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| **Title** | ***Gridiron Rescue - One Health Football Technology Project*** |
| **Introduction** | One Health is a collaborative effort for medical professionals and researchers to share mutually beneficial knowledge and information regarding animals, humans, and the environment.  This project focuses on the real world application of students creating wearable devices that monitor football player performance and help prevent injuries.  Following the Engineering Design Process, students are tasked with the objective of incorporating a wearable device with nanotechnology into the design of the football helmet to help teach proper body positioning while also helping to prevent spinal, head, neck, heat and cardiovascular injuries and illnesses. Students will utilize 21st Century skills and technology, cross curricular activities (STEM), differentiated lesson choices, global applications, team collaboration, communication and presentation skills. CTE subjects include business, marketing, family and consumer science, and tech ed.  Although the rate of occurrence is low, the following instances do happen on football fields throughout the United States each year and even one occurrence is one too many.   * Concussions * Catastrophic neck and spinal injuries * Heat exhaustion and heat stroke * Cardiac arrest * Brain damage (long term exposure)   As of right now, there are no game approved devices of any kind to monitor such situations. Devices that are available are “add-ons” to the helmet that are detachable and used primarily in only certain situations during practice due to their lack of feasibility and inability to function under certain conditions.  Our goal is to create an integrated device into the construction of the helmet with the primary objective of teaching players to position their bodies correctly when hitting and tackling while also striving to include as many of the other areas of concern as possible using additional sensors. Another objective is researching additional applications of such technology under the One Health Initiative. |
| **Real Science Application** | “Head Up Football” is a nationwide education program teaching players, coaches, parents, and other stakeholders the importance of proper football player form and techniques to prevent injuries. Many states, school districts, schools, and leagues are requiring Heads Up training for all involved. The University of North Carolina is a leading institution of preventing football head injuries and have developed their own education program called “HIT System” while also working on developing sensor integrated helmets to improve safety.  <http://espn.go.com/espn/otl/story/_/id/8311371/significant-advances-being-made-concussion-research-universities-nationwide>  <http://www.wralsportsfan.com/football/video/12110238/>  <http://college.unc.edu/2011/09/22/unc-concussion-researcher-named-macarthur-fellow/>  <http://tbicenter.unc.edu/index.html>  <http://myfox8.com/2014/08/21/wake-forest-university-studying-youth-football-helmets/> |
| **Curriculum Alignment** | **High School (grades 9-12) primary use would be an end of course project.**  **Business Law**  2.01 Understand elements and characteristics of a contract.  3.04 Understand intellectual property law.  6.01 Understand sales and consumer law.  **Principles of Business & Finance (POB)**  1.03 Understand business in the global marketplace.  2.03 Understand production and operations.  2.04 Understand applications and issues of technology.  3.01 Understand principles of marketing.  **Marketing**  2.06 Apply quality assurances to enhance product/service offerings.  2.07 Reinforce company’s image to exhibit the company’s brand promise.  2.10 Employ sales processes and techniques to enhance customer relationships and to increase the likelihood of making sales.  3.01 Acquire a foundational knowledge of product/service management to understand its nature and scope.  4.12 Understand data-collection methods to evaluate their appropriateness for the research problem/issue.  **Apparel and Textile Production II**  1.02B2 Textile Design and Science: Technical Innovations.  **Technology Engineering and Design**  4.02 Apply the steps of the design process.  **Physical Science**  3.1 Understand the types of energy, conservation of energy and energy transfer.  **Physics**  1.2 Analyze systems of forces and their interaction with matter. |
| **Learning Outcomes** | **Participants will:**  *Approach a 21st Century challenge utilizing the engineering design process.*  *Use STEM to solve CTE course activities and problems.*  *Explain the One Health initiative.*  *Explore new ideas and concepts to benefit others under One Health.*  *Collaborate and work as a cohesive team.*  *Create a new product to benefit Search & Rescue with at least one sensor.*  *Proceed through the steps involved in protecting intellectual property.*  *Identify their target market.*  *Explore global opportunities and applications of their product.*  *Determine alternate users/uses of their product.*  *Develop a marketing plan for bringing product to market.*  *Apply the 4-P’s of marketing.*  *Conduct a SWOT analysis.*  *Use proper spelling, grammar, and formatting in written documents.*  *Exhibit high quality presentation skills.*  *Utilize outside resources, technology, and experts as needed* |
