Unit Calendar

Day: 2/12 Unit 1 Lesson 1 Introducing the Anchoring Phenomenon

Objective: Using a class generated list of criteria and constraints, students will create initial proposals on why some collisions could cause concussions in football and how to reduce the frequency of concussions.

Tasks: In this lesson, students observe the anchoring phenomenon for this storyline, a video of player deaths in high school football, including a student from Bogan High School. Students then follow this by examining the concussion issue on a national scale through reading two articles on concussion incidence throughout the country.

Day: 2/13 Unit 1 Lesson 1 Concussions: Initial Proposals

Objective: Using a class generated list of criteria and constraints, students will create initial proposals on why some collisions could cause concussions in football and how to reduce the frequency of concussions.

Tasks: In this lesson, students propose initial ideas about how to make football safer and reduce concussions, and while doing so, they choose the constraints on the ideas such that the game of tackle football at its core continues.

Day: 2/14 Unit 1 Lesson 2 Constructing Initial Models

Objective: Students develop initial models to explain the causes behind under what collisions can lead to concussions in football.

Tasks: In this lesson, we focus in from the broad problem of concussions to begin to figure out what causes a concussion in the first place. Students observe a video of several different football tackles and begin to discuss general ideas around what makes collisions different from one another. Afterwards, they watch two focus videos and create initial models to help explain what they think is responsible for these two specific collisions being dangerous. They use the patterns in their observations and comparisons to propose initial causative inferences as to why concussions occur during collisions.

Day: 2/15 Unit 1 Lesson 3 Intro to Mass and Velocity, Start Experiment Plan

Objective: Students plan and conduct an investigation, collect data, and analyze patterns in the data to begin to explain the causes behind why concussions might happen during collisions.

Tasks: In this lesson, students are first introduced to the concepts of speed, direction, and velocity such that they can use these ideas to make sense of how they might be related to causes of concussions.

Day: 2/19 Unit 1 Lesson 3 Collisions Experiment Design

Objective: Students plan and conduct an investigation, collect data, and analyze patterns in the data to begin to explain the causes behind why concussions might happen during collisions.

Tasks: To test these relationships, students brainstorm several different types of football collisions by varying the mass and initial velocity of each player that they then test with carts on tracks.

Day: 2/20 Unit 1 Lesson 3 Collisions Experiment

Objective: Students plan and conduct an investigation, collect data, and analyze patterns in the data to begin to explain the causes behind why concussions might happen during collisions.

Tasks: Students collect observational data on the outcomes of each collision, which they then use to create class rules and a scientific explanation on what factors likely cause concussions to occur.

Day: 2/21 Unit 1 Lesson 3 Analyzing Experiment Data

Objective: Students plan and conduct an investigation, collect data, and analyze patterns in the data to begin to explain the causes behind why concussions might happen during collisions.

Tasks: Students collect observational data on the outcomes of each collision, which they then use to create class rules and a scientific explanation on what factors likely cause concussions to occur.

Day: 2/22 Unit 1 Lesson 4 Introducing Velocity

Objective: Students design an investigation and use patterns in data to explain how a mass and velocity are related in mathematical and systems models of conservation of momentum.

Tasks: Students collect observational data on the outcomes of each collision, which they then use to create class rules and a scientific explanation on what factors likely cause concussions to occur.

Day: 2/25 Unit 1 Lesson 4 Velocity Experiment Design

Objective: Students design an investigation and use patterns in data to explain how a mass and velocity are related in mathematical and systems models of conservation of momentum.

Tasks: In this lesson, students design an investigation to gather quantitative data on how mass and velocity are related to each other in collisions.

Day: 2/26 Unit 1 Lesson 4 Velocity Experiment and Data Analysis

Objective: Students design an investigation and use patterns in data to explain how a mass and velocity are related in mathematical and systems models of conservation of momentum.

Tasks: Students use proportional reasoning to look for patterns in the data they have gathered and share these patterns across the class to look for similar proportional patterns.

Day: 2/27 Unit 1 Lesson 4 Practice with Velocity

Objective: Students design an investigation and use patterns in data to explain how a mass and velocity are related in mathematical and systems models of conservation of momentum.

Tasks: Students use proportional reasoning to look for patterns in the data they have gathered and share these patterns across the class to look for similar proportional patterns.

Day: 2/28 Unit 1 Lesson 4 Introducing Momentum

Objective: Students design an investigation and use patterns in data to explain how a mass and velocity are related in mathematical and systems models of conservation of momentum.

