A-head of the Game

10 x 55 minute periods

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Materials

- Styrofoam head
- 1 Triax SIM-P: Wearable Head Impact Monitor for all sports
- 1 bowling ball pendulum

SUBJECT/GRADE LEVEL

Subject Area: Science

Grade Level: Middle School

STANDARDS

Next Generation Science Standards

- MS-PS2-1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
- MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

LESSON OBJECTIVE(S)

Students will design, build and test a protective football helmet to reduce the severity of impact in hopes of preventing concussions.

ENGAGEMENT

Brief Description: Introduce the challenge and access students' prior knowledge.

Procedures:

Provide students with the backstory: You and your friends are attending a high school football game, and it is down to the final play. The intensity is high and the game is a close one. Down! Set! Hut! The quarterback hands off the ball to the running back, who is on the verge of breaking a school record. The running back bursts through the hole and appears to be on his way to a 40 yd. touchdown when he is blindsided by a player from the opposing team. In the collision, the defender's helmet strikes the running back's helmet sending him crashing to the turf. The impact of the two helmets was so severe that the running back was rushed off the field after lying motionless for several minutes. It was later determined that he sustained a concussion.

Provide the Challenge:
Within the next few weeks, concerns about the current helmet policies in your school district become a major debate. The data in your district shows that the number of concussions has not only increased, but concussions are also happening in middle school football. Because you and your classmates are studying engineering design, your class decides to join together for a solution! Your teacher divides your class into groups so that each group may come up with a helmet design that can withstand the force of impact. You will all test your design with an impact drop system. The results will be evaluated to determine the helmet that has the least damage from impact.

Students will begin generating ideas using the discussion questions. Students will first work independently, and will then share their ideas with their group members. It is suggested that students have access to whiteboards so they may brainstorm their ideas about concussions visually.

EXPLORATION

Brief Description: Students read articles on concussions in the current news.

Procedures:

Students will be placed in small groups with each group receiving a different article about concussions. Student groups will work together to answer a set of questions that go along with the articles. Mix the groups up so that each group has a student that read a different article. Have each student summarize to their group what the article was about.

EXPLANATION

Brief Description: Students understand what a concussion is, how it happens, the consequences, and policies regarding concussions for their district.

Procedures:
Start off with having student's research their school/state policy regarding concussions. Students will then work collaboratively with their groups to complete reflection questions reviewing the key elements of the state concussion policies.

Discussion Questions:

1. What is a concussion? How many occur each year?
2. What must coaches do when they suspect athletes of having a concussion? When can they return to play? What are the consequences of not following this policy?
3. Identify three signs and three symptoms of a concussion.
4. What is the best way to heal a concussion? Support your response with three ways to accomplish this.

Biology Class: Students will view two short videos, read a page on the signs and symptoms of concussions, and view a PowerPoint to learn what happens to the brain during a concussion.
What Is a Concussion? | HEADS UP | CDC Injury Center

1. A concussion is a change in what?
2. A concussion is not a _____ injury. It's a _____ injury. What do you think that means?
3. What happens to the brain when the head is struck?
4. In order to have a concussion, do you have to lose consciousness (get knocked out)?
5. Why are athletes at risk for concussions?
6. What is another way to get a concussion other than sports?
7. Why do you think it is important to protect against concussions?

What Is A Concussion?

1. What causes a concussion?
2. What specifically can be damaged as a result of the brain hitting the inside of the skull?
3. What do the chemical changes in the brain do to the brain?

Physical Science Class: The teacher will distribute a KWL chart to each student. Students will generate knowledge about what they know about concussions, forces, energy, and acceleration. Students will then generate a list of three things they want to know in the second column. Students will silently read the attached article and as a class, the video will be viewed. Following the video the students will share what they learned in the third column of their charts.

EXTEND

Brief Description: Students will work in groups of 2-3 students to complete an engineering challenge to design, build and test a protective football helmet.

Procedures:

- Pass out the following worksheet.
- Ask: Which group will develop the best helmet for protecting against concussions?
- Imagine: Develop a 1:2 scale drawing of your individual helmet design.
- Plan: Work with your group to choose the best design and to determine the materials necessary for building your helmet prototype.
- Create: Work with your group to build your helmet according to the group approved 1:2 scale drawing. Set up a controlled experiment sheet to test the force of impact using your helmet prototype.
- Improve: As a group complete the reflection questions identifying the points of success with your helmet designs as well as two areas for improving your helmet design.
- Communicate: complete a quad chart with your group to share in the class poster session reviewing our helmet design challenge.

EVALUATION

Brief Description: Students write a letter presenting data and scientific reasoning.

Procedures: Individually students will write letters to the school board sharing their research and data collected from the engineering design challenge. Students will be expected to complete formal letters explaining what they learned about concussions from a physical and biological standpoint. Students will also be expected to share the testing that they completed and the results that they gathered through their experimentation. Rubric

REFERENCES

- http://www.biapa.org/atf/cf/%7BE07F6363-A589-41AA-B9C1-990FEE288F44%7D/Model%20Policy%20Concussion.pdf
- https://www.eduplace.com/graphicorganizer/pdf/kwl.pdf
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