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| **Introduction** | While obesity levels in adolescents in North Carolina are slowly decreasing, overall levels are still critically high. Statistics from the Centers for Disease Control and Prevention indicate that in 2011 31.4% of 10-17 year olds were overweight or obese. In 2007, there were 33.5 and in 2003, 33.9% were overweight or obese. According to the Youth Risk Behavior Survey, only 48% of high school age students participate in the recommended 60 minutes or more of exercise, 5 days a week.Through this Project Based Learning unit, students will explore how to track exercise using the Fitbit One, which uses a 3-axis accelerometer (measures forward/backward, lateral and vertical movement and then sends data to an app). They will also learn about the One Health initiative and STEM careers associated with it. Using a mind map, they will illustrate research they find on benefits of exercise and short/long-term consequences of not exercising. Finally, using the Engineering Design Process, they will create a study to find out if they are meeting the daily exercise guidelines of at least 60 minutes of exercise, for at least 5 days a week. To summarize their findings, students will collect, organize, display and analyze their data. |
| **Curriculum Alignment** |

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| **Content Area** | **Grade**  | **Common Core Math** |
| Math.6.SP.A.2 | 6 | Understand that a set of data collected to answer a statistical question has a distribution, which can be described by its center, spread, and overall shape. |
| Math.6.SP.B.4 | 6 | Display numerical data in plots on a number line, including dot plots, histograms, and box plots. |
| Math.6.SP.B.5.b | 6 | Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. |
| Math.6.SP.B.5.c | 6 | Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. |

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| **Learning Outcomes** | LO 1: Students will independently conduct research on health benefits of exercising. LO 2: Students will work in cooperative groups to create a mind map of their research.LO 3: Students will use the Engineering Design Process and work in cooperative groups to design a  study to test intensity levels of exercise. LO 4: Students will create a graphical representation of data from their study. LO 5: Students will analyze data from the graphical representation. |
| **Time Required and Location** | Day 1: 50-minute class period in classroom with laptops (intro and research).Day 2: 50-minute class period in classroom with laptops (students create project).Day 3: 50-minute class periods outside in open space (students test and collect data).Day 4: 50-minute class period in classroom with laptops (students graph and analyze data). Day 5: 50-minute class period in classroom with laptops (students create presentation of info).Day 6: 50-minute class period in classroom with laptops (students present info). |
| **Materials Needed** | Teacher List* Video on One Health initiative: <https://www.youtube.com/watch?v=gJ9ybOumITg>
* Video on Sensors. <https://www.youtube.com/watch?v=AggUlRheoxs> and/or <https://www.youtube.com/watch?v=qy2f55fAkqo>
* NCSU Student poster on use of sensors in real-world: <http://www.tx.ncsu.edu/tecs/academics/senior-design/13-14-projects/posters/elephant-collar.pdf>
* Types of Engineers Website: <http://www.sciencekids.co.nz/sciencefacts/engineering/typesofengineeringjobs.html>
* Video on Crash Test Dummies: <https://www.youtube.com/watch?v=1JkDcLBfxRk>
* Article on Crash Test Dummies:<http://science.howstuffworks.com/science-vs-myth/everyday-myths/can-crash-test-dummies-really-simulate-human-injuries1.htm>

Student Materials List* Laptops
* Fitbit per student (or other fitness tracking device)
* Graph Paper
* Ruler
* Mind Map (google has an extension, Mindmup. Make sure you turn on collaborator mode)
* Other materials may be needed as determined by each group’s project
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| **Safety** | None |
| **Student Prior Knowledge** | These activities will take place during the Graphing/Data Analysis unit. Students should already be familiar with types of graphs and measures of center.  |
| **Teacher Preparations** | * Become familiar with sensors and accelerometers.
* Prepare presentation on sensors and accelerometers.
* Become familiar with One Health initiative.
* Prepare presentation on One Health initiative.
* Create effective cooperative groups.
* Create rubrics for project.
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| **Activities** | **Day 1****Engage**LO 1: Students will independently conduct research on health benefits of exercising. LO 2: Students will work in cooperative groups to create a mind map of their research.* Students will watch a clip on One Health. <https://www.youtube.com/watch?v=gJ9ybOumITg>
* Following the video, students will view the Elephant Collar Poster that NCSU students created as an example of One Health, Sensors and Engineering. <http://www.tx.ncsu.edu/tecs/academics/senior-design/13-14-projects/posters/elephant-collar.pdf>
* Video on engineers by NASA; <https://www.youtube.com/watch?v=wE-z_TJyziI>

