BSED Science Lesson Plan Template

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| WEST CHESTER UNIVERSITY LESSON PLAN TEMPLATE |
| **Lesson Title / Day****TOTAL LESSON TIME: 1 hr 45 min** | **Cell Energetics: Cellular Respiration** (a focus on glycolysis, the Acetyl CoA link reaction, and the Krebs cycle) |
| **Lesson Big Idea***What is the big idea threaded throughout the instructional sequence? (This could be a CCC specifically applied to the content addressed.)**How will this lesson connect to the big idea / contribute exploring it*? | **Big Idea-Energy and Matter (CCC): In all chemical reactions of cell energetics, energy cannot be created or destroyed—It only moves between one place and another place.**This lesson is about the section of cell energetics that deals with cellular respiration. Cellular respiration is a stellar example of this big idea, because in every step, there is a release of energy that is both leveraged to form high energy molecules and lost to the environment as heat. This lesson will explore this concept thoroughly as the class follows the journey of the carbon molecules in glucose as it is broken down for energy. DCI = [LS1.C: Organization for Matter and Energy Flow in Organisms](http://www.nap.edu/openbook.php?record_id=13165&page=147)* [As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.](http://www.nap.edu/openbook.php?record_id=13165&page=147)

**Essential Question:** What happens to the oxygen and carbohydrates our body demands? |
| **NGSS (**[**link**](https://www.nextgenscience.org/)**) / PA STEELS Standard (**[**link**](https://www.education.pa.gov/Teachers%20-%20Administrators/Curriculum/Science/Pages/Science-Standards.aspx)**)***List the relevant standard for this lesson (including designation). Also, explain what aspect of the standard will be emphasized in the lesson.* |

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| **NGSS STANDARD: HS-LS1-7.****PA STEELS:**Organization for Matter and Energy Flow in Organisms | **Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food (GLUCOSE) molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.**3.1.9-12.G Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. |

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| **ISTE (Technology) Standards (IF APPROPRIATE)**[www.iste.org](http://www.iste.org) / [ISTE Standards for Educators](https://www.wcupa.edu/education-socialWork/assessmentAccreditation/documents/ISTE_Standards_For_Educators.pdf)*When addressing this section, you should include the standard number and the sub-component (e.g., 3a, 4a-c, etc.). More importantly, describe how technology will be used to enhance the learning in the lesson.* | **2.7.b** **Use Tech to Create Assessments**For a chunk of the assessment at the end of the lesson, I used AI to generate questions and carefully revised and tweaked them to be more in-depth. AI also was used to generate most of the play that is used to boost participation and make learning more interactive.**2.2.c Model Digital Tool Use**I modeled for Ms. Falcone the power of AI as a supplement to lesson planning. AI is currently no match for human discernment of what makes a good assessment, but it does give an excellent place to start building from. |
| **Objective(s)***A typical lesson will include 1 – 3 objectives. Make sure the objectives (a) clearly connect to the standard, (b) are concise but unambiguous, (c)* *have directly observable / measurable verbs, and (d) align with instruction and assessment.* | 1. Students will be able to develop a model that explains what happens to the molecules we breathe in and the molecules we consume. \*
2. \*Students will be able to conceptually connect their two revised models to each other using acquired knowledge of cellular respiration.
3. Students will be able to create a diagram that illustrates the journey of the carbons and energy within glucose as it goes through cellular respiration.
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| **Materials / Resources***This should include any items you need to support exploration of phenomenon, any media (books, music, movies) you might reference, and any technology items you would utilize (including web sites). Make sure to cite resources as appropriate.* | Sugar and Ash Experiment: “Some sugar, some fire, and something else”1. Sugar cubes
2. Ash
3. Fire source
4. Small whiteboards
5. Aluminum foil
6. Forceps

Martin the mitochondria (stuffed mitochondria)“Battle for the Aegis” playRedox Video: <https://www.youtube.com/watch?v=6gtcvqLmPo8>Cellular respiration video<https://www.youtube.com/watch?v=pNzFYBA2Ofg> |
| **Opening / Engage***Anticipated length: \_\_50\_\_ minutes**How will you start the storyline to the IS and / or frame the lesson? How will you engage the students / get them invested in the lesson? How will you determine where the students are in their understanding / build on their prior knowledge?**Provide enough details for yourself and for those trying to picture what you are planning.* | **Eliciting Ideas/making models (10 min)**Students will create a model after sharing ideas with the class based on their hypotheses of the following questions:What happens to the air we breathe?If we ate some sugar, what would happen to it?**Introduction to experiment variables: Think pair share activity. (15 min)**1. Sugar cubes will be handed out to the students and they will be allowed to also observe ashes.
2. T will ask “which will burn the best? The sugar cube coated in ashes, or the sugar cube without them? Why?”
3. Ss will think (30 sec), talk to their neighbor/argue based on evidence (4 min), then share their ideas with the class (10 min). T will do a popcorn activity for this step where the only one who can talk is the one holding Martin the mitochondria. Ss will toss the stuffed toy to another student who has a raised hand.

*The science and engineering practice (SEP), Arguing Based on Evidence, will be satisfied here.*1. T will write a class model on the whiteboard during the sharing phase.

