Name(s): ______________________ Date: __________ Period: __________

STUDENT HANDOUT TO PHYSICS CINEMA CLASSICS C WAVE PROPAGATION
TITLE 3 VARIOUS MEDIA
To Accompany Activity #5 The Effects of Amplitude and Media on Speed

Purpose: Observe and calculate the speed of wave pulses in various media.

Below is a list of frame sequences and the distance a pulse travels in that sequence. View the segments on the DVD and calculate the speed of the wave (each non–slow–motion frame is 1/24th of a second). At times you must make estimates. Compare speeds and answer questions.

Event/media	Frames	# of frames	Distance (m)	Velocity (m/s)	Slomo factor
1st Slinky™ ff	3.2	17	1	NA	NA
2nd Slinky™	3.3	17	1	NA	NA
2 Slinkies™	3.4	3	1		NA
2 Slinkies™	3.5	1	1		NA
1st event different stretch left (loose)	3.7	4	1.2 (est)		NA
1st event different stretch right (tight)	3.7	3	1.2 (est)		NA
2nd event/different stretch same data 1st event above	3.7	4	1.2 (est)		NA
	3.7	3	1.2 (est)		NA
1st event/3 media garden hose	3.12	2 (est)	1		NA
Slinky™	3.12	3 (est)	1		NA
Brass spring	3.12	2 (est)	1		NA
2nd event 3 media garden hose	3.13	10	1	NA	
Slinky™	3.13	16	1	NA	
Brass spring	3.13	6	1	NA	
Event 3 3 media in slow motion	3.14	Same	As	Event 3	Above
Event 4 3 media in slow motion	3.15	Same	As	Event 3	Above

1. How did you calculate the speed of the pulses?

 ____

 ____

2. How do the speeds in the Slinky™, hose and brass spring compare?

 ____

 ____

3. What is the effect of media on wave speed? Give specific example(s).

 ____

 ____

PHYSICS CINEMA CLASSICS C WAVE PROPAGATION
TITLE 3 VARIOUS MEDIA
To Accompany Activity #5 The Effects of Amplitude and Media on Speed (Teacher Notes)

Objectives:

- Students will determine the speed of a longitudinal pulse and compare it to speed of a transverse pulse.
- Students will describe the factors that affect the speed of a wave through a given medium the transfer of energy without the transfer of the medium.
- Students will observe and calculate the speed of wave pulses in various media.

Title 3 shows pulses sent down and back a variety of media stretched across a table: Slinky™, Springs, and garden hoses of different materials, sizes, and tensions.

Teacher Information to share with the students.
To calculate and compare speeds in the different media, use a distance scale and the frame counter. Calculate speeds of wave pulses by dividing the distance traveled by the time of travel. In non–slow–motion segments, each frame represents 1/24th second. Confine your measurements to areas near the center of the screen to minimize camera parallax errors. Count frames as the peak of a pulse travels from the 100 cm mark to the 200 cm mark. Several normal speed segments are too fast for accurate measurement but may allow estimates. Viewers can only guess about linear density, since density also changes with tension.

Classroom Activity
The following worksheet includes a list of frame sequences and distances for which students can calculate velocities or slow-motion factors. Assign as many or as few of these segments as you feel appropriate to stimulate discussion. Students should notice that waves travel faster in a medium with more tension.

Have students view the segments on the DVD and calculate the speed of the wave (each frame represents 1/24th second). At times, students must make estimates. Have students compare speeds and answer questions on the A1 audio track. The italicized numbers in the Velocity and Slo–Mo Factor columns do not appear on the students' worksheet.

Below is a list of frame sequences and the distance a pulse travels in that sequence. View the segments on the DVD and calculate the speed of the wave (each non–slow–motion frame is 1/24th of a second). At times you must make estimates. Compare speeds and answer questions.

Event/media	**Frames**	**# 0f frames**	**Distance (m)**	**Velocity m/s**	**Slomo factor**
1st Slinky™	3.2	17	1	NA	NA
2nd Slinky™	3.3	17	1	NA	NA
2 Slinkies™	3.4	3	1	8	NA
2 Slinkies™	3.5	1	1	8	NA
1st event different stretch left (loose)	3.7	4	1.2 (est)	7.2	NA
1st event different stretch right (tight)	3.7	3	1.2 (est)	9.6	NA

2nd event/different stretch same data 1st event above	3.7	4	1.2 (est)	7.2	NA
	3.7	3	1.2 (est)	9.6	NA
1st event/3 media garden hose	3.12	2 (est)	1	12	NA
Slinky™	3.12	3 (est)	1	8	NA
Brass spring	3.12	2 (est)	1	12	NA
2nd event 3 media garden hose	3.13	10	1	NA	5:1
Slinky™	3.13	16	1	NA	5:1
Brass spring	3.13	6	1	NA	5:1
Event 3 3 media in slow motion	3.14	Same	As	Event 3	Above
Event 4 3 media in slow motion	3.15	Same	As	Event 3	Above

1. How did you calculate the speed of the pulses?
   Calculate speeds of wave pulses by dividing the distance traveled by the time of travel. To calculate the time of travel, use number of frames counted divided by the number of frames per second to determine the time per number of frames counted.

2. How do the speeds in the Slinky™, hose and brass spring compare?
   The speed of the transverse pulse in the garden hose and brass spring are approximately equal. The speed in the Slinky™ *is slower.*

3. What is the effect of media on wave speed? Give specific example(s).
   The greater the tension is, the greater the speed is as shown by the loose versus tight Slinky™ *data. The speeds in the hose and brass spring are faster than the* Slinky™ *speed indicating that the mass/length may affect the speed. However, the three are not under the same tension. If a* Slinky™ *and heavy coil are connected, and they are under the same tension, the pulse travels faster in the* Slinky™. *Avoid relating density to speed directly because the speed of sound is related inversely to the square root of the density of the liquid or solid through which it travels. The equation for the speed of a wave in a string is speed equals the square root of the quotient of the tension divided by the mass per length of the string. At this point it seems sufficient for the students to realize that the greater the tension, the greater the speed.*