Unit 2: Dynamics

Content Area: **Science**
Course(s): **Physics/Lab Honors**
Time Period: **6 weeks**
Length: **Weeks**
Status: **Published**

Unit Overview

This unit is the explanation of why things move, discussing how Newton's Three Laws relate to the motion of objects in 1 and 2 dimensions. It also describes circular motion and creates an understanding of the role of centrpietal force in circular motion.

Transfer

Students will be able to see Newton's Three laws in action every day of their life as we talk about how they relate to our daily lives.

Students will be able to put their knowledge to the test on incline planes, equilibrium tables, atwood machines labs.

Students will be able to analyze the loop of a roller coaster, discussing how the centripetal and "centrifugal force" keep them safe.

For more information, read the following article by Grant Wiggins.

http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=60

Meaning

Understandings

1) Students will understand how Newton's Three Laws of motion govern the principles as why things move certain ways.

2) Students will understand how a centripetal force can cause a centripetal acceleration.

3) Students will understand how an imbalance in force causes an acceleration and how balanced forces ALWAYS result in a zero acceleration.

Essential Questions

1) There is no way we actually see Newton's Three Laws in our everyday life... or do we?

2) I feel like it is always harder to get started pushing something than to keep it moving...why in the world is that?

3) Two masses are attached to a string. Is there any way that the lighter mass can pull the heavier mass in a direction the heavier mass doesn't want to go in?

4) How can you calculate the exact force to cancel out a bunch of other forces?

5) Instead of a ski lift, is it possible to just ski back up the mountain if I have a big enough force?

6) My favorite ride at the carnival is the Gravitron, but how do I stick to the walls with no glue?

7) What force actually causes an object to spin in a circle?

Application of Knowledge and Skill

1) Use Newton's Three Laws to help them overcome issues in their own life involving the motion of objects or driving in a car.

2) Predict what will happen to an object if certain forces are applied to it.

3) Take turns in a car more safely in slippery conditions on the road.

Students will know...

1) Newton's Three Laws of Motion and give real world examples of each.

2) What friction is and the difference between static and kinetic friction.

3) What inertia is, how it relates to mass, and how it affects the motion of an object.

4) How force, mass, and acceleration are related to each other.

5) That a centripetal force causes a centripetal acceleration.

6) The difference between centripetal force and centrifugal force.

Students will be skilled at...

1) Solving problems using Newton's 2nd Law of motion.

2) Solving atwood machine problems.

3) Solving Equilibrium problems.

4) Solving Inclined Plane Problems

5) Solving pull or push the box problems

Academic Vocabulary

Academic Vocabulary	Application Vocabulary
force	normal force
inertia	equilibrium
friction force	static friction
inclined plane	kinetic friction
centrifugal	Atwood Machine
centripetal	action

rotational inertia	reaction
fulcrum	trigonometry
moment of Inertia	mass
angular acceleration	velocity
angular velocity	radius
	torque

Learning Goal 1

SWBAT apply Newton's Three Laws of Motion conceptually and mathematically to a variety of scenarios in 1-D.

Proficiency Scale

- SWBAT apply Newton's Three Laws of Motion conceptually and mathematically a variety of scenarios in 1-D.

MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
SCI.HS-PS2-1	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.

Target 1

SWBAT Describe what a force is, some different types of forces and the difference between balanced/unbalanced forces; along with drawing free body diagrams to visually describe these forces.

- SWBAT Describe what a force is, some different types of forces and the difference between balanced/unbalanced forces; along with drawing free body diagrams to visually describe these forces.

Target 2

SWBAT List all three of Newton's Three Laws and give examples of each related to their everyday lives.

- SWBAT List all three of Newton's Laws of Motion and give examples of each related to their everyday lives.

Target 3

SWBAT use Newton's Second Law and Kinematics to solve for the Force, Mass, and Acceleration of moving

objects.

