CONCEPT-BASED LESSON PLANNING PROCESS GUIDE

Classroom Context: This lesson plan was delivered as part of the broader lesson "The Cycles of Matter" which was imbedded within the Unit: Matter and Energy in Ecosystems for a sophomore level General Biology Course. Peak Virtual Academy is a blended/hybrid on-line school for grades 6-12. Students work on the on-line portion of the curriculum three days per week and are on-site the other two. On-site is reserved for lab based activities or other interactive lessons. The 29 students who participated come from a wide range of ethnic and socioeconomic backgrounds. Each student had access to a computer as well as other support materials for the lesson.

Shift in Instructional Design	*Lesson Elements and Design*	*Metacognitive Reflection*
The Unit Generalization and Focusing Lens asks students to …	**Lesson Focus:** (*Connection to Generalization and/or Focusing Lens in the District Sample Curriculum Project)* The teacher will introduce energy and matter within environmental systems so that students can identify misconceptions and demonstrate their current understanding of the concepts as it applies to the appropriate science standard and evidence outcome. This lesson is the foundation for the lessons that follow that fully support the science standard and evidence outcomes specified. Students will understand that ecosystems function through the transformation of matter and energy. Evidence Outcomes: 2.1d: Develop, communicate, and justify an evidence based scientific explanation showing how ecosystems follow the laws of conservation of matter and energy. 2.1f: Describe how the carbon cycle works.	*How does this specific lesson advance the big idea or generalization of the unit? What connections might be made between other content areas?* *This lesson will formally define "conservation of matter" which then allows students to apply their understanding towards successfully achieving the lesson's evidence outcomes. Students will be required to utilize appropriate math skills when quantifying the amount of carbon stored in trees during the carbon cycle.*
This lesson objective / learning target is critical to student understanding because…	**Objectives / Learning Targets:** *(Key knowledge & skills students will master in the lesson)* *(Language may be pulled from the task in the Learning Experience:"…so that students can…")* I can demonstrate the law of conservation of matter within an ecosystem as it applies to the carbon cycle.	*In what ways does the learning target support the generalization?* *It supports the generalization by allowing students to investigate the in which matter (carbon) is transformed (while being conserved) within the carbon cycle.*

<table>
<tr><td></td><td>I can calculate how much carbon dioxide captured from the atmosphere is trapped in a tree via photosynthesis. (Extension activity applied after this lesson)</td><td></td></tr>
<tr><td>Instructional strategies</td><td>Instructional Strategy Menu (not exhaustive):
Student-generated questions
Teacher-provided inquiry questions (Independent work, collaborative group)
Teacher modeling
Close reading protocol
Hands-on/experiential (including computer simulations in follow up lessons)
Direct instruction
Collaborative groups – Whip Around, Jigsaw</td><td>Which instructional strategies will foster learning the lesson's skills, processes, or content?

All of the ones selected will foster these.</td></tr>
<tr><td>In the first 3-7 minutes of the lesson,</td><td>Opening (hook / anticipatory set / lesson launch)

Instructional Strategy chosen: Teacher-provided inquiry questions

How do trees grow so big?

Why is this strategy impactful:
(In what ways does this strategy move the learner toward meeting the learning target? How would this strategy ensure all students, with differentiated needs, could feel successful?)
Activates background knowledge (vocab)
Helps teacher identify misconceptions

Scientific Practices:
Asking Inquiry Based Questions
How does this strategy support meeting the "just-right challenge," or "building relationships," or "creating relevancy," or "fostering disciplinary literacy"?

This strategy allows me to identify prior knowledge and misconceptions. The inquiry based question is something all students can relate to and provides an understandable concept to connect learning objectives to.</td><td>In what ways does the chosen strategy work toward a larger purpose at the beginning of the lesson (e.g., engaging students, increasing curiosity, stimulating student-generated questions, etc.)?

This will increase curiosity and engage students through questioning.

In what ways does the chosen strategy(ies) work toward a larger purpose (e.g. increasing collaboration; interacting with complex texts; situating students in real-life, relevant experiences; increasing student agency; stimulating student discourse; etc.)?