**Explore****Types of Engineers Research** Students will be placed into cooperative groups and will divide and conquer research on various types of engineers using the given websites. While researching, they will organize their information on a collaborative site, [www.mindmup.com](http://www.mindmup.com). One student needs to create the initial mind map, invite other students by email and then they all can access it. To make sure it’s working in real time, all students need to go to “extension” and turn on real-time collaboration. <http://www.sciencekids.co.nz/sciencefacts/engineering/typesofengineeringjobs.html><http://www.futuresinengineering.com/what.php?id=2><http://www.engg-kids.com/WhatdoesanEngdo.html>**Health Benefits of Exercise Research** Students will be placed into same cooperative groups and will now research health benefits of exercise using the links below. While researching, they will organize their information on another mindmup.<http://kidshealth.org/parent/nutrition_center/staying_fit/exercise.html><http://fit.webmd.com/kids/move/article/exercise-helps-body><http://www.heart.org/HEARTORG/GettingHealthy/HealthierKids/ActivitiesforKids/The-AHAs-Recommendations-for-Physical-Activity-in-Children_UCM_304053_Article.jsp><http://www.nlm.nih.gov/medlineplus/exerciseforchildren.html>**Elaborate/Explain**1. Watch [One Health](https://www.youtube.com/watch?v=gJ9ybOumITg) video clip as an introduction of what One Health is.
2. View the [Elephant Collar](http://www.tx.ncsu.edu/tecs/academics/senior-design/13-14-projects/posters/elephant-collar.pdf) poster as a real-life application of One Health and one that is occurring at North Carolina State University in Raleigh.
3. To help the students realize that it takes different types of engineers for a project like this to come together, watch this clip on [engineers by NASA](https://www.youtube.com/watch?v=wE-z_TJyziI).
4. Students should now be placed in groups of 3. Smaller groups are preferred so that it’s easier to hold each person accountable. From the engineering sites provided, each student should take one type of engineer that they may be interested in and research to find 5 interesting facts to be added to the group MindMup.
5. Remaining in the same groups, students will now research health benefits of exercise using the links provided. While researching, each student should add their 5 facts to their facts to another mindmup to organize and share their information.

*\*\*For students that have a hard time accessing/working with mindmup, a paper mind-map can be used to organize information.* *\*\*For students that may have lost computer privileges, one or two articles from each section can be printed on paper for the student to conduct their research. Their research can be organized on a paper mind-map.***Day 2****Engage**Students will watch a video on sensors. <https://www.youtube.com/watch?v=AggUlRheoxs> and/or <https://www.youtube.com/watch?v=qy2f55fAkqo>**Explore**LO 3: Students will use the Engineering Design Process and work in cooperative groups to design a study to test intensity levels of exercise.Teacher will share the problem statement: “Human health care is extremely costly. Obesity levels are on the rise. 49% of adults incorrectly think that they are participating in adequate intensities of exercise. How can you, acting as an engineer, tackle this problem using sensors?”Working in cooperative teams that were set yesterday, students will begin the Engineering Design Process to create a project. Constraints: students must use at least one sensor and data has to be able to be graphed. * Ask: How can we, acting as an engineer, tackle this problem using sensors?
* Imagine: Brainstorm how can we set-up a study to test this? What data will be collected? What types of engineers will be needed?
* Plan: Gather materials, draw diagrams, set up data collection tables
* Create: Follow the plan (organize data, collect data, display data, analyze data)
* Improve: How can study be improved? What could work better? Repeat steps.

