It's All In Your Head

Understanding Concussions through the use of Wearable Sensors

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Name:

Concussions, a type of Traumatic Brain Injury, may be caused by a blow to the head or a violent shaking of the head and body. Concussions are a hot topic in sports that involve regular head impacts, such as football and soccer. Victims may also suffer concussions from car accidents, epileptic seizures, and extreme sports such as skateboarding and cycling. If an individual suffers a large number of concussions during their lifetime, long term effects including **neurodegeneration**, the progressive loss of structure or function of neurons, may occur. As research continues into the mechanism behind concussions and the long-term effects, there may be a way to prevent neurodegeneration in at risk individuals.

One of the main ways to prevent long term injury is to diagnose concussion victims faster and more accurately. Scientists around the globe have implemented the use of wearable sensors as a method of detection during athletic play. When a blow to the head occurs, the sensor alerts medical staff near a victim of the impact. It should be noted, these sensors cannot diagnose a concussion, but they can alert trainers to potential injuries that often go unnoticed in real time.

Your high school athletic department is considering purchasing wearable sensors to aid in the detection of sports related concussions. While most school officials believe sensors are needed, there is some hesitation to spend money from individuals who ask if sensors are really needed. Funders have asked you to prepare a presentation that addresses:

1. What is a concussion and what are some common symptoms?
2. Evaluate the wearable concussion sensors that your school is considering for accuracy, cost, ease of use, and practicality.
3. Provide a recommendation to the school around which sensor the school should purchase in an effort to best serve student athletes, keeping in mind the budget is limited and large purchases must be justified.

PART I – Understanding Concussions through the use of a Model

GOAL: To identify and explain the mechanism behind a concussion.

MATERIALS

- Plastic container w/ lid
- Gelatin
- Distilled Water
- Pool Noodle
- Bubble Wrap
- Clear Packing Tape
- Video Recording Device

☐ 1. Locate the plastic container that will serve as a model skull and the gelatin inside that will serve as a model brain.

☐ 2. Add 300mL of water to your model, simulating cerebrospinal fluid.

☐ 3. Record a slow-motion video from above the model as it is struck by an outside force (pool noodle)

As you observe the video, what do you notice happening to the brain as the skull is struck?

How is energy being transferred from an outside force to the different parts of the model to cause a concussion?

What else besides being struck by an outside force might cause a similar reaction to happen?

☐ 4. Add a "helmet" to the model by carefully wrapping bubble wrap around the sides of the plastic container.

PREDICT: What will change now that the helmet has been added?

☐ 5. Strike the model skull again and observe how the gelatin reacts inside the plastic container to simulate impact an athlete would experience while wearing a helmet.

☐ 6. Record a slow-motion video from above the helmet model as it is struck by an outside force (pool noodle).

Compare the video to the video of the model with no skull protection.

What differences did you see? Did adding a helmet help prevent a concussion from occurring? If so, how? If not, why not?

Develop and use a diagram to illustrate how a blow to the head can cause a concussion:

PART II – Understanding Concussion Symptoms

GOAL: To understand the symptoms of concussions and how a potential victim might be identified.

MATERIALS

- Concussion Goggles

- ☐ 1. Develop a series of tests and challenges to have a volunteer perform while wearing concussion simulating goggles.
- ☐ 2. Place the concussion simulating goggles on the volunteer and ask them to perform the tests and challenges.
- ☐ 3. Ask the volunteer to describe what he/she is feeling as they complete the tasks assigned.
- ☐ 4. Record symptoms the volunteer describes as well as group observations.

Goggle Test Protocol

Symptoms experienced by volunteer:

Observations:

PART III – Evaluating Current Wearable Sensors

GOAL: To understand and evaluate wearable devices currently on the market based on accuracy, cost, ease of use, and practicality.

MATERIALS

- ROSH Headband
- Cue Sport Sensor
- Vector Mouth Guard
- Unisex Head Form
- Sports Helmet
- Athlete Intelligence Software

☐ 1. Identify how each sensor is designed to alert trainers to a possible concussion.

☐ 2. Test and evaluate each sensor for accuracy, cost, ease of use, and practicality. Which features of each sensor are most important and why?

☐ 3. Complete the table below to compare each design.

SENSOR	COST	DESCRIPTION	STRENGTHS	WEAKNESSES
ROSH Headband				
Cue Sport Sensor				
Vector Mouth Guard				

? Which of the current sensors would you recommend your athletic department implement? Why? Which components of that sensor led you to choose it over other available models?

PART IV- Conclusion: Presentation and Future Recommendations

Develop and present your pitch to school officials that addresses and explains the following:

1. What is a concussion and what are some common symptoms?

2. What current wearable sensors are available on the market and the strengths and weaknesses of each model?

3. Which sensor would you recommend the school purchase in an effort to best serve student athletes, keeping in mind the budget is limited and large purchases must be justified?

4. How could school athletic staff make better decisions about the health of their athletes if the school purchased these sensors?

5. What features could be added to wearable devices that were not present in the sensors surveyed? Why would these additions be valuable?