It provides relevancy (why do I need to know this and why would it be important?) to the ultimate goal which is to have students understand and apply the concept of "Conservation of Matter within an Ecosystem".
Students have to collaborate during group work, but also develop their own reasoning and explanation using disciplinary literacy skills in science. They develop disciplinary literacy by me stimulating student discourse.</td></tr>
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The Learning Experience will	***Learning Experience / Lesson***	
	Instructional Strategy chosen: *Student-generated questions, Teacher-provided inquiry questions, Teacher modeling, Close reading protocol, Hands-on/experiential – computer simulations, Direct Instruction, Collaborative Groups utilizing "whip-around" and "jigsaw"* **Scientific Practices:** 1. Asking questions 2. Developing and using models 4. Analyzing and interpreting data 6. Constructing explanations (for science) 8. Obtaining, evaluating, and communicating information Group Performance: 1. Access Prior Knowledge: How do trees get so big" – cooperative group "whip-around" 2. Groups will access historical data and background knowledge to create a model that demonstrates the Law of Conservation of Matter within an Ecosystem 3. Teacher-directed formal definition 4. Cooperative group – "jigsaw", each group has a representative share their groups model with the other groups. 5. Exit Ticket (Revisit-Modify) Follow-up Lessons: Each individual will work with computer simulations of the carbon cycle and calculate the amount of carbon "trapped" in the original tree. **Why is this strategy impactful:** (*In what ways does this strategy move the learner toward meeting the learning target? How would this strategy ensure all students, with differentiated needs, can feel successful?)* *The teacher facilitates the questioning, researching, and modeling. Each group designs their own model based on prior knowledge. As groups share models information is added (and potentially discarded)*	*In what ways does the chosen strategy cement the learning? Through engagement and personalization through questioning and collaboration. In doing so it provides a clear purpose and obtainable goal that students can connect content to.* *What evidence will show that the strategies impacted student learning? Were the strategies effective through the learning process?* This strategy focused on disciplinary literacy as well as connecting together all the scientific practices used throughout the lesson.

	as it relates to the phenomena of conservation of matter and nutrient cycling. **How does this strategy support meeting the "just-right challenge," or "building relationships," or "creating relevancy," or "fostering disciplinary literacy"?** **Group discussions and modeling create a safer space to share ideas if students know that they are building collective understanding. This strategy pushes students to collaborate and ask questions and share ideas as they explore the phenomena. It also holds each student responsible and accountable for their own learning.**	
The closing activity reinforces the learning.	***Closure*** ***Formative assessments will be conducted throughout the lesson both during individual and group work. The final formative assessment focuses on modifying and revising explanations as new evidence is obtained.*** At first I thought… But now, I know... Our original model changed from… **Instructional Strategy chosen: Individual work and formative assessment** **Why is this strategy impactful:** (*In what ways does this strategy move the learner toward meeting the learning target? How would this strategy ensure all students, with differentiated needs, could feel successful?)* *Students synthesized what they have learned about the overall phenomena that answers the question "How Do Trees Get So Big?" Students need to modify and revise their own understanding of the phenomena in question.*	

	How does this strategy support meeting the "just-right challenge," or "building relationships," or "creating relevancy," or "fostering disciplinary literacy"? **Students need to communicate their learning in writing and verbally. In addition they have to reference their model in their explanation and understand how their knowledge of the concept has been modified or revised in the process.**	
Technological resources that will support student learning and move students toward the learning target.	***Technological Resource and application:*** ***Teacher will need a computer (power-point presentation guides lesson instructions)*** ***Students (cooperative groups) will need materials for drawing their models.*** Follow up lessons will require both teacher and students have a computer and internet connection in order to use computer simulations for modeling nutrient cycling and quantifying the conservation of matter as carbon is cycled throughout a ecosystem. **How: In what ways does this chosen resource support meeting the "just-right challenge," or "building relationships," or "creating relevancy," or "fostering disciplinary literacy"?**	*How will my students and I strategically use technology resources to enhance the learning experience (and support "meetingthe just-right challenge," "building relationships," "creating relevancy," and/or "fostering disciplinary literacy")?* *In this particular lesson the technology is simply helping present the guiding questions in order to create relevancy for this learning objective.* *In the lessons that follow the technology allows for interactive models related to the learning objectives.*
Formative assessment will be a quick Check for Understanding in which students will demonstrate they are or are not on track.	***Formative Assessment*** **Formative Assessment tool/method: Questioning and observing throughout the lesson. Questions that students ask, the support for their questions, responses, and their reasoning. In addition, students have to create models used to share with other students and modify and revise their understanding of the learning objective.** **Learning indicators of success:** *(What evidence will show that the learner is moving toward mastery of the learning target?)* *The modified and revised model of the carbon cycle and how matter is*	*What "indicators of success" will show that the students are gaining mastery?* *How will I use that evidence in a feedback loop?* *Student engagement in all aspects of the lesson:* • *Initial Questions*

	conserved within ecosystems. Individual understanding evaluated with the exit ticket. *The next several lessons will require students have moved toward mastery of the learning target.*	• *Historical Data Exercise* • *Formal Definition* • *Modeling/Jigsaw Presentation* • *Exit Ticket* *This evidence shows developing understand that is modified and revised as necessary. This will be continued in the next several lessons that follow.*

Reflection: (What are the *strengths in the lesson plan? What changes would I make in the lesson plan for next time*?)