**Elaborate/Explain**1. Review the types of engineers and benefits of exercise from yesterday.
2. Start today with a video clip on [sensors](https://www.youtube.com/watch?v=AggUlRheoxs) (here’s another [choice](https://www.youtube.com/watch?v=qy2f55fAkqo)).
3. Read the problem statement: “Human health care is extremely costly. Obesity levels are on the rise. 49% of adults incorrectly think that they are participating in adequate intensities of exercise. How can you, acting as an engineer, tackle this problem using sensors?”
4. Students will remain in the same groups from yesterday. Using the Engineering Design Process, students need to design a project that will test the problem you just stated, keeping in mind that at least one sensor must be used and data has to be able to be graphed. Sensors can also be found in iPhone 6 or 6+ or fitness tracking devices like Fitbit, Nike Fuel, Jawbone Up, etc. Students will have one class period outside to run their experiment.
5. Provide this info:
* **Ask**: How can we, acting as an engineer, tackle this problem using sensors?
* **Imagine**: Brainstorm how can we set-up a study to test this? What data will be collected?
* **Plan**: Gather materials, draw diagrams, set up data collection tables
* **Create**: Follow the plan (organize data, collect data, display data, analyze data)
* **Improve**: How can study be improved? What could work better? Repeat steps.
1. Students should record their brainstorming on paper
2. Teacher should be monitoring progress of groups to ensure the planning is completed by the end of day 3 and fits the criteria. Teacher needs to ensure that data is able to be tracked and graphed.

Example:* **Ask**: Do students get enough activity during the day, including free-time, recess, or after-school activities? Students could wear a fitness tracking device that has an accelerometer sensor, to track the how many steps the student takes and the frequency of the activity.
* **Imagine**: Set**-**Up: Students will wear the fitness tracking device at recess and will complete 3 tests. The tracking device timer will need to be started and stopped for each test. For the first test, students will play soccer with the class for ten minutes. For the second test, students will play a tag game with the class for 10 minutes. For the final test, students will walk around the playground, talking with their friends for 10 minutes.

Data to Collect: After each test, students need to record steps taken. * **Plan**: Gather materials (fitbits, data tables, soccer ball), draw diagrams of students on field, set up data collection tables
* **Create**: Follow the plan (organize data, collect data, display data, analyze data)
* **Improve**: How can study be improved? What could work better? Repeat steps.

