

## FOURIER MAKING WAVES PHET SIMULATION

Fourier Making Waves PhET Simulation:

<https://phet.colorado.edu/en/simulations/fourier-making-waves/about>

Set up instructions for simulation:

- Click play.
  - Click on “Discrete.”
1. Drag the different amplitude bars in the top third of the simulation up or down. Each amplitude bar that you move away from 0 amplitude adds another individual wave in the middle section of the simulation. The bottom third of the simulation shows the superposition of all the waves together.
    - Go to the wave game.
      - Hit “Wave Game” at the bottom of the screen.
      - Choose level 1 to start with and increase the difficulty as you succeed in matching each wave.
  2. Spend 10 minutes leveling up on the game trying to match the waves by changing the individual amplitudes of additional waves.
    - Go back to the first simulation by hitting “Discrete” at the bottom of the screen.
  3. Click through the Waveform options (sinusoidal, triangle, square, sawtooth, and wave packet) at the top of the toolbar on the right side. Notice how adding the waves can approximate any shape. If you click “Harmonics” below the Wave Form button to decrease the number of harmonic waves to be added, the approximation becomes worse, and if you increase the number of harmonics the approximation becomes better. If the simulation could add more than 11 waves, the approximation would be an even better approximation of whatever shape that you wanted.
  4. Go to the “Wave Packet” wave form option button. As you decrease the number of “Harmonics,” what happens to the width of the wave packet?
  5. What is the width of the wave packet when there is only one harmonic?
  6. If you could add more and more harmonics to the simulation, what would the width of the wave front eventually become?
  7. How does the Fourier Transformation explain how the Heisenberg Uncertainty Principle is a necessary part of understanding what can be known about the position and momentum of a particle?