept the ping pong ball electrons from ETC protein #13
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to PS I pigment #20
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)
- As you give away the electron, pull proton #16 into the lumen. This requires energy, so make it seem like you are really putting a lot of effort to move the proton.

16– you are proton

- Wear a label that reads “Proton H+”
- Stand outside the desks in the “stroma” of the chloroplast. Stand near ETC protein #15.
- When the time is right, ETC protein #15 is going to move you into the lumen of the thylakoid. Make it seem like you don’t want to go into the lumen, and that the ETC protein is forcing you against your will.
- Once inside the lumen, slowly move around the lumen as a proton
- IF (and only IF) ATP synthase moves you out of the lumen, act as if this is a huge relief and that you are so glad to be out of there.

17– you are ATP synthase

- Wear a label that reads “ATP Synthase”
- Watch to see when ETC protein #15 gives away the ping pong ball electrons to PS I pigment #20.
- When the electrons are passed on, take any mingling “proton H⁺” from the lumen and gently move it across the membrane (desks) into the stroma.
- After you’ve moved the proton, grab inorganic phosphate #18 and ADP #19. Link their arms together to make ATP.
- In a very excite voice, call out “I’ve made ATP!!”

18– you are inorganic phosphate

- Wear a label that reads “Pi”
- Mill around the lumen, however stay kind of near ATP synthase #20
- When the time is right, ATP synthase is going to link your arm with ADP #19. You need to kind of act like you don’t want to be connected to the ADP (remember you are repelled by the other phosphates). But, eventually give in to ATP synthases and link arms with ADP.
- Once you are an ATP, act all hyper and excited!! You are a high energy molecule now! Skip out of the lumen and into the stroma singing “I’ll see you later!”

19– you are ADP

- Wear a label that reads “ADP”
- Mill around the lumen, however stay kind of near ATP synthase #20
- When the time is right, ATP synthase is going to link your arm with Pi #18. You need to kind of act like you don’t want to be connected to the Pi (remember, your two phosphates are repelled by the other phosphate). But, eventually give in to ATP synthases and link arms with ADP.
- Once you are an ATP, act all hyper and excited!! You are a high energy molecule now! Skip out of the lumen and into the stroma singing “I’ll see you later!”

20– you are PS I Pigment

- Wear a label that reads “PS I pigment”
- ETC protein #15 is going to give you two electrons.
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- Hold the electrons and begin to wiggle in place
- After ATP synthase #17 has made ATP, the sun #21 will shine a light on you.
- Pass the electrons to PSI pigment #22
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

21 – you are THE SUN

- Wear a label that reads “700nm wavelength”
- Hold a flash light
- After ATP synthase #17 has made ATP, shine your light towards PS I pigment #20
- In a booming voice, say, “let there be light.”

22– you are PS I Pigment

- Wear a label that reads “PS I pigment”
- Accept the ping pong ball electrons from PSI pigment #20
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to PSI pigment #23
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

23– you are PS I Reaction Center Pigment

- Wear a label that reads “PS I reaction center pigment”
- Accept the ping pong ball electrons from PSI pigment #22
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to ETC protein #24
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

24– you are ETC Protein

- Wear a label that reads “ETC protein”
- Accept the ping pong ball electrons from PSI reaction center pigment #23
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to ETC protein #25
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

25– you are ETC Protein

- Wear a label that reads “ETC protein”
- Accept the ping pong ball electrons from ETC protein #24
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to ETC protein #26
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

26– you are ETC Protein

- Wear a label that reads “ETC protein”
- Accept the ping pong ball electrons from ETC protein #25
- Hold the electrons and begin to wiggle in place
- When you get the electrons, say “GER” in a mean voice (to represent reduction)
- After a moment, pass the electrons to NADPH Oxidase
- Stop wiggling
- When you give away the electrons, say “LEO” in a sweet, high pitched voice (to represent oxidation)

27– you are NADPH Oxidase

- Wear a label that reads “NADPH Oxidase”
- ETC protein #26 is going to give you two electrons.
- When you have the electrons, take “proton H+” #28 and attach it to NADP+ #29. Link their arms together to make NADPH. Give them the electrons.
- In a very excite voice, call out “I’ve made NADPH!!”

28– you are proton

- Wear a label that reads “Proton H+”
- Mingle inside the lumen, but stay near NADPH oxidase #27.
- When the time is right, NADPH Oxidase #27 is going to attach you to NADP+ #29. Link arms with NADP+ and take the electrons from NADPH oxidase.
- Once you are a NADPH, act all hyper and excited!! You are a high energy molecule now! Skip out of the lumen and into the stroma singing “I’ll see you later!”

29– you are NADP+

- Wear a label that reads “NADP+”
- Mingle inside the lumen, but stay near NADPH oxidase #27.
- When the time is right, NADPH Oxidase #27 is going to attach you to a proton #28. Link arms with the proton and take the electrons from NADPH oxidase.
- Once you are a NADPH, act all hyper and excited!! You are a high energy molecule now! Skip out of the lumen and into the stroma singing “I’ll see you later!”