Strengths:

- It makes the learning objective tangible, one students can relate to. We actually went outside for a portion of the lesson and used trees on our campus to introduce the topic.
- Cooperative Group work. By using the "whip-around" technique it forces all students to work independently, an opportunity to share, and an opportunity to collaborate. Everyone has to contribute whether they know very much or not. Also, I really like the jigsaw aspect. It held every student accountable for understanding the model and sharing it with other groups.
- The reading assignment does an excellent job of meeting literacy objectives and was easy to modify for different reading levels. It also demonstrates how the process of science works from a historical perspective.
- Was an excellent segway to the lessons that followed.

Changes:

- The reading was difficult for many of my students. The vocabulary used in van Helmont's willow experiment confused many students which slowed the entire process down. I would definatley modify the reading anticipating which vocabulary was going to cause the most problems.
- The questions/analysis in the reading took longer to review than anticipated. I think I would break the reading and questions into a separate lesson.The questions and may need to be revised and/or shortend.

Connection to Performance Goal: (*What did I do in this lesson that gives evidence or may be used as an artifact for my professional growth plan?)*

One of the goals in my professional growth plan is to foster collaboration in my classroom. In order to successfully implement the PBL model student to student and student to adult collaboration is essential. This lesson relies on collaboration and gives students to work within the acceptable norms.

Student Feedback: (*What did students say about the lesson? Did they find it engaging, interesting, appropriately challenging? Did their feedback confirm my own perception of the lesson?)*

We asked students to reflect on the lesson. They did not like the way I created the cooperative groups. They had wanted to form their own groups. I explained once again why I select certain students for each group. It is based on their multiple intelligence profile. I make sure there is someone strong as a linguistic learner, someone strong in logic/math, etc.. I will not put 3 or 4 strong kinesthetic learners in the same group because none of them will read the instructions.

The student responses to the questions/analysis section of the van Helmont's willow experiment were weak. Students really struggled to come up with meaningful answers and needed significant guidance. I would consider modifying the questions eliminating some of them.
What students found was that by completing this lesson it made the following lessons make much more sense. When we went to the computer simulations and then on to making the mass of carbon in trees calculations it helped them see the big picture. The exit ticket results were all over the place but the one concept that offered the most confusion is the chemical changes that happen. How can a gas you can't see become a tree?

Time Suggested: One one-hour class period. However, having done this in one period I would prefer to extend it to at least 90 minutes.

Materials Needed:

- Tree Seed
- Adult Tree of same species
- Power Point (7 slides) – Conservation of Matter
- Analyzing van Helmont's Willow Experiment (http://www.botany.org/bsa/psb/2003/psb49-3.html#Misconceptions)
- Definition of Conservation of Matter
- Butcher Paper, markers for drawing models
- Exit Ticket (two questions)
- Student Reflection (two questions)
- Follow up lessons (utilized explorelearning.com Nutrient Cycling computer simulation and the carbon mass calculator found at http://www.treebenefits.com/calculator)

Cross-Content Connections: Language Arts and Math

Lesson Implementation:

- Teacher presents phenomenon (slide one)
- Students engage in science performances (slide two)
  - Students access prior knowledge
- Investigate what topic form a historical perspective (slide three, four, and five)
  Students Reason
  - Collaborative Group "whip-around" (what do I know, what do you know, what does the group know, how does this modify what I know?)
  - Students build a model of their understanding
- Students Communicate

    - Collaborative Group “jig-saw” (present their model, how do other models support or revise mine?
- Teacher and students reflect on learning – Exit Ticket (slide six and seven)
- Students conceptualize core ideas and crosscutting concepts (modeling in this lesson and the ones that follow)
- Students increase proficiency with using practices and crosscutting concepts to make sense of phenomena
- Students apply learning to make sense of novel phenomena beyond the classroom (tree carbon calculations if following lessons as well as other nutrient cycle models)

Reflection: At the end of the class period, participants were asked to reflect (two question quiz) on their learning. (slide seven)