**Day 3**LO 3: Students will use the Engineering Design Process and work in cooperative groups to design a study to test intensity levels of exercise.Students will go outside to an open space to conduct their experiment. Remind students to collect data on their data tables. Make sure to provide boundaries if necessary to your setting. **Day 4**LO 4: Students will create a graphical representation of data from their study. LO 5: Students will analyze data from the graphical representation.Students will graph their data. Depending on each groups experiment, most students will probably create a bar graph. Encourage students to include the data of their group members into their graph so that more data can be analyzed and so that trends can show up.What trends do students notice on their graph? Students should compare their graph to their group. Students should record their analysis on paper. Students should take this data and think about the statistics teacher presented on the increase in obesity to realize whether they are making good decisions at recess or after school, in regards to their health. **Day 5 and Day 6**Day 5 Groups will create a presentation using whatever mode/media they prefer (powerpoint, prezi, trifold, etc.). Things that need to be included in presentation are Mindmup, Engineering Design Process plan (including what improvements they’d like to make to their plan), the graphs they created, and data analysis. Presentations should be 3-5 minutes each, depending on the number of groups you have and the number of minutes the period is. Take the number of minutes in period and divide by the number of groups, and the answer will yield how many maximum minutes each presentation should be.Day 6 Groups will present.If time is an issue, students may present informally using their Mindmup, Engineering Design Process plan (including what improvements they’d like to make to their plan), the graphs they created, and data analysis. Presentations should be 3-5 minutes each, depending on the number of groups you have and the number of minutes the period is. Take the number of minutes in period and divide by the number of groups, and the answer will yield how many maximum minutes each presentation should be.  |
| **Assessment** | Rubric for student research, created project and presentation are available at the end of the lesson. |
| **Extension Activities**  | Students could opt to track data longer than one period. Students could wear the device for a few weeks and try to increase their activity levels. Each day, students could graph their data using a line graph, since line graphs show change in data over time. |
| **Modifications** | * Students will still be placed in cooperative groups, but the class could do a majority of the planning of the project together. For each stage of the Engineering Design Process, students will table talk ideas, share out as a class, and then the class will come up with a consensus.
* As they enter the Create phase, each group will carry out their test.
* If possible, the Special Ed teacher will collaborate with teacher to add additional modifications.
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| **Alternative Assessments** | The use of the rubric for assessment will serve as the alternative assessment, in lieu of a written test. |
| **References** | Adolescent Obesity Trends: <http://www.ncsl.org/research/health/childhood-obesity-trends-state-rates.aspx> **Source:** National Survey of Children's Health. NCSH 2003. Data query from the Child and Adolescent Health Measurement Initiative. Data Resource Center for Child and Adolescent Health website.Retrieved 02/21/2014 from [www.childhealthdata.org](http://www.childhealthdata.org).  Adolescent Exercise: <http://www.eatsmartmovemorenc.com/Data/Texts/Quick%20Facts.pdf> Youth Risk Behavioral Survey. North Carolina Healthy Schools. Department of Public Instruction and Department of Health and Human Resources. 2011. Available at: http://www.nchealthyschools.org/data/yrbs/ |
| **Comments** | Ms. Bass partnered with [**Dr. Jesse Jur**](http://ncsu.edu/nano/faculty/profiles/details.php/69) and [**Dr. Gail Jones**](http://ced.ncsu.edu/user/gail_jones) of [NC State University](http://www.ncsu.edu/) to explore the work of the [NC State Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)](http://assist.ncsu.edu/) research team. During the Kenan experience, Ms. Bass learned about One Health, nanotechnology and sensors. One Health is an initiative developed to connect research between humans, animals and the environment across the globe to improve the life of all, using nanotechnology and sensors. “Elephants for Africa Forever” was a One Health project in which NCSU students created a prototype for an elephant collar that monitored the elephant, created safe boundaries and was self-powered using solar panels. To simulate the Engineering Design Process, combined with values of the One Health initiative, Ms. Bass’ research team of teachers created an ideation prototype to test stress levels in dogs to allow for enhanced preventive care using cortisol, temperature, GPS, and accelerometer sensors combined within a self-powered, implantable device. Also during this summer experience, the Kenan Fellows toured research labs, explored 3D printing, participated in a Nike Fuelband teardown, and learned more about various types of engineering. Ms. Bass has been teaching for 13 years in Wake County and is currently teaching 6th grade math at Hilburn Academy, a K-8 STEM school in Raleigh. Ms. Bass graduated from the University of North Carolina at Chapel Hill as a North Carolina Teaching Fellow.  |

**Rubric: “Activate Now: Your Active Minutes Explored”**

**Group:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period:\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_**

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| **Criteria** | **5** | **3** | **1** |
| MindMup Research | Mindmup Concept Map has 5 facts about engineers and 5 facts about health benefits of exercise, taken from the websites provided.  | Mindmup Concept Map has 3-4 facts about engineers and 3-4 facts about health benefits of exercise, taken from the websites provided. | Mindmup Concept Map has 1-2 facts about engineers and 1-2 facts about health benefits of exercise, taken from the websites provided. |
| Engineering Design Process | Student created project addresses the health question, collects data in an organized way, and considers improvements to be made in project. | Student created project addresses the health question, collects data in a somewhat organized way, and may or may not consider improvements to be made in project. | Student created project does not address the health question, data collection is not organized, and improvements are not considered. |
| Graph | Graph accurately displays data and both axis are labeled and scaled accurately. Care has been taken to be neat.  | Graph somewhat accurately displays data. Both axis may or may not be labeled and scaled accurately. Some care has been taken to be neat.  | Graph does not display data accurately. Axis are not labeled and scaled accurately. Some care has been taken to be neat.  |
| Presentation | The presentation reflects the group’s knowledge and implementation of all steps of the Engineering Design Process. All five steps have been represented and accounted for with examples.  | The presentation reflects the group’s knowledge of some of the steps of the Engineering Design Process. At least three to four steps have been represented.  | The presentation does not reflect the use of the Engineering Design Process effectively. Students are unable to explain how they used 1 or 0 steps of the process. |

**Total Points \_\_\_\_\_\_\_ / 20 = \_\_\_\_\_\_%**

**Comments:**