Unit 5: Waves and Rotational Motion

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

Unit Overview

This unit covers concepts of simple harmonic motion and wave motion (standing waves mostly). It then covers the basics of rotational dynamics.

Transfer

Use their knowledge of wave behavior at a boundary to explain how mirrors and lenses work in every day life.

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

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

Meaning

Understandings

1) Scientists identify waves through their defining characteristics. Any physical phenomena that demonstrate all of these characteristics is considered a wave.

2) Waves are the result of an interaction between objects that are in themselves undergoing simple harmonic motion.

3) The energy of a wave decreases as you move away from the source since the wave front continues to get larger and the energy must be distributed over the entire wave front. This would not be true for one-dimensional waves.

4) Physical waves require a media in order to propagate. Sound is an example of a physical wave. Waves in

the electromagnetic spectrum do not require a medium to propagate.

5) When the medium of a wave is changed, it can be effected in many ways.

6) Radians and Revolutions can be described to use an angular position just as the typical units for distance can measure a linear position.

7) A torque can cause something to angularly accelerate just like a force makes something linearly accelerate.

Essential Questions

1) Why is it that we can see light waves, but not sound waves? How can these two physical phenomena both be waves yet they are different? Are there specific characteristics that describe wave phenomena?

2) How have humans and other species adapted to utilize the wave nature or properties to their advantage? How do we use properties of waves to solve problems that we care about?

3) What happens to a wave if the medium changes or ends? Do all waves respond the same?

4) When I sit in the upper deck at the baseball game (my dad is so cheap), why do I see the bat hit the ball before I hear the bat hit the ball?

5) How could the same force acting on objects with the same mass cause different angular accelerations?

Application of Knowledge and Skill

1) Students will be able to reproduce the resonant frequency of a tuning fork using a glass tube on top of water.

2) Students will be able to solve for the speed of sound using tuning fork and air column.

3) Students will be able to solve for the hanging mass required to create a specific harmonic in strings standing

wave.

Students will know...

1) How to define and describe terms relating to wave phenomena.

2) How to describe the properties of sound, how it is detected and produced.

3) The difference between an longitudinal and transverse wave.

4) The difference between the harmonics produced by a standing wave.

5) The difference between an open open tube and an open closed tube.

6) How the distribution of mass of an object can affect the way it rotates.

7) How to use radians and revolutions to measure an angular distance.

Students will be skilled at...

1) Determine the frequency of a wave to its period or visa-versa.

2) Evaluate the speed of a wave to its wavelength and frequency.

3) Determine medium and temperature to the speed of sound waves.

4) Solving for multiple harmonics in standing waves.

5) Calculate the speed of a longitudinal wave through liquids and solids, and the speed of transverse waves in ropes and strings.

6) Determine the beat frequency produced by two different frequencies and how this can be utilized to tune instruments.

7) Solving kinematic problems using the rotational kinematic equations.

8) Solving rotational dynamics problems.

9) Addressing the forces that are causing the torques that make something rotationally accelerate.

10) Solving equilibrium sea-saw problems.

Academic Vocabulary

Academic	Application
transverse wave	wave
longitudinal wave	medium
electromagnetic wave	harmonic
mechanical wave	fundamental frequency
trough	beat
amplitude	beat frequency
crest	doppler effect
wave length	rotate
frequency	torque
period	moment of inertia
Standing wave	angular position
revolutions	angular acceleration
radians	angular velocity

Learning Goal 1

SWBAT describe simple harmonic motion and the restoring force as well as solve pendulum and simple harmonic oscillator problems.

Proficiency Scale

- SWBAT describe simple harmonic motion and the restoring force as well as solve pendulum and

simple harmonic oscillator problems.

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.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.6-8.MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
SCI.6-8.MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Target 1

SWBAT describe simple harmonic motion and the restoring as well as graph simple harmonic motion on X v T, V v T, and A v T graph

- SWBAT describe simple harmonic motion and the restoring as well as graph simple harmonic motion on X v T, V v T, and A v T graph

Target 2

SWBAT use Hooke's Law to solve force/spring problems

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Target 3

SWBAT solve problems involving the period of pendulum and spring oscillator.

- SWBAT solve problems involving the period of pendulum and spring oscillator.

Learning Goal 2

SWBAT explain that interference leads to standing waves and beats, and that the direction of a wave may change when the wave travels through a new medium.

Proficiency Scale

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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.
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SCI.6-8.MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
SCI.6-8.MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Target 1

SWBAT describe the way a wave moves and solve for its speed, along with defining the major parts of a wave.

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Target 2

SWBAT solve for the different harmonics of a standing wave on a string using the tension in the string and unit mass density of the string.

- SWBAT solve for the different harmonics of a standing wave on a string using the tension in the string and unit mass density of the string.

Target 3

SWBAT describe the difference between sound standing waves in an open/open tube vs and open/closed tube. SWBAT Mathematically solve for the different harmonics in either type of tube.

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Learning Goal 3

SWBAT solve basic rotational kinematic problems and rotational dynamics problems along with qualitatively

explain the differences between the causes of rotational acceleration vs linear acceleration.

- SWBAT solve basic rotational kinematic problems and rotational dynamics problems along with qualitatively explain the differences between the causes of rotational acceleration vs linear acceleration.

Target 1

SWBAT relate rotational kinematic variables such as position and velocity to their rotational counterparts. Specifically describing position in terms of radians and revolutions.

- SWBAT relate rotational kinematic variables such as position and velocity to their rotational counterparts. Specifically describing position in terms of radians and revolutions.

Target 2

SWBAT Solve basic rotational kinematic problems

- SWBAT Solve basic rotational kinematic problems

Target 3

SWBAT qualitatively describe what a torque is and how the rotational inertia of an object affects this torque along with solving basic sea-saw equilibrium problems

- SWBAT qualitatively describe what a torque is and how the rotational inertia of an object affects this torque along with solving basic sea-saw equilibrium problems

Target 4

SWBAT describe how a torque can cause an object with a specific moment of inertia to angularly accelerate. SWBAT solve basic rotational dynamic problems.

- SWBAT describe how a torque can cause an object with a specific moment of inertia to angularly accelerate. SWBAT solve basic rotational dynamic problems.

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.
- Provide Mathematical assistance for rotational kinematic problems
- Use videos and online simulations of wave motion to supplement lessons.

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

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.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LA.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
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.