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| **Lesson Plan for Grades:** 9-12**Length of Lesson:** 90 minutes |
| **Authored by:** UT Environmental Science Institute**Date created:** 02/02/2025 |
| **Subject area/course:*** Biology
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| **Materials:*** [Enzyme Catalase Lab](https://utexas.box.com/s/ibsn0vlh96tfi146uuuxzlvxy1sn1u96) Worksheet (online or printed out):
	+ Each group/ station will need (enough for groups of 3-4)
		- 3 containers with hydrogen peroxide at different temperatures
			* The teacher will have prepared 3 labelled containers of hydrogen peroxide: one in an ice bath, one at room temperature, and one in a warm water bath.
		- One container of potato puree (1 potato’s worth for each group)
		- 3 petri dish/ spot plates
		- 5 Hole punched small pieces of paper
		- Tweezers
		- 3 drop bottles with vinegar, water, and 0.5% bleach (or pipettes and small beakers with each liquid)
		- 3 small beakers (at least 60 mL)
* Choice board template (online or printed out for each student):
	+ <https://utexas.box.com/s/leqf55smzlj0xgk2j1snhub4wmugqlgv>
* Lesson plan slideshow:
	+ [Canva](https://www.canva.com/design/DAGeq43fjdI/Nux3BT0DtTwhNWOTuAYe-Q/edit):
	+ Microsoft Powerpoint:
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| **TEKS/SEs:****Energy conversion in organisms*** B.11 Biological structures, functions, and processes. The student knows the significance of matter cycling, energy flow, and enzymes in living organisms.
* B.11(B) investigate and explain the role of enzymes in facilitating cellular processes
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| **Lesson objective(s):*** Student will be able to understand the structure, functions, and processes of enzymes
* Students will be able to explain how enzymes work best under specific conditions (pH, temperature, etc.)
* Students will be measuring, experimenting, and hypothesizing the behavior of enyzymes under certain conditions
* Student will be able to correlate the power of enzymes to world-saving processes
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| **Differentiation strategies to meet diverse learner needs:*** This lesson includes the “choice board” activity, which allows students to choose how they will learn and demonstrate their understanding of the concept. Each student, no matter which options of “input” and output” they choose, will learn the same content required for the output and class evaluation at the end of the lesson.
* The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills.
* ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration. With the choice board, the teacher may make recommendations as needed for these students, such as recommending watching the “Amoeba Sisters” video with English captions for one of their inputs and doing the “Fill in the Blank” as one of their outputs.
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| **ENGAGEMENT (5 minutes)**The teacher will begin class with an engaging class discussion on superheroes. The teacher will ask: “*Who is your favorite hero? Which one is the most powerful? Why?*” * For teachers with a “bell ringer” system, this can be the bell ringer for the day. Have students write down their favorite superhero, and how they believe they are powerful.

Following the class responses, the teacher will explain how * *what are some of the worlds biggest issues right now?” T*he teacher will pause for a couple of seconds to let this sit with students, then the teacher will ask some students to share their thoughts with the person next to them for a few seconds, then ask the class to share some of their answers.
* *“Not all heroes wear capes” as itty bitty enzymes (if properly engineered) can actually “save the world”.*
* *“What do I mean by save the world? Enzymes can be “superpowered” to break down plastic, reducing our pollution, carbon footprint and its negative impact on the environment. But, what even are enzymes, how do they work? What do they even do?”*
* The teacher will continue with a brief summary on enzymes as explained on the slides.