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Target 4

SWBAT determine the difference between static and kinetic friction along with mathematically solve for problems dealing with both types of friction.

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Target 5

SWBAT Solve full atwood and half atwood machine problems, with and without friction.

- SWBAT Solve full atwood and half atwood machine problems, with and without friction.

Learning Goal 2

SWBAT apply Newton's Three Laws of Motion conceptually and mathematically in a variety of scenarios in 2-D.

Proficiency Scale

- SWBAT apply Newton's Three Laws of Motion conceptually and mathematically in a variety of scenarios in 2-D.

MA.N-VM.B.4b	Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
SCI.HS-PS2-1	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.

Target 1

SWBAT Describe what it means when forces are in a state of equilibrium, along with solving equilibrium problems. The problems will contain 2 unknowns at times.

- SWBAT Describe what it means when forces are in a state of equilibrium, along with solving equilibrium problems.

Target 2

SWBAT Describe the forces acting on an object on an incline plane and solve incline plan problems, including half atwood on incline problems.

- SWBAT Describe the forces acting on an object on an incline plane and solve incline plan problems, including half atwood on incline problems.

Target 3

SWBAT solve pull or push the box problems

- SWBAT solve pull or push the box problems (If time permits)

Learning Goal 3

SWBAT Describe qualitatively and quantitatively what forces are responsible for causing circular motion.

Proficiency Scale

- SWBAT Describe qualitatively and quantitatively what forces are responsible for causing circular motion.

MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
SCI.HS-PS2-1	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.

Target 1

SWBAT describe qualitatively and quantitatively how a centripetal force can cause a centripetal acceleration, along with distinguish between a centripetal force and a centrifugal force.

- SWBAT describe qualitatively and quantitatively how a centripetal force can cause a centripetal acceleration, and distinguish between a centripetal force and a centrifugal force.

Target 2

SWBAT solve for the centripetal force required to make a certain turn, and determine whether or not a turn can be made at a certain speed given a specific centripetal force.

- SWBAT solve for the centripetal force required to make a certain turn, and determine whether or not a turn can be made at a certain speed given a specific centripetal force.

Target 3

SWBAT solve problems and draw free body diagrams dealing with uniform circular motion in 2 dimensions.

- SWBAT solve problems dealing with uniform circular motion in 2 dimensions.

Target 4

SWBAT to describe how the G-force acting on an object can affect it and how the G-force is calculated.

- SWBAT to describe how the G-force acting on an object can affect it and how the G-force is calculated.

Target 5

SWBAT describe the principles of nonuniform circular motion qualitatively only.

- SWBAT describe the principles of nonuniform circular motion qualitatively only.

Target 6

SWBAT derive and equation for the variables in a concical pendulum as well as the ideal banking velocity and banking angle of a car on a banked curve.

- SWBAT derive and equation for the variables in a concical pendulum as well as the ideal banking velocity and banking angle of a car on a banked curve.

Formative Assessment and Performance Opportunities

Lab Reports

Worksheets

PowerPoints with Notes

Homework and Classwork Activities

Group Activities

In Class Discussion

Do Nows and Closures

Class Polling

Observation

Summative Assessment

Unit Assessment will be created collaboratively and used for every student in the course. In addition, there will be other assessments in the form of lab reports, pen and paper tests, and quizzes.

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Accommodations/Modifications

- All instruction, labs, activities, and assessments will be modified and enhanced to adhere to individual student's IEPs and 504s. As well differentiated classroom management strategies will be utilized as to adhere to these students individual plans as well.
- Allow the use of calculators for all calculation problems and provide support with formulas.
- Provide visual resources to accompany complex text.

Unit Resources

Teacher generated PowerPoints, Notes, Labs and Worksheets

Textbooks

Resource Books

Internet Resources

Computer Based Activities

Projector

Smart Board

Calculators

21st Century Life and Careers

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP10.1	Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

Interdisciplinary Connections

MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.

MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MA.F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
MA.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.