| **Time Required and Location** | Introductory Lesson: 90 Minute Class Block in High School Computer Lab/Classroom. |
| **Materials Needed** | **Teacher List**  *Computer with internet, speakers, printer, and projector*  *Flip chart paper or whiteboard space for each group to use for ideation process*  *Markers, highlighters, dry erase erasers, pens, pencils, and Post-It Notes*  *Storage space for work in progress (milk crates, cardboard boxes, etc.)*  *The following will be used throughout the project, minimum quantity is one per class, prefer one per group*   * ***Football Helmet*** * ***Helmet Halo -***  *hit right football training sensor $10 from Champs* [*CLICK HERE*](http://www.champssports.com/product/model:206761/sku:129955&SID=7391&inceptor=1&cm_mmc=SEM-_-PLA-_-Google-_-129955&gclid=CKa9hZeUzMYCFVIbgQodMb0GVg)   Image result for helmet halo footballImage result for helmet halo football   * ***Lilypad Adruino & Accelerometer –*** *sold separately from Spark Fun*   LilyPad Accelerometer ADXL335   * ***Lilypad Accelerometer –*** *sensor that is sold separately* * ***Access to sewing kits and soldering stations***   **Student List**  *•Computer with internet and printing capability (may be used in pairs if needed)*  *•Notebook, folder, pencil or pen* |
| **Safety** | **Basic classroom, computer, and lab safety:**   * Safe internet practices * No horseplay * Proper care for all equipment * Protect hands and eyes as needed with gloves and safety glasses |
| **Participant Prior Knowledge** | **Students should have basic knowledge of football. Check out this website for a quick refresher if needed.**  [**http://usafootball.com/football-basics**](http://usafootball.com/football-basics)  **Foundational understanding for their respective course of study.**  **Business Law** – contract law, protecting intellectual property, and sales law  **Marketing** – developing new products and maximizing sales revenue  **Apparel** – sewing processes and textile design  **Tech Ed** – engineering design  **Physical Science** – energy  **Physics** - force |
| **Facilitator Preparations** | Compile supplies, prep classroom, and/or lab.  Contact outside stakeholders as needed.  Teacher should review all included videos, websites, and get acquainted with the One Health Initiative, One Health Challenge, TI SensorTag, LilyPad Arduino Coding, and football.  Teachers may also want to complete this online activity to introduce One Health and wearable devices to themselves in their own planning and preparation.  <https://prezi.com/gf73xq4kcbbr/one-health-wearable-device/> |
| **Activities** | ***This is an introductory ideation lesson. Teacher may expand to unit plan for product creation given ample time and resources.***  ***\*\*\*My daily classroom routine is for my students to immediately log into their computers and go directly to the Blackboard website to find the day’s lesson and begin working on the warm-up activity independently as I start class.\*\*\****  ***OPTION 1 FULL LESSON (Approximately 90 minutes)***  ***Warm Up Activity – 15 minutes***  *Hand each student a Post-It Note as they enter the room.*  *Goal: students will gain an introduction to One Health.*  *Part 1 (10 minutes) – Students will explore both the One Health Initiative and ASSIST’s One Health Challenge websites, pointing out to pay particular attention to the Initiative’s “About One Health” page and the Challenge’s Students page with videos. After 10 minutes of exploratory time, students should turn their monitors off (turning off monitors helps eliminate student distractions from computer when needed, without having to log back in when using the computer again, the monitors off are also an indication to the teacher as to which students are finished with the first part of the activity).*  *On their Post-It Note, students should write down the following three items they learned about One Health:*   * *Their own description/definition of One Health* * *One fact they found fascinating* * *One question they want answered about One Health*   *Students should then place Post-It Notes on classroom whiteboard when finished. By this time, the students should all be settled and teacher should have all administrative items out of the way and has begun circulating room monitoring students.*  *Part 2 (5 minutes) – Teacher will take a moment to review the agenda and expectations for the class period. With the help of a student helper, the teacher will review the student Post-It Notes on the board with the entire class - quickly. The student helper will compile a list of common questions and themes the students want addressed on the whiteboard or flip chart paper – whichever is most useful for the setting. While doing so, the teacher facilitates a class conversation in addressing questions and concerns about One Health. At the end of the discussion, any questions left unanswered are marked for further investigation with the goal being to have such questions answered by the end of the class.