Open the program at <https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html>

Play with it awhile to get a feel for it. Pay special attention to making a wave manually with a wrench, with using the slow-motion button (you have to re-set it each time), and the orange re-set button.

See how to use the blue pause/pay button. Learn what differences to the damping and tension buttons make.

1. Set it to manual, fixed end, high tension, low or no damping, slow-motion. These will be your settings for most of this lab. Reset the setting after each use.
2. Produce one quick wave by yanking the wrench **down** and back up. Which way does the waveform point (up or down)? Down
3. What happens to that direction when the wave hits the clamp on the right and bounces back to you (up or down)? Up
4. How does this show the principle of incident and reflected waves? Answers vary, something to the effect that the angle of reflection will be the same but in opposite directions and signs.
5. Do it again, but this time make a positive wave by quickly yanking the wrench **up** and back down. Are the incident and reflected waves still opposites? Yes
6. Make a complete statement about what is happening, using the terms “reflected”, “incident” and “inverted”. Answers vary.
7. Now it gets challenging. You want to make a destructive interference wave. Make a quick, large “up” wave as before, and when the wave gets to about the 3rd green ball marker make another large up wave.
8. What happens when an inverted (negative) wave crosses an up (positive) wave? HINT: You might have to do this several times to get it to work. It helps visualize it by using the pause button. Did you ever get the waveforms to completely destroy each other? No, they merely neutralize each other while passing through each other.
9. When the waves pass through each other they immediately regain their original form. Now, do you need to re-write your answer to #8? Answers vary.
10. Finally, try to make a constructive interference. This is a little easier. You will make an “up” wave as before, and then about the time of the 3rd green ball, make a “down” wave. What will be the direction of the “down” wave after it reflects? Up
11. What happens to the amplitude when two waves pass each other? It drastically increases.
12. Sometimes in the ocean a “rogue wave” will seemingly come out of nowhere, tower over small ships and quickly disappear. They can be quite dangerous. From what you have done, explain in a sentence or two what might cause rogue waves.

Answers vary. Basically if you have one mild wave coming at or overrunning a second mild wave, as one passes through the other you suddenly get a very large wave for just a moment. This is due to constructive interference.

*In parts of the Caribbean you can get three such waves colliding, especially during the fall. These can make sudden and incredible waves.*

*Storms far out to sea often produce rogues on the beach, as fast-moving waves from “elsewhere” over-run your regular waves as they break. The calm average is around 6 to 8 waves per minute but stronger winds elsewhere (wherever that is) will produce larger waves with longer wavelengths of about 3 to 4 per minute. These collide with those smaller 6 to 8 per minute waves, often near the beach as the breakers form.*

*Want to know more? Then you’re ready for an oceanography course !*