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**Knowledge Rich Curriculum Plan**

Science – Physics

Year 13



| **Science****Year 13 Physics**  | **Unit: Thermal Physics** |  |  |
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| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Tiered Vocabulary**  | **Prior Knowledge:***In order to know this students, need to already know that…* |
| **Lesson:** **Thermal Energy Transfer** | * Students will know that not all particles in a body travel at the same speed
* Students will know that the distribution of particle speed depends on the temperature of the body
* Students will know that the particles in a body have randomly distributed potential energies depending on their relative positions
* Students will know that a closed system is one that doesn't allow transfer of matter in or out
* Students will know that in a closed system the total internal energy is constant, as long as it's not heated or cooled, or no work is done
* Students will know that when a substance changes state:

1) its kinetic energy (and temperature) stays the same2) The potential energy of the particles is altered3) The internal energy of the substance increases* Students will know how to practically determine the specific heat capacity of a substance
* Students will know how to complete calculations (using equations from the data booklet) for specific heat capacity, mass, energy change, temperature change, specific latent heat
* Students will know that a continuous flow calorimeter is a method that can be used to determine specific heat capacity of a substance
 |  | * ***Students need to already know that internal energy = kinetic energy + potential energy***
* ***Students need to already know that the specific heat capacity of a substance is the amount of energy needed to raise the temperature of 1 kg of a substance by 1 K***
* ***Students need to already know that specific latent heat is the energy needed to change state of 1 kg of a substance without increasing the temperature***
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| **Lesson:** **Gas Laws** | * Students will know that the lowest possible temperature called absolute zero.
* Students will know that at absolute zero (0 K), all particles have the minimum possible kinetic energy.
* Students will know that within the Kelvin scale a particle's energy is proportional to its temperature
* Students will know that there are three gas laws (which apply to a fixed mass of gas):

Boyle's Law: pV = constant (at constant temperature)Charles's Law: V/T = constant (at constant pressure)The Pressure Law: p/T = constant (at constant volume)* Students will know that all the gas laws can be determined practically
 |  | * ***Students need to already know how to convert from Kelvin to degrees Celsius***
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| **Lesson:** **Ideal Gases** | * Students will know that the molecular mass of a gas is the mass of one molecule of that gas
* Students will know that molecular mass is given relative to the mass of a carbon-12 atom
* Students will know that the Molar mass is the mass of one molecule of a gas
* Students will know that at a fixed pressure and temperature, a fixed volume of gas will contain the same amount gas molecules, no matter what the gas is
* Students will know that number of moles is determined by mass divided by molecular mass
* Students will know that all of the gas laws are combined to form the ideal gas equation:

pV = nRTp = pressureV = Volumen = number of molesR = molar gas constantT = temperature* Students will know that the Boltzmann's constant, k, is a gas constant for one particle of gas
* Students will know that Boltzmann's constant is equivalent to R/Na (Molar gas constant/ Avogadro's constant)
* Student's will know that the equation of state of an ideal gas is pV = NkT
* Students will know that when work is done it can change the volume of a gas at constant pressure
* Students will know that the work done in changing the volume of a gas at a constant pressure is given by:
* Work done = p x change in volume
 | Molecular mass: the mass of one molecule | * ***Students need to already know that there are three gas laws (which apply to a fixed mass of gas):***
* ***Boyle's Law: pV = constant (at constant temperature)***
* ***Charles's Law: V/T = constant (at constant pressure)***
* ***The Pressure Law: p/T = constant (at constant volume)***
* ***Students need to already know how to convert from Kelvin to degrees Celsius***
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| **Lesson:** **Pressure of Ideal Gases** | * Students will know how to derive the pressure of an ideal gas
* Students will know that root mean square speed is the average of the square speeds of all gas particles
* Students will know that the assumptions made in kinetic theory are:

1) The molecules continually move around randomly2) The motion of the molecules follows Newton's laws3) Collisions between molecules themselves or at the walls of a container are perfectly elastic4) Except for during collisions, molecules are always moving in straight lines5) Any forces that act during collisions last for much less time than the time between collisions* Students will know that any gases that follow these assumptions are ideal gases.
* Students will know that real gases behave like ideal gases as long as the pressure isn't too big and the temperature is reasonably high
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| **Lesson:** **Required Practical 8** | * Students will know how to investigate Boyles' law and Charles's law
 |  | * ***Students need to already know that there are three gas laws (which apply to a fixed mass of gas):***

***Boyle's Law: pV = constant (at constant temperature)******Charles's Law: V/T = constant (at constant pressure)******The Pressure Law: p/T = constant (at constant volume)*** |
| **Lesson:** **Kinetic Energy and the development of Theories** | * Students will know how to combine ideal gas equation, pressure of an ideal gas equation and Boltzmann's constant
* Students will know that gas laws are empirical (based on observations and evidence) and kinetic theory is theoretical (based on assumptions and derivations)
* Students will know that empirical laws can predict what will happen, but not explain why
* Students will know how our understanding of gases has developed over thousands of years
* Students will know that:

1) the first ideas about gases came about 2000 years ago (Democritus)2) Robert Boyle discovered the relationship between pressure and volume at constant temperature in 16623) Charles's law was discovered in 17874) The pressure law was discovered in 1699, and then rediscovered in 1809* 5) Robert Brown discovered Brownian motion, which helped support kinetic theory
* Students will know that Brownian motion says that the random motion witnessed in a fluid is due to the collisions with fast, randomly moving particles in the fluid
* Students will know that for scientific ideas to be accepted they need to be independently validated
 | Empirical law: based on observations and evidenceTheoretical law: based on assumptions and derivations | * ***Students need to already know that there are three gas laws (which apply to a fixed mass of gas):***

***Boyle's Law: pV = constant (at constant temperature)******Charles's Law: V/T = constant (at constant pressure)******The Pressure Law: p/T = constant (at constant volume)*** |