*  ***Activity #1 (10 minutes) – Heads Up Football***  *Goal: Students to connect their learning in the classroom with a relevant activity/interest in their lives, such as football.*  *Show the video in link below about research being conducted at UNC regarding football injuries and read corresponding article as a class.*  [*http://usatoday30.usatoday.com/sports/story/2011-11-23/UNC-professor-battles-concussions-through-research/51337506/1*](http://usatoday30.usatoday.com/sports/story/2011-11-23/UNC-professor-battles-concussions-through-research/51337506/1)  *\*\*Teacher may opt to substitute one of the other videos listed in the introduction.*  ***Activity #2 (5 minutes) – Demonstrate “Helmet Halo”***  *Goal: Students see a working wearable device, identifying its capabilities and limitations*  *Place Helmet Halo on football helmet and demonstrate to students that an alarm is activated once the player drops his/her head into an unsafe position increasing the possibility of injury. Have students “breakdown” the pros and cons of the actual Helmet Halo product creating a class list on the whiteboard. Pass helmet around for a hands-on experience.*  ***Activity #3 (25 minutes) – “Lilypad” & “TI SensorTag” Tutorial***  *Goal: Introduce students to concept of wearable devices and Lilypad technology*  *Step One - Show tutorial video on SparkFun website:* [*https://www.sparkfun.com/tutorials/313*](https://www.sparkfun.com/tutorials/313)*. Have a Lilypad on hand to pass around to students for another hands-on experience.*  *Step Two – With a Lilypad connected to the computer that has a projector, perform simple demo of Arduino coding of one or more of the sensors.*  *Step Three – Show TI SensorTag intro video*  [*http://www.ti.com/ww/en/wireless\_connectivity/sensortag2015/gettingStarted.html*](http://www.ti.com/ww/en/wireless_connectivity/sensortag2015/gettingStarted.html)  *Step Four – Using a mobile device with the TI SensorTag already downloaded, demonstrate to students how the data is transmitted to the app in real time.*  ***Activity #4 (30 minutes) – Engineering Design Process***  *Goal: Students work in teams to brainstorm ideas of integrating wearable device into football helmet.*  *Step One 15 minutes - Students will collaboratively and rapidly generate ideas for product integration into football helmet, identifying what they want to monitor and how. Each team will share out ideas.*  *Step Two 15 minutes – Each team of students will develop one idea for a wearable device that incorporates nanotechnology and benefits One Health. If time permitting, request each team create a rough sketch of what their prototype would look like. Post drawings on wall for sharing.*  ***\*\*Extra activities below\*\****  ***OPTION 2 MINI LESSON (Time Varies Approximately 15-30 minutes)***  *If time is limited, teacher may opt to have students complete this self-guided interactive online activity to introduce the One Health initiative and the concept of wearable devices. May also be used to replace the warm-up activity and activity #3. Teachers may also use this as a tool to introduce the lesson to themselves in their own planning and preparation.*  [*https://prezi.com/gf73xq4kcbbr/one-health-wearable-device/*](https://prezi.com/gf73xq4kcbbr/one-health-wearable-device/)  ***OPTION 3 ONE HEALTH COMPETITION***  **Form a Team and Participate in the One Health Challenge**  [**http://assistonehealth.com/**](http://assistonehealth.com/)  *Each team will deliver a prototype wearable device with the ability to be integrated into a football helmet that helps teach players to not drop their heads with a corresponding presentation. Collaboration with other courses and subject areas is highly encouraged.*  **Rough Outline of Topics Covered**  ***Day One*** *– Introduction to project, One Health, Heads Up Football, and demo*  ***Day Two*** *– Introduction to sensors and Lilypad Arduino*  ***Day Three*** *– Team creation, set-up project logistics, and online community*  ***Day Four*** *– Anatomy lesson utilizing Anatomy 4-D app or other appropriate technology*  ***Day Five*** *– Lesson on wearable devices*  ***Day Six*** *– Ideation/Brainstorming, research and lab work*  ***Day Seven*** *– Industry expert guest speaker (in person or via Skype) and research*  ***Day Eight*** *– Research and lab work*  ***Day Nine*** *– Research and lab work*  ***Day Ten*** *– Prototypes and rough drafts due*  ***Day Eleven*** *– Finalize products and plan event*  ***Day Twelve*** *– Finalize products and plan event*  ***Day Thirteen*** *– Practice Presentations*  ***Day Fourteen*** *– Extra day for any delays*  ***Day Fifteen*** *–Compete in One Health Challenge*  **Host a Community Event**  *Event can be one your team hosts and builds from the ground up or join in on an existing event such as a 5K run or community health fair to show off student work and help educate your neighbors on your topic.*  ***Day Sixteen*** *– Collaborate and plan community event*  ***Day Seventeen*** *– Collaborate and plan community event, send out invitations*  ***Day Eighteen*** *– Practice community event*  ***Day Nineteen*** *- Extra day for any delays*  ***Day Twenty*** *– Host community event (date can be in the future)* |