Tasks: Students then use the patterns from the last two days to consider how the product of mass and velocity, or momentum, is conserved in a collision in a defined system.

Day: 3/1 Unit 1 Lesson 4 Practicing with Momentum

Objective: Students design an investigation and use patterns in data to explain how a mass and velocity are related in mathematical and systems models of conservation of momentum.

Tasks: Finally, students revise their arguments from the previous lesson on which aspect of collisions, mass or velocity, makes them more dangerous.

Day: 3/4 Unit 1 Lesson 5 Model Revision

Objective: Students revise initial models to explain the causes behind under what collisions can lead to concussions in football.

Tasks: In this lesson, students revisit the anchoring phenomenon for this secondary storyline and use the mathematical model $m_1 \Delta V_1 = m_2 \Delta V_2$ to determine the momentum of each of the players involved in the focus tackles from Lesson 2. After sharing and discussing what they find, students apply these values, and their other ideas from other investigation to revise their initial models and share their explanations of the anchoring phenomenon. This sharing transitions to students generating questions and determining the next steps they want to take in their investigation.

Day: 3/5 Unit 1 Lesson 6 Introducing Acceleration, Experiment Design

Objective: Students carry out an investigation to gather data on patterns in changes in position, velocity, and acceleration to develop an explanation of how objects speed up and slow down.

Tasks: In this lesson, students observe a lesson-level phenomenon of races between a jet fighter and a race car and between a race car and a cheetah and share their initial explanations.

Day: 3/6 Unit 1 Lesson 6 Acceleration Experiment

Objective: Students carry out an investigation to gather data on patterns in changes in position, velocity, and acceleration to develop an explanation of how objects speed up and slow down.

Tasks: To investigate the changes in the motion of these objects, students carry out investigations using carts and tracks and gather data on changes in position, velocity, and acceleration.

Day: 3/7 Unit 1 Lesson 6 Slope Review, Analyzing Experiment Data

Objective: Students carry out an investigation to gather data on patterns in changes in position, velocity, and acceleration to develop an explanation of how objects speed up and slow down.

Tasks: Students use data from these investigations and mathematical representations of rate of change to support claims that the rate of change of position is equal to velocity, and the rate of change of velocity equals acceleration.

Day: 3/8 Unit 1 Lesson 6 Wrap Up Acceleration

Objective: Students carry out an investigation to gather data on patterns in changes in position, velocity, and acceleration to develop an explanation of how objects speed up and slow down.

Tasks: Students then use the findings from their experiment to revise their initial explanations of the lesson-level phenomenon

Day: 3/11 Unit 1 Lesson 7 Introducing Force

Objective: Students plan and carry out investigations to explain the proportional relationships between force, mass, and acceleration in collisions.

Tasks: In this lesson, students will make initial explanations about which of two football players, a larger or smaller player, experiences more force in a collision. Then, students will model this collision using carts on tracks and measure the force on each cart. Students will observe that despite different masses, velocities, or accelerations, the force on each car is always equal and opposite. Students call this equal and opposite force Newton's 3rd Law.

Day: 3/12 Unit 1 Lesson 7 Force Experiment Design

Objective: Students plan and carry out investigations to explain the proportional relationships between force, mass, and acceleration in collisions.

Tasks: Students then design and carry out experiments to test this idea using a variety of masses and accelerations for each cart, and explain the motion changes in these carts using the range of ideas from the unit, including equal and opposite forces, changes in acceleration, F=ma, momentum, and momentum changes.

Day: 3/13 Unit 1 Lesson 7 Force Experiment

Objective: Students plan and carry out investigations to explain the proportional relationships between force, mass, and acceleration in collisions.

Tasks: Students then design and carry out experiments to test this idea using a variety of masses and accelerations for each cart, and explain the motion changes in these carts using the range of ideas from the unit, including equal and opposite forces, changes in acceleration, F=ma, momentum, and momentum changes.

Day: 3/14 Unit 1 Lesson 7 Analyzing Force Experiment Data

Objective: Students plan and carry out investigations to explain the proportional relationships between force, mass, and acceleration in collisions.

Tasks: Students then design and carry out experiments to test this idea using a variety of masses and accelerations for each cart, and explain the motion changes in these carts using the range of ideas from the unit, including equal and opposite forces, changes in acceleration, F=ma, momentum, and momentum changes.

