Semester 1 Skills

Level 1: My Science Toolkit

1.1 - I can define and use the definitions and equations of distance, displacement, speed, velocity, and acceleration.
1.2 - I can use dimensional analysis to convert metric distance units (ex. km to meters, cm to meters).
1.3 - I can conduct an investigation to identify and communicate the relationship between an independent and dependent variable.
1.4 - I can use motion tracking software: Vernier Logger Pro or Vernier Graphical Analysis.
1.5 - I can create a functioning spreadsheet in Google Sheets that uses equations and formulas to take inputs and produce outputs
1.6 - I can identify the most common graphing patterns that we will see in this physics class from the shape of the graph and the equation.
1.7 - I can make a claim based on evidence and support it with reasoning (CER).

BOSS CHALLENGE: Assessment of skills

Level 2: Texting and Driving - Motion

2.1 - I can define and differentiate between and use equations for:

- ☐ average velocity
- ☐ initial velocity
- ☐ final velocity
- ☐ instantaneous velocity
- ☐ acceleration

2.2 - I can manipulate all equations on the Level 2 section of the Equation Sheet to solve for a chosen variable. ex: $v = d/t \rightarrow t = d/v$
2.3 - MID UNIT CHALLENGE - I can apply the Level 2 skills including constant and accelerated motion to predict when a water balloon should be released in order to hit a target moving at a constant velocity.
2.4 - I can interpret distance-time graphs.
2.5 - I can identify when an object is at rest, traveling at a constant speed or accelerating from a graph
2.6 - I can create a graph in Google Sheets that shows the following:

- ☐ scatter plot,
- ☐ trendline (line of best fit),
- ☐ Equation
- ☐ R-squared

2.7 - I can identify and explain the significance of equation (mathematical model) and R-squared value of a Google Sheets Graph
2.8 - I can communicate the value of finding patterns and explain the reasoning behind making data-informed decisions based on them.

2.9 - I can use STEM to enhance a social discussion.

BOSS CHALLENGE: Texting and Driving: Create an app that can predict stopping distances while texting and driving.

- I can communicate the value of finding patterns and explain the reasoning behind making data-informed decisions based on them.
- I can use STEM to enhance a social discussion.

Level 3: Save the Walnut - Forces and Impulse

3.1 - I can define Force, acceleration, mass, create a free body diagram of an object at rest, at a constant velocity, and accelerating, and solve for a given variable. $F=ma$

3.2 - I can define momentum, impulse, the Impulse-Momentum Theorem, and solve for a given variable. $F\Delta t = m\Delta v$

3.3 - I can show that for a change in momentum, force in the direction of the change in momentum is decreased by increasing the time interval of the collision ($F\Delta t = m\Delta v$, the Impulse-Momentum Theorem)

3.4 - I can use an photogate and logger pro to analyze the acceleration of a cart on a modified Atwood's Machine

3.5 - I can organize data that represents the net force on a macroscopic object, its mass (which is held constant), and its acceleration in a spreadsheet.

3.6 - I can use the change in time during a collision, the object's change in velocity, and the mass of the object to determine the average force during a collision.

3.7 - I can use models to analyze the data and identify relationships (patterns) within the datasets, including:

- [ ] A more massive object experiencing the same net force as a less massive object has a smaller acceleration
- [ ] A larger net force on a given object produces a correspondingly larger acceleration
- [ ] Distinguish between causal and correlational relationships linking force, mass, and acceleration

3.8 - I can create a graph in Google Sheets that shows the following:

- [ ] scatter plot,
- [ ] trendline (line of best fit),
- [ ] equation
- [ ] R-squared

3.9 - I can identify and explain the significance of equation (mathematical model) and R-squared value of a Google Sheets Graph

3.10 - I can use an accelerometer and a LabQuest to create an acceleration vs time graph in order to determine the change in time during a collision (x-axis) and the change in velocity (integral, area under the spike).

3.11 - I can use data as evidence to describe functional dependence for $a = F_{net}/m$ (e.g., double force yields double acceleration, etc.) and express the relationship $F_{net}=ma$ in terms of cause and effect.

3.12 - I can explain how the Impulse-Momentum Theorem can be used to reduce the net force applied to an object by extending the time the force is applied to the object during the collision.

BOSS CHALLENGE: Save the Walnut: I can apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a walnut during a collision.

Level 4: Bungee Jump - Energy

4.1 - I can identify and describe* the components to be computationally modeled, including:

- ☐ The boundaries of the system and that the reference level for potential energy = 0 (must include Earth!);
- ☐ The initial energies of the system's components (kinetic energy, spring potential energy,, gravitational potential energy, frictional energy — all expressed as a total amount of Joules in each component), including a quantification in an algebraic description to calculate the total initial energy of the system;
- ☐ The energy flows in or out of the system, including a quantification in an algebraic description with flow into the system defined as positive; and
- ☐ The final energies of the system components, including a quantification in an algebraic description to calculate the total final energy of the system.

4.2 - I can use the algebraic descriptions of the initial and final energy state of the system, along with the energy flows to create a computational model (e.g., simple computer program, spreadsheet, simulation software package application) that is based on the principle of the conservation of energy.

4.3 - I can use the computational model to calculate changes in the energy of one component of the system when changes in the energy of the other components and the energy flows are known.

4.4 - I can use the computational model to predict the maximum possible change in the energy of one component of the system for a given set of energy flows.

4.5 - I can identify and describe the limitations of the computational model, based on the assumptions that were made in creating the algebraic descriptions of energy changes and flows in the system.

BOSS CHALLENGE: Bungee Jump: I can create a bungee jump app that calculates the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.