| **Assessment** | *Completed at the end of class with about 5 minutes remaining.*  **Revisit and discuss Post-It Note questions from warm-up activity.**  **Exit Ticket (5 minutes):**  Have the students answer the following online using a website such as Socrative or on scrap pieces of paper.   * Identify 3 things learned in today’s lesson. * List two questions you have about today’s material learned. * List one experience you would change about today’s lesson. * List one item you loved about today’s lesson.   **Students will be assessed on their projects addressing each of the following:**   * Does device help prevent player injury? * Does device have ability to be integrated into helmet? If not, students must identify why and propose a solution. * What other elements of safety have been incorporated in device through sensors such as body temperature monitoring? * Have students identified other uses for the same technology within One Health? * Are presentations and other forms of communication clearly understood and professional? |
| **Critical Vocabulary** | **Wearable Devices** – personal computing devices such as a fitness monitor watch that is made to be worn on body or as part of clothing.  **Nanotechnology** – very small technology that utilizes energy harvesting and sensors to help power wearable devices.  **One Health Initiative** – interrelated study of the health aspects shared among humans, animals, and the environment. |
| **Community Engagement** | Based on availability of time and student performance, teachers may find hosting a community event beneficial as a capstone to the project in which students will educate the public on their research, products, and player safety to all identified stakeholders.  ***\*\*\*My students plan to compete in the One Health Competition at NC State University, a technology/art showcase event at our school, and at our annual football safety clinic for parents.\*\*\****  **Possible Events and Audiences Include:**  Presentations of student research and product demonstrations at:   * parents, players, coaches * football camps * coaches clinics, conferences, and seminars * youth football leagues * school administration * colleges * sporting goods manufacturers and retailers * athletic trainers and medical staff * science fairs * health fairs * other athletic events |
| **Extension Activities** | **Based on availability of time and student performance, teachers may find the following beneficial:**   * Developing a unit lesson plan with prototype product creation * Collaborating with teachers in other subject areas for a larger cross-curricular project * Hosting a community event to educate the public on player safety and the students’ research and products to all identified stakeholders such as players, coaches, medical staff, teachers, administrators, parents, sporting goods representatives, etc.   **Possible One Health extension activities include:**   * 3-D printed prototype of device * Video commercial for One Health Initiative * Field trip to local college football team to learn about Heads Up * Create an entirely different wearable device of your choice * Data collection of device in use on field throughout the football season * Program additional sensors for new player health/safety concerns as they arise or to increase rigor of study for students * Partner with colleges/universities for additional research * Work with football organizations to help educate public * Strive for game approved use of device by partnering with sports officials and manufacturers |

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| **Modifications** | Students that struggle working on teams may excel in situations in which they are allowed to work alone.  Speech and audio assistance as needed for students. |
| **Alternative Assessments** | For students with learning disabilities or English language learners that may need extended time and/or additional practice, teacher may choose to offer alternative project deliverables such as reports, educational videos, and on field demonstrations. |
| **References** | <http://www.onehealthinitiative.com/index.php>  <http://assistonehealth.com/>  <http://usafootball.com/>  <http://tbicenter.unc.edu/>  <https://www.arduino.cc/> |
| **Supplemental Information** | Anatomy 4-D app to use during human anatomy lesson: <http://daqri.com/project/anatomy-4d/#.VaaPJPlVgSU> |
| **Comments** | Created as part of a teacher immersion learning experience within the Kenan Fellows Program at NC State University’s ASSIST Center. |
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