Day: 3/15 Unit 1 Lesson 7 Newton's Laws, Mathematical Models

Objective: Students plan and carry out investigations to explain the proportional relationships between force, mass, and acceleration in collisions.

Tasks: Students then design and carry out experiments to test this idea using a variety of masses and accelerations for each cart, and explain the motion changes in these carts using the range of ideas from the unit, including equal and opposite forces, changes in acceleration, F=ma, momentum, and momentum changes.

Day: 3/18 Unit 1 Lesson 7 Newton's Laws Practice

Objective: Students plan and carry out investigations to explain the proportional relationships between force, mass, and acceleration in collisions.

Tasks: Students will explain motion using the range of ideas from the unit, including equal and opposite forces, changes in acceleration, F=ma, momentum, and momentum changes.

Day: 3/19 Unit 1 Lesson 8 Correlation and Causation

Objective: Students obtain, evaluate, and communicate information to develop a cause and effect model that demonstrates how acceleration of the head is linked to incidence of concussions.

Tasks: In this lesson, students use algebraic representations to calculate different pieces of data from NFL collisions to determine if incidence of concussions from collisions is most closely related to force, mass, or acceleration. By preparing visual representations of the data, students make a claim that acceleration is most closely related to concussion incidence.

Day: 3/20 Unit 1 Lesson 8 Concussion Occurrences Data

Objective: Students obtain, evaluate, and communicate information to develop a cause and effect model that demonstrates how acceleration of the head is linked to incidence of concussions.

Tasks: To further establish a cause and effect relationship between acceleration to the head and brain injury, students obtain, evaluate, and communicate information from a series of texts to create a cause and effect model of how brain injury occurs in collisions.

Day: 3/21 Unit 1 Lesson 9 What Makes Helmets Safer

Objective: Students will iteratively design structures of helmet components to functionally reduce acceleration, keeping in mind criteria and constraints.

Tasks: In this lesson, students first test a variety of materials to investigate their ability to reduce force and acceleration and increase impact time in a collision. Using the data they gather on the performance of these materials, they see patterns in how some types of materials can reduce maximum force and acceleration and increase collision time.

Day: 3/22 Unit 1 Lesson 9 What Makes Helmets Safer

Objective: Students will iteratively design structures of helmet components to functionally reduce acceleration, keeping in mind criteria and constraints.

Tasks: Using the data on how each material performs, students then design a cross-section component of a football helmet that will best reduce acceleration upon impact. Students collect data on their helmet component's performance and iterate on their designs. Finally, students use physics and engineering design principles and evidence from their trials to justify their final design.

Day: 3/25 - 3/29 Egg Drop Week

Objective: Students will research, construct, and test a "helmet" for a hard boiled egg.

Tasks: Using their knowledge of helmet materials and engineering constraints, students will design, construct, and test a model helmet to protect an egg in a collision.

Day: 4/1 Unit 1 Lesson 10 Final IHSA Proposals

Objective: Students will revise their final models of how concussions occur then create, revise, and present a proposal to the IHSA on how to improve player safety in high school football, including changes to structures of equipment and rule changes.

Tasks: In this lesson, students will collaboratively construct an explanation for how different mathematical equations help explain the changes in motion we observe in the two focus football tackles from the anchoring phenomenon. Using the ideas students build together, students then revise their models of how concussions occur during these football collisions. Finally, students update their initial proposals to the IHSA as to how to make the game of football safer and present these proposals to their peers.

Day: 4/2 Unit 1 Lesson 10 Final IHSA Proposals

Objective: Students will revise their final models of how concussions occur then create, revise, and present a proposal to the IHSA on how to improve player safety in high school football, including changes to structures of equipment and rule changes.

Tasks: In this lesson, students will collaboratively construct an explanation for how different mathematical equations help explain the changes in motion we observe in the two focus football tackles from the anchoring phenomenon. Using the ideas students build together, students then revise their models of how concussions occur during these football collisions. Finally, students update their initial proposals to the IHSA as to how to make the game of football safer and present these proposals to their peers.

Day: 4/3 Unit 1 Lesson 10 Proposal Presentations

Objective: Students will revise their final models of how concussions occur then create, revise, and present a proposal to the IHSA on how to improve player safety in high school football, including changes to structures of equipment and rule changes.

Tasks: Students will present their final IHSA proposals to their peers in class.

Day: 4/4 Unit 1 Summative Assessment Task

Tasks: Students will complete the Unit 1 Summative Assessment Task