B Biosynthesis at a Glance (approximately 3-6 traditional class days):

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| Seg | Model Move | Est Time  (min) | Overview | Resources | What did we figure out? |
| 1 | **M🡪Q** | 15-20 | We now switch to thinking about the matter from the food we eat and how it is involved in cellular respiration. We ask, is it used for anything else? We quickly review relevant ideas from past models and reason that the food we eat provides us with the components we need to build new body tissue. | * CR Doodle Sheet * IOU Representation * B 01 Doodle Digestion Diagram * B 02 Doodle Sheet | We’ve explicitly shifted our focus to questions about how we use matter after two triangles of dealing with energy. And we have reviewed what happens to the matter once it enters our bodies. |
| 2 | **M🡪Q** | 15 | We now go deeper to try to understand what happens to the food we eat beyond what we need for energy, growth and maintenance. We then ask why would we store excess fat, what purpose does it serve? In this way we develop ideas around fat as an energy reserve so if you run out of glucose, then you can draw on your fat for fuel for cellular respiration. | * B 01 Doodle Digestion Diagram * B 02 Doodle Sheet | We have figured out that when you take in excess food, it is stored as fat. We also reasoned that this fat provides an energy reserve if your glucose pool runs dry. Only as a last result would you draw from your amino acid pool for fuel. |
| 3 | **M🡪P** | 20-30 | We apply the chemical reaction model to the process of building new biomolecules in our cells.  Electrolysis Path: In classrooms that did electrolysis, this can be a simple conversation asking which reaction diagram makes sense for biosynthesis—the uphill reaction or the downhill reaction?  Burning Ethanol Path: In classrooms that have only considered energy-releasing reactions, we need to take some time to consider how energy might be involved in the synthesis of larger biomolecules. We do this in a paper activity by “building a protein” from amino acids to see that synthesis takes work. | * B 02 Doodle Sheet   Burning Ethanol Pathway:   * B 03 Building a Protein TEACHER GUIDE * B 03 Amino Acids PDFs (multiple files) | We figured out that building biomolecules requires energy, as indicated in our “uphill” reaction diagram. The energy comes from chemical reactions such as cellular respiration. |
| 4 | **M** | 30 | Now that we recognize both occur in our cells, we pause for a moment to consider the pairing of energy-releasing and energy-requiring reactions in the body. We apply our models (Chemical Reactions, Energy from Food and Matter from Food) to the case of the coma patient in order to reinforce the idea of our bodies as matter and energy cycling machines. | * B 02 Doodle Sheet * Posted Chemical Reaction model * Posted Energy from Food Model * Posted Matter from Food Model | We now have some concept that energy “cycles” in organisms. These cycles keep us going at our bare minimum or maintain the basal metabolic rate. If we need to do more than just maintain our body, then we need more fuel. |
| 5 | **M🡪P** | 20-150 | Now we have the revised models we need to tackle the Hibernating Bear explanation. We work in groups to consider any new ideas and to evaluate our understanding. [This learning segment is heavily scaffolded and depending on your students you may wish to use all of it or very little]. | * CR Doodle Sheet * B 02 Doodle Sheet * B 05 Hibernating Bear Four Corners Handout * B 05 Hibernating Bear Four Corners Readings (as needed) | We hope to have a coherent explanation for the Hibernating Bear that includes two key points: (1) When we use more food than we eat our body begins breaking down stored fat for cellular respiration. (2) This reaction produces H2O (lost as sweat or urine) and CO2 which is exhaled. H2O input and output are equal, so the matter he lost is mostly converted to CO2. |
| 6 | **M🡪P** | 30 | We ask students to apply the models to explain how exercising helps a person lose weight. Then they use their model ideas of Energy from Food and Matter from Food to individually explain where the weight goes when someone loses weight. | * B 02 Doodle Sheet * B 06 Why Exercise Handout | Exercise helps with weight loss because exercise requires a lot of energy and the more energy we need, the more cellular respiration must happen to provide the energy. The more cell respiration, the more food (or fat when all food is used up, fat) is converted to CO2 and leaves the body when we exhale. Students have also figured out that when weight is lost matter is lost in the form of carbon dioxide that is breathed out. Their explanation is written in a complete, coherent model-based explanation using the models developed while making sense of the hibernating bear phenomenon. |
| 7 | **M🡪P** | 20 | We use our two big models, Energy from Food and Matter from Food, to individually write final explanations for the Hibernating Bear. This is the summative assessment. | * B 07 Hibernating Bear Challenge Handout * B 07 Hibernating Bear Challenge Rubric | We’ve figured out that when we lose weight, we lose matter in the form of carbon dioxide that we breathe out. The final product is a complete, coherent model-based written explanation for the Hibernating Bear (see rubric). |