P Photosynthesis at a Glance (approximately 7 traditional class days):

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| Seg | Model Move | Est Time  (min) | Overview | Resources | What did we figure out? |
| 1 | **M🡪P** | 55 | In finally moving our attention to matter and energy in plants, we consider a new Challenge Question: Seed to Tree. How does a tiny acorn grow into few-ton oak tree? We reference our models for Matter from Food and Energy from Food in order to generate a list of key points and questions that will motivate our investigations in the coming learning segments. | * P Doodle Sheet | We’ve established some ideas around matter and energy in plants, but we have a number of questions, especially regarding the role of CO2. |
| 2 | **Q🡪P** | 110 | We set aside some of our questions in favor of addressing a central idea, “What is the role of CO2 with plants?” Students design, set-up and execute an investigation to look at CO2 output and uptake in an aquatic plant in both light and dark conditions. | * P Doodle Sheet * P 02 Photosynthesis Lab TEACHER GUIDE * P 02 Photosynthesis Lab * Lab Supplies as outlined in the TEACHER GUIDE | We’ve decided on an experimental design that will help us answer our questions about CO2 and light. We await the results. |
| 3 | **P🡪M** | 55 | We examine the results of our experiment and construct posters that communicate our findings and analysis. We review other groups’ results and discuss as a class. | * P Doodle Sheet * P 03 Gallery Walk Feedback Sheet | We come away with some key ideas about photosynthesis: we recognize that plants use CO2 in the light because they are doing photosynthesis. In the dark, plants give off CO2 because they are doing cell respiration. But we still wonder about whether plants may be respiring in the light too. |
| 4 | **P🡪M** | 55 | Here we examine the phenomena from the lab more deeply to refine our model ideas. We debate some lingering unsettled ideas using “Light and Dark” Four Corners activity and data from some additional experiments. | * P Doodle Sheet * P 04 Light and Dark Four Corners Handout | We conclude that plants only do photosynthesis in the light, but they do cell respiration all of the time. Since photosynthesis happens at a much faster rate than cell respiration under light conditions, the net effect of a plant on the environment over time is to reduce the amount of CO2 in the atmosphere. |
| 5 | **M** | 10-15 | We apply the chemical reaction model to photosynthesis, specifically to reason about the nature of the energy change involved. | * P Doodle Sheet | We see that photosynthesis requires energy, specifically the energy in sunlight. The sun’s energy is used to rearrange low energy reactants into high energy products. |
| 6 | **M** | 20 | We know the products of photosynthesis are glucose and O2, and we know that one of the reactants is CO2. We once again put our model ideas about matter to work and determine the other product, glucose. Photosynthesis is the opposite chemical equation to cellular respiration. | * P Doodle Sheet | We now have the reactants and products and have realized that chemical equation for photosynthesis is the reverse of cellular respiration. All cellular energy (ATP) comes from glucose, and all glucose is made in photosynthesis using the sun’s energy. Therefore all energy for life originally comes from the sun. |
| 7 | **M** | 30 | We summarize the model.  *Might be able to collapse this into the last learning segment or to collapse more than one learning segment.* | * P Doodle Sheet | We’ve added language to our two models: Matter from Food and Energy from Food. |
| 8 | **M🡪P** | 110 | We return to the Seed to Tree Challenge Question and answer the question, “Where did all of the matter come from?” In explaining this phenomenon, we apply both the model for Matter from Food and the model for Energy from Food. | * P Doodle Sheet * P 08 Seed to Tree Handout | The majority of the mass of a tree comes from the CO2 it takes in from the atmosphere. The plant turns it into glucose through photosynthesis. Any glucose the plant doesn’t respire for energy can be used to generate the carbon-containing matter that makes up the plant. We related the seed to tree phenomenon to the Biggest Loser. |