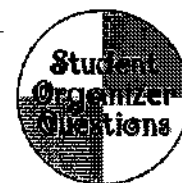


Name _____ Period _____ Date _____



Understanding Car Crashes When Physics Meets Biology

Video Concept Organizer

Part I: Pre-video inquiry

Directions: Before viewing the video, record your ideas about questions #1 and #2 below. Be prepared to discuss your responses with your partner(s) and the class.

1. Why is it that some spectacular race car crashes produce only minor injuries?

2. How can three collisions occur in one crash between a car and a wall?

**Running time
24 minutes**

01:36

Part II: During the video

Directions: To help you remember the key science concepts discussed during the video, fill in the blanks or circle the correct answers.

What is the first scientific discipline that comes to mind when you think of car crashes? It's probably physics because _____ govern what happens to a vehicle in a crash.

But if we want to understand the effects of a crash on a human body, we need look at what occurs when physical _____ are applied to organs, tissues and cells, and this happens when physics meets biology in the field of _____.

04:04

History of crash research

_____, a medical doctor and biophysicist in the United States Air Force, used himself as the test subject in his investigations of human tolerance to high *g* environments.

04:20

In one of his many tests, Dr. Stapp reached a speed of _____ miles per hour before one of the most powerful braking systems of all time stopped him in _____ seconds, subjecting him to more than 40 times the pull of gravity, or _____ *gs*.

05:12

Crash test dummy lab

These dummies behind me are a perfect example of combining **science, technology, engineering, and mathematics** to produce new **tools** that extend scientific understanding.

06:00

Family of dummies	Height (feet) [meters]		Weight (lbs) [mass in kg]	
95 th percentile male	6' 2"	[1.88 m]	223 lbs	[101 kg]
5 th percentile female	5'	[1.52 m]	107 lbs	[48.5 kg]
50 th percentile male	5' 9"	[1.75]	172 lbs	[78.0kg]
CRABI - 6 month old	26.3"	[0.67 m]	17.3 lbs	[7.85 kg]

06:24

Side impact dummy: The accelerometers give us the _____ of the mass. The load cell measures _____, and we have the potentiometers that measure the _____.

07:44

Biofidelity (circle *more* or *less*): The *more* or *less* biofidelic, the *more* or *less* like a human being it is in representing how it moves, what types of stresses it measures in the crash test, and then the true-to-lifeness of those measurements to the prediction of injury in a real person.

08:30

Crash anatomy

Let's start with some basic anatomy. The human body contains more than _____ cells. The body is structurally organized into four levels: _____, _____, _____, and _____.

The body contains four large, fluid-filled spaces called _____ that house and protect the major internal organs.

11:30

The third collision

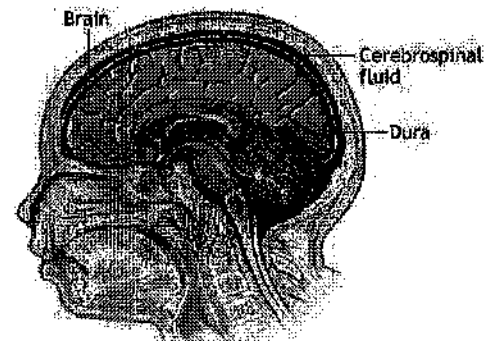
The first collision is between the car and the _____. The second is between the driver and the _____. And the third is between the driver's _____ and the inside walls of his or her _____.

What do you think will happen to the brain during impact?

Circle one: Will it *move forward*, *move backward*, or *stay in the same spot*?

The initial movement of the gel or brain is toward the _____ of the skull.

This type of brain injury is called **coup-contrecoup**, which is a French term meaning _____.



13:00

Stretch, twist, and tear

With the heart and its blood vessels, the ascending aorta and its arch are _____ while the descending aorta is _____.

Predict what will happen to the unsupported section of gel during the collision:

14:10

The unsupported section of gel _____ and tears away from the supported gel.

14:30

Stress and strain

_____ is a measure of the average deforming force exerted over a defined area of tissue. Stress produces _____. Strain is a measure of how much the tissue _____ as a result of the stress.

Three basic types of stress are _____ stress from stretching, _____ stress from opposing forces, and _____ stress from uniform compression.

_____ to human tissue is like failure to a structure.

16:00

Shockwaves

Shockwaves change _____ and/or _____ as they move through tissues of different densities producing complex wave interactions and stress on your organs.

Cell damage and death

Chemicals leaving the cell (circle three): *potassium, glutamine, phosphate, glucose, calcium*

Chemicals entering the cell (circle one): *glucose, calcium, potassium*

This failed auto-regulation can cause areas of the brain to become **ischemic**, that means inadequate _____ delivery, and therefore are at risk of malfunction to the point of cellular death.

18:00

Building safer race cars

Crash recorders measure _____ in three directions.

Crash recorder data are used to design _____ that re-enact the crash and help produce design changes.

List three race car safety features brought about by the study of injury biomechanics:

1. _____
2. _____
3. _____

19:15

Crash testing at the Vehicle Research Center (VRC)

You try to design the structure of the car so that it crushes in front so you're bringing the car to a stop _____.

21:06

Bed of nails

Pressure is equal to the _____ exerted on a surface divided by the total _____ over which the force is exerted.

Pressure = _____

More nails means _____ pressure.

22:18

Sundown

Keeping people safe in crashes has to do with extending _____, keeping the occupant compartment _____ and _____ the occupants to the compartment.