**Transition:** “*Let's see an enzyme reaction thing work in real time. We will be performing a quick experiment to see how the enzymes in a potato break down a toxic chemical, and also how they react to different pH and temperatures.”*  |
| **EXPLORATION (25 minutes)**<https://utexas.app.box.com/file/1785260881464> The teacher will form the class into groups of 3-4 and send them to their respective stations where the materials will be ready for them. Students can open the worksheet online, or the teacher may print out the worksheets for students to fill out.* Prior to the start of class, the teacher will have set the materials up for the students. This can be on their own desks, or the lab tables provided in the classroom. Teacher will set up enough stations to provide for groups of 3-4 students in each group. Teacher will have the listed materials ready for use in each station.
* The teacher will review what an enzyme is before the start of the lab. This is slide 5 on the slideshow. After a quick and brief explanation of what an enzyme is, the teacher will introduce the lab.
* Before splitting the students into groups or going further with the lab, the teacher will review the safety regulations:
	+ Students will NOT consume any of the materials today.
	+ Students will NOT horse around
	+ Students will be responsible for collecting their own data
	+ If any substance spills, please alert the teacher right away.
* After ensuring each student understands the safety regulations, the teacher will then allow the students to form into groups of 3-4 and head to their stations to conduct the lab.
* The teacher will begin a 20 minute timer (imbedded into the slides)
* The teacher will walk around throughout the lab to assess the students’ progress and their hypothesis.
	+ The teacher may ask “*How did you come to that hypothesis?”, “What are you finding?”, “what surprised you?”, “What did you see?”*
	+ TIP: If the paper disc takes more than 1 minute to rise, tell students that the enzyme is denatured and they can stop timing and move on to the next trial.
* Once the teacher sees that majority of the classroom is beginning to finish their labs, the teacher will remind each student to throw trash away, dump waste into the sink, and to wash their hands if they got any substances on their hands. Once every student is done with the lab, the teacher will ask the students to return to their desks.
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| **EXPLANATION (40 minutes)**Following the lab activity and cleanup, students will return to their original seats and the teacher will get their attention to review their findings. The teacher will ask the class to share their thoughts with a partner, and then share their answers with the class.* After talking about their lab, the teacher will then explain the steps for the next activity. The teacher will introduce the choice board assignment, which gives students the option to choose how they will both learn the content and check their understanding of it. If the class is hearing of the choice board activity concept for the first time, the teacher will thoroughly review the directions (inputted into the slides). The teacher will explain how it works: Choose at least \_\_ inputs and \_\_ outputs. Complete the outputs first and then the inputs. The teacher will choose to have the choice board template printed to be turned in on paper, or as a virtual assignment. The teacher can evaluate each output with a stamp or checkmark for students to know if their work is correct.

The teacher will start a timer for 20 minutes to allow the students to complete their input and output. The teacher will walk around to check that each student is on track and if they have any questions.* The teacher will note when students begin to complete their work and have them keep their outputs with them (whether they completed the lesson online or on paper) to keep as their notes. If students have a journal for this class, they can glue the worksheet into it. If they take notes virtually, they can save their outputs into a folder they have for the class.
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| **ELABORATION (15 minutes)**The teacher will move on with the lesson by connecting back to the topic brought up in the beginning of class, that enzymes (if properly engineered) can save the world. * The teacher will explain how everything we do leaves a footprint, both visible and not as visible. The teacher will ask the class to think of some examples of our visible footprint (such as clothing, trash, etc.) The teacher will then explain how this is why scientists and engineers work to create a “sustainable” planet by creating from “sustainable” materials like plants. “*However, the issue with this is that it ultimately ends up in the dump”*
* The teacher will follow up this discussion with a brief [Kahoot](https://create.kahoot.it/share/plastics-trivia-for-enzyme-lesson-plan/aafc346f-8bb5-45e7-a2b1-a63907b220a8) trivia game on the exact, massive amounts of plastic that ends up in the waste and comparing these amounts to real-world things.
* Following the Kahoot game, the teacher may ask the class “*Has anyone heard of bioengineers? What do they do exactly? Well, this is one of the many important issues that they work to solve.”* The teacher will explain the more fun facts from the slide following the video. The facts explain how plastic alternatives are not entirely better, and that they ultimately end up in the dump. *“A solution is needed”*
* The teacher will play a clip from the talk to introduce the enzyme: PETase.
* The teacher will review how the enzyme works, what it does, and how this “superpowered” enzyme can “save the world.”
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| **EVALUATION (throughout entire lesson)**The output choices that the students complete will be the evaluation, as well as the GimKit review, which the teacher will wrap up the lesson with. The teacher will be able to see students’ answers and assess their understanding of the topic. * The teacher will move on to the last slide and have the class play the Gimkit on Enzymes
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| **SOURCES AND RESOURCES*** Science Lessons that Rock: <https://sciencelessonsthatrock.com/catalase-enzyme-lab-html/>
* Education.com: <https://www.education.com/science-fair/article/activator/>
* GimKit: <https://www.gimkit.com/view/67c7d37eec3ecdcb258a7961>
* Dr. Hal Aper Hot Science Cool Talk #133 “Bioengineering to Save the World” <https://www.youtube.com/watch?v=sSMUjHnU2b4>
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