**Experiment + Eliciting/refining class model (15 min)*** Both cubes will be burned to the tune of “burning down the house” by the Talking Heads (makes it more fun) and Ss will record more observations. (5 min)
* “What did the ash do for the sugar cube that made it combust easier?” (5 min)
* Create a chemical equation for the combustion reaction using class observations. (5 min)

**Redox portion (10 min)*** T will introduce students to the basics of redox reactions with instruction and a video.
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| **Body of the Lesson***Anticipated length: \_\_40\_\_ minutes**How will you transition into the body of the lesson? How will you keep the storyline moving? How will you facilitate the main learning experience? (This could include planned questions to ask.) If there is group work, how will you organize / structure it? If there is a formative assessment, how will you implement it? What challenges in student learning can you anticipate?**Provide enough details for yourself and for those trying to picture what you are planning.* | **Glycolysis (15 min):** “What do we think glycolysis means?” Ss will likely deduce it means “breaking sugar.”Ss will volunteer for characters in the play, and we will explore what happens when we “break” some things in cellular respiration. (5 min)T will go over the content of glycolysis using multiple modes of learning through utilization of video simulations and lecture. Following energy transfers and carbon structure will be emphasized during instruction (10 min)**Link Reaction (10 min):**T will go over the structure of pyruvate and why it is so important that it needs CoA to bind to it. The method it crosses the mitochondrial membrane will also be explained. This will be supplemented with a video simulation of this process.**Krebs cycle/brief intro to ETC (15 min):**T will go over the Krebs cycle and its’ dependence on Acetyl CoA formed by pyruvate. T will emphasize energy states of molecules as the cycle progresses and how this energy is harvested/lost to the environment.T will also briefly introduce the ETC and how e- tend to move towards more positive net charges, ending in the reduction of O2 into H2O. |
| **Closing / Elaborate***Anticipated length: \_\_15\_\_ minutes**How will you formalize the learning that has occurred? How will you assess where students are at the end of the lesson? If the lesson might end partway through an activity, what is a good stopping point? How will you keep the storyline going to set up the next lesson?**Provide enough details for yourself and for those trying to picture what you are planning.* | Students will refine their ideas of “What happens to the air we breathe?If we ate some sugar, what would happen to it?” using evidence from the lesson. They will revise the two models that they drew in their notes at the start of class and attempt to connect the two models using what they now know about cellular respiration. (5 min)*This revision of their models satisfies the SEP for Developing and Using Models**“*[*Use a model based on evidence to illustrate the relationships between systems or between components of a system.*](http://www.nap.edu/openbook.php?record_id=13165&page=56)*”*For the remainder of the time, students will work on the worksheet. (rest of class…worksheet will likely take 20-30 min total) This worksheet will act as a buffer in case the lesson runs short, |
| **Differentiation***What differentiated support will you provide for students whose academic development is below or above their grade level? What specific differentiation of content, process, products, and/or learning environment will you use to meet the needs of all of your students*? *How does your lesson support student differences with regard to linguistic, academic, and cultural diversity?* | * I created a backup worksheet that has larger lettering for students with severe visual impairments if they need it.
* I also will keep in mind the students with IEPs regarding learning disabilities in the class and will be sure to check in with them during the worksheet portion of the lesson.
* I also understand that some students may feel less inclined to participate, so to ensure my classroom is inclusive, I implemented multiple ways the whole class can participate and share their ideas through funneling-free expression of hypotheses, think pair share, roles during the play, and drawing models.
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| **Assessment (Formal or Informal)***How will you determine whether the learning objectives were met? You should describe**each formal or informal assessment and how it is aligned to the objectives.* | **Formal formative assessment:** The worksheet they will be given which is adapted from both human generated, AI generated, and POGIL questions. This worksheet is made to both reinforce key ideas in cellular respiration and to exercise critical thinking regarding cellular processes and energy.**Informal formative assessment:** This will be done by eliciting student ideas before the phenomena, after, and during the lesson. The students will also create models of their hypotheses that will be observed to understand their retention of the content and prior knowledge. |
| **REFLECTION ON INSTRUCTION** | **Bullet points in the lens of NGSS generated by ChatGPT based on a reflection paper I wrote.****Successful Aspects Aligned with Next Generation Science Standards (NGSS):*** Executed a 1hr 45min AP Biology class that adhered to Next Generation Science Standards, specifically targeting cellular respiration components such as glycolysis, the acetyl-CoA link reaction, and the Krebs cycle. The implementation of the POE activity at the lesson's commencement aligns with NGSS's emphasis on engaging students in three-dimensional learning experiences, fostering their critical thinking skills while exploring scientific phenomena in a non-graded environment.
* Incorporated class models within the POE activity, aligning with NGSS practices by encouraging students to construct and revise models as part of the sense-making process. The use of a stuffed mitochondrion as a speaking tool exemplifies NGSS's focus on fostering communication skills and student engagement in scientific discourse, contributing to a collaborative and participatory learning environment.
* Introduced a case study on arsenic poisoning through a play, demonstrating adherence to NGSS Crosscutting Concepts by connecting cellular respiration concepts with real-world applications. This approach accommodated diverse learning styles, promoting the integration of science and engineering practices, one of the key pillars of NGSS.

**Areas for Improvement in Alignment with NGSS:*** Recognized a missed opportunity in not highlighting students' thought processes during the hypothesis phase of the POE activity. Future iterations of the lesson could better align with NGSS by emphasizing and explicitly showcasing the scientific practices of constructing explanations and engaging in argumentation, fostering a deeper understanding of core ideas.
* Identified the need for improved transitions between lesson sections to explicitly explain the significance of creating models, running experiments, and connecting observed phenomena to the broader context of cellular respiration. Enhancing these transitions aligns with NGSS's call for coherent and connected learning experiences that integrate disciplinary core ideas with science and engineering practices and crosscutting concepts.
* Acknowledged the challenge of handling heavy content within a single class, proposing a focus on teaching glycolysis in future lessons. This adjustment aligns with NGSS's emphasis on depth over breadth, allowing for a more in-depth exploration of a specific core idea and providing opportunities for students to engage in scientific investigations and argumentation.
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Notes of reflection for next time!