LESSON PLAN TEMPLATE

GENERAL INFORMATION

Lesson Title & Subject(s): Gas Laws and the Automotive HVAC System

Topic or Unit of Study: Physical Science/Physics/Automotive

Grade/Level: 9-12

Instructional Setting:
Classroom: This lesson takes place in two separate classes. One period in science and one period in automotive class. If class sizes are small enough, the two teachers could combine classes and co-teach in the automotive room.

STANDARDS AND OBJECTIVES

Your State Core Curriculum/Student Achievement Standard(s):
Click here to find your state standards, or visit your state office of education website.
Colorado State Standards: Physical Science Standard 1.1 - Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding structure, properties, and interactions of matter.

Lesson Objective(s):

a. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. (HS-PS1-5) *(Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.) (Boundary Statement: Limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.)*

MATERIALS AND RESOURCES

Instructional Materials:
Tools needed:
Option 1: Can of R-134 refrigerant, pressure gauges, a heat source, and safety equipment.
Option 2: HVAC Trainer(A-Tech, Consulab, MegaTech, etc)and safety equipment.
Option 3: Zspace simulator

Resources:
Scuba Video: https://www.scubadiving.com/travel/florida-florida-keys/diving-vandenberg
Automotive HVAC: Use automotive text book (Electude, cengage, CDX, Zspace, etc.)

INSTRUCTIONAL PLAN

Sequence of Instructional Procedures/Activities/Events (provide description and indicate approximate time for each):

1. **Student Prerequisite Skills/Connections to Previous Learning:**
   Students should have already learned about molecules, valence rings, states of matter, and interaction on an atomic level. This lesson will build off of that information to put it in context/application. Students should understand that gasses are affected by temperature and pressure.

2. **Presentation Procedures for New Information *and/or* Modeling:**

Presentation Procedures for New Information*:*

Warm up: What do these have in common? (5 min)

Note: These all deal with temperature and gasses expanding and contracting.
Students can do a think-pair-share (2 mins to think(write what they think),1 minute Pair (discuss what they wrote), 2 min share(choose a couple groups to share their thoughts)

Introduction to lesson: Deliver the gas laws (on paper, anchor poster, or written on board for students to reference throughout lesson). Introduce Boyles' law, Charles' Law, and the combination of the two.
Teachers take turns giving real world examples of the laws as they apply to the topic.
Example: Science teacher talks about Scuba Diving and how pressure on gasses in lungs can have dire consequences when resurfacing. Auto Teacher explain how temp can cause tire pressure to increase or decrease as well as friction causing tire temp to increase and the affect on traction for the race car.
Other options: Can of air getting cold when being depleted. Pressurized canisters exploding in hot cars or near heat sources. Sealed bags of chips bloating as they increase in elevation.

Student engagement: Have students try to come up with as many examples of the pressure property in a group.

Modeling: Discuss how using the gauges, the students can gather the data to plug into the equations and solve for the missing variable. Use random numbers and have students practice plugging the numbers into the math equation and solve. Work with students to make sure they can solve the equation correctly.

Guided Parctice: Next show the students how to find their own data using the gauges. Have the students read the gauges and plug the numbers into the equation and solve for the missing variable. Use the heating element or bleed off valve to continue to vary the gauge readings and having the students plug in the new readings to find the missing variable.

Guided Practice: More advance practice will be identifying the variable change (increase or decrease) with only knowing what was down to the application. Example: Ask the

students/groups what would happen to the pressure if the heat variable is increased. Look for them to explain how and why the pressure is affected without doing the math.

3. **Lesson outcome/ Demonstration of Learning:** (this needs to directly reflect the objective) Write down their own explanation of the relationship between pressure and temperature on gasses. Measure their understanding by their ability to include components of the equations, and terms from the lesson (i.e. expand, contract, friction, molecules, volume, etc.).

Differentiated Instruction Accommodations:

When grouping the students, you should attempt to pair stronger students with weaker students to help spread your ability to help everyone. Remember that teaching is the highest level of demonstrating learning. The more advance students will be challenged to explain their thoughts and ideas to the less advanced partners. The less advance partners can ask the rudimentary questions to the partners that can answer for you, freeing you up to move around the class more freely and address the majority of the class.

Use of Technology:

DO NOT just stand at the front and talk at the students. Keep a timer running in your pocket, phone, watch, or computer. The students should be talking over 50% of the time. If you are talking for more than 5 mins straight, STOP. Ask a question and let the students respond back.

Use the technology components to allow students more opportunity to interact with the lesson. If you can purchase a trainer, or virtual reality trainer, it will be much easier for you to release the students to interact with the components before they have all the information. The key is that the students interact with the components, get stuck, and come to you with questions. If the students come to the table with questions, they are more engaged with what you have to say.