# Honors Physics - Unit 2 - Forces

## Unit Focus

Students will explore forces as being a push or a pull. They will begin by evaluating if a system of forces is balanced or unbalanced. They will be introduced to the creation of free body diagrams as a modality to analyze and survey motion in order to determine if the motion is, or is not, accelerated. Students will explore Newton's three laws of motion and apply their understanding to real life situations. With this new understanding, students will explore the principle of force of frictions as an application of Newton's Third Laws of Motion. Ultimately, students will be using these skills to help them understand the Physics of a person skydiving as well as other complex concepts like Atwood machines and inclined planes. At the end of the unit students will explore the concept of torque as well as balanced and unbalanced situations of torque and apply this knowledge in analyzing objects in static equilibrium.

## Stage 1: Desired Results - Key Understandings

### Standard(s)

**Next Generation Science**
*High School Physical Sciences: 9 - 12*

- Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. *HS-PS2-1*
- Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. *HS-PS2-3*

**NGSS/NSTA Science & Engineering Practices**
*NGSS Science & Engineering Practices: 9-12*

- Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. *SE.9-12.4.3*
- Apply techniques of algebra and functions to represent and solve scientific and engineering problems. *SE.9-12.5.4*

**Madison Public Schools Profile of a Graduate**
*Critical Thinking*

### Transfer

**T1** Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
**T2** Use the scientific process to generate evidence that addresses the original questions.

### Meaning

| Understanding(s) | Essential Question(s) |
|---|---|
| **U1** Pushes and pulls have different strengths and directions.<br>**U2** The pattern of an object's motion in various situations can be observed and measured from which predictions can be made.<br>**U3** Objects in motion remain in straight-line motion at constant speed, and objects at rest remain at rest unless acted upon by unbalanced forces. (Newton's 1st law).<br>**U4** The acceleration of an object depends upon its mass and the net force acting on it. (Newton's 2nd Law)<br>**U5** Forces between objects come in pairs that are equal in magnitude but opposite in direction (Newton's 3rd law) | **Q1** Why do forces always come in pairs?<br>**Q2** How does an object's mass affect its motion?<br>**Q3** How is it possible for an object to stay in constant motion or constant rest forever? |

### Acquisition of Knowledge and Skill

| Knowledge | Skill(s) |
|---|---|
| **K1** F = ma<br>**K2** A body in motion (rest) stays in motion (at rest) unless acted upon by a net force | **S1** Be able to recognize when an object is in equilibrium and to use the condition of equilibrium to |

| Stage 1: Desired Results - Key Understandings | | |
|---|---|---|
| • Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)<br><br>*Creative Thinking*<br>• Idea Generation: Studying a problem, need or model (mentor text, political piece, documents, art work, etc.) to consider limitations and imagine new solutions/transformations. (POG.2.1) | **K3** Forces come in pairs; a force on an object causes an equal and opposite reaction force on another object<br>**K4** Forces can be contact (2 objects touching each other) or non-contact forces (caused by fields)<br>**K5** Force is measured in Newtons<br>**K6** Torque is a rotational force related to the size of the force and the distance of the force to the pivot point<br>**K7** Force is a vector; its direction is relevant as is its magnitude | solve for unknown forces and/or masses, including situations where torque is relevant<br>**S2** Be able to add horizontal and vertical vectors together to find the resultant using trig or Pythagorean Theorem.<br>**S3** Be able to break a vector down into its horizontal and vertical components using trig.<br>**S4** Be able to draw force diagrams (also known as free body diagrams) for a described object.<br>**S5** Be able to identify and label all forces (gravitational, normal, tension, push/pull and friction) and show their directions on a force diagram.<br>**S6** Be able to apply Newton's 2nd Law of Motion in order to solve for unknown forces and/or accelerations.<br>**S7** Be able to assess real life situations and determine which of Newton's Laws applies in each situation.<br>**S8** Be able to use kinematics in conjunction with force problems in order to determine acceleration, velocity, time and/or position. |