Name(s): ________________________ Date: _________ Period: _________

# Student Handout to Physics Cinema Classics C Wave Machine Title 4 Chapters 1 – 3 – 5, 8, 10 and 11
# To accompany Activity #5 The Effects of Amplitude and Media on Speed, Activity #8 Spring Laboratory Activity
# My Waves Are Faster Than Your Waves!

**Purpose:** Determine the velocity of a transverse wave in a slinky.
Examine the qualitative relationship between amplitude and speed for a given media.
Determine the relationship between wave (pulse) speed and the size or shape of the wave.

View chapters 1, 3, 4, 5 8, 10 and 11 of Title 4 Wave Machine!

1. Describe the wave machine.
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

2. The length of the torsion bar machine is 1.0 meter. Time one round trip and calculate the speed of the pulse in m/s. Show your work here.

3. In chapter 4 a smaller amplitude pulse is generated. Determine the speed of the pulse for one round trip. You may use a stopwatch or note the size of the pulse and the stopping time displayed on the timer. In each instance the distance is 1 meter. How does the time for one round trip for the smaller pulse compare with that of the larger pulse?
   ________________________________________________________________
   ________________________________________________________________

4. In chapter 5 a larger amplitude pulse is generated. What is the speed of the large pulse compared to the small pulse?
   ________________________________________________________________
   ________________________________________________________________

5. In chapter 8 a broad pulse (a pulse with a larger wavelength) is generated. How does the time for one round trip for this pulse compare with that of the other pulses?
   ________________________________________________________________
   ________________________________________________________________

6. In chapter 10 a second machine with shorter rods is placed on top of the longer rod machine. The machines are connected and a pulse is generated simultaneously in both machines. Are the speeds the same? ______If not what factor contributes to the difference in the speeds?
   ________________________________________________________________
   ________________________________________________________________

   Upon what does the speed depend?
   ________________________________________________________________
   ________________________________________________________________

# Teacher Notes for Physics Cinema Classics C Wave Propagation Title 4 Chapters 1 – 3 – 5, 8, 10 and 11 Wave Machine
# To accompany Activity #5 The Effects of Amplitude and Media on Speed, Activity #8 Spring Laboratory Activity
# My Waves Are Faster Than Your Waves!

**Objectives:**

- Students will determine the speed of a transverse pulse.
- The students will examine the qualitative relationship between amplitude and speed for a given media.
- Students will discover that wave (pulse) speed is independent of size or shape; it depends upon the medium.

**Description**

Title 4 Wave Machine uses a torsion bar wave machine to demonstrate transverse pulses. Pulses of various sizes and shapes are started, travel to the opposite end, are reflected, and return to the starting point. Each event is timed. In the final sequence a second wave machine with shorter arms is placed above the first. Waves are started on each machine simultaneously and the difference in speed (due to the different media) is apparent.

**Teacher Information**

The main concept in this lesson is that the speed of the pulse is independent of the size or shape of the pulse. In the sequences used, a timer is shown. Point out to the students that it is zeroed at the start of each event and stopped at the end. While the timer cannot be read exactly, the position shows that the time is the same in each case. Instructions for building a low-cost wave machine are available in the AAPT publication *String & Sticky Tape Experiments*, activity 5.02.

## Teacher's Answers to Student Worksheet

**Purpose:** Determine the velocity of a transverse wave in a slinky.
Examine the qualitative relationship between amplitude and speed for a given media.
Determine the relationship between wave (pulse) speed and the size or shape of the wave.

View chapters 1, 3, 4, 5 8, 10 and 11 of Title 4 Wave Machine!

1. Describe the machine.
   *The torsion bar machine has evenly spaced metal rods along a central wire. The rods are free to move independent of one another and the wave motion propagates through the system.*

2. The length of the torsion bar machine is 1 meter. Time one round trip and calculate the speed of the pulse in m/s.
   *The speed is constant throughout the trip and is approximately 0.33 m/s. (i.e., 2.0 meters in 6.0 seconds)*

3. In chapter 4 a smaller amplitude pulse is generated. Determine the speed of the pulse for one round trip. You may use a stopwatch or note the size of the pulse and the stopping time displayed on the timer. In each instance the distance is 1 meter. How does the time for one round trip for the smaller pulse compare with that of the larger pulse?

   *The time frames are the same with the same distances traveled, so the speeds are the same.*

4. In chapter 5 a larger amplitude pulse is generated. What is the speed of the large pulse compared to the small pulse?

   *The time frames are the same with the same distances traveled, so the speeds are the same.*

5. In chapter 8 a broad pulse (a pulse with a larger wavelength) is generated. How does the time for one round trip for this pulse compare with that of the other pulses?

   *The time frames are the same with the same distances traveled, so the speeds are the same*

6. In chapter 10 a second machine with shorter rods is placed on top of the longer rod machine. The machines are connected and a pulse is generated simultaneously in both machines. Are the speeds the same? __*No*__ If not what factor contributes to the difference in the speeds?

   *The fact that the rods have a different mass/length affects the rate at which the wave can travel.*

   Upon what does the speed depend?

   *The second machine is placed on top. Its waves clearly travel faster. Therefore the speed of the pulse is independent of size or shape and depends upon characteristics of the medium.*