

# Unit 5: Waves

Content Area: **Science**  
Course(s): **Physics/Lab College Prep**  
Time Period: **4th Marking Period**  
Length: **4 Weeks**  
Status: **Published**

## Unit Overview

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This unit covers the principles of waves and how they travel. It discusses the different properties of sound and light, and how certain barriers can affect these waves.

## Transfer

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

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

[http://www.authenticeducation.org/ae\\_bigideas/article.lasso?artid=60](http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=60)

## Meaning

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## Understandings

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- 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.

### **Essential Questions**

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- 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?

### **Application of Knowledge and Skill**

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- 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 understand why clothing stores use convex and concave mirrors to sell more clothes.

### **Students will know...**

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- 1) How to define and describe terms relating to wave phenomena, including resonance.

- 2) How to describe the properties of sound, how it is detected and produced.
- 3) Describe the properties of light, including reflection, refraction, and diffraction.
- 4) The difference between a longitudinal and transverse wave along with the difference between an electromagnetic and transform wave.

### **Students will be skilled at...**

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- 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) Solve problems relating to wave phenomena, including resonance.
- 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 intensity of a sound in Decibels.
- 7) Determine the beat frequency produced by two different frequencies and how this can be utilized to tune instruments.
- 8) Solve optics problems in mirrors and lenses mathematically and using ray diagrams.
- 9) State Snell's Law and use it to predict the path of a light ray as it travels from one medium into another. Explain the "Index of Refraction" for a medium.
- 10) Use the thin lens equations and the sign conventions to determine the position, magnification, and size of the image, produced by an object placed a specified distance from a converging and diverging lens.
- 11) Draw Ray Diagrams and locate the position of the image produced by an object at a specified distance from a plane mirror. State the characteristics of the image.
- 12) Use the mirror equations and the sign conventions to determine the position, magnification, and size of the image, produced by an object placed a specified distance from a spherical mirror.

### **Academic Vocabulary**

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Academic	Application
transverse wave	wave
longitudinal wave	medium
electromagnetic wave	diffraction
mechanical wave	refraction
trough	reflection
amplitude	interference
crest	
wave length	
frequency	
period	
standing wave	

## Learning Goal 1

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SWBAT explain that a wave is a transfer of energy, not matter and can be described by its amplitude, frequency, wavelength, speed, and energy. This repeats as a function of time and position.

### Proficiency Scale

- SWBAT explain that a wave is transfer of energy, not matter and can be described by its amplitude, frequency, wavelength, speed, and energy. This repeats as a function of time and position.

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.HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

## **Target 1**

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SWBAT Define what a wave is and the characteristics of a wave, along with distinguishing between a longitudinal and a transverse wave.

- SWBAT Define what a wave is and the characteristics of a wave, along with distinguishing between a longitudinal and a transverse wave.

## **Target 2**

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SWBAT compare and contrast electromagnetic and mechanical waves, along with describing sound as a mechanical wave and relate it to everyday examples.

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## **Target 3**

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SWBAT relate the amplitude of a wave, to the amount of energy that wave is carrying.

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## **Target 4**

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SWBAT solve for the period and frequency of a wave and explain how they inversely relate to each other.

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## **Target 5**

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SWBAT Describe a wave based on its wavelength and frequency, and relate these two things mathematically to find the speed of the wave.

- SWBAT Describe a wave based on its wavelength and frequency, and relate these two things mathematically to find the speed of the wave.

## **Learning Goal 2**

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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

- 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.

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.HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

SCI.HS-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

### **Target 1**

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SWBAT Define Reflection, Refraction, Diffraction and give examples of each.

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### **Target 2**

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SWBAT define and explain interference and give examples of interference heard in everyday life such as beats.

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### **Target 3**

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SWBAT describe what a standing wave is, identifying a node and antinode, and setting their own standing wave up in a long tube.

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## **Formative Assessment and Performance Opportunities**

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Lab Reports

Worksheets

PowerPoints with Notes

Homework and Classwork Activities

Group Activities

In Class Discussion

Do Nows and Closures

Class Polling

Observation

## **Summative Assessment**

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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. Common Assessment is administered through LinkIt.

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## **Accommodations/Modifications**

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

## **Unit Resources**

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Teacher generated PowerPoints, Notes, Labs and Worksheets

Textbooks

Resource Books

Internet Resources

Computer Based Activities

Projector

Smart Board

Calculators

## **21st Century Life and Careers**

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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

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LA.RST.9-10.8

Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

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.