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| **Section of Lesson** | This lesson focuses the ideation process by giving students a real world problem and having the students conceptualize and design a prototype of a solution. Students must use the engineering design process to develop their product and will present their solution to a rescue dog handler. |
| **Title** | **Dog on a Mission** |
| **Introduction** | One of the best tools in rescue missions in the wake of natural disasters is not a technological gadget, but a dog. Rescue dogs are trained to find people in the midst of rubble where humans and technology might otherwise fail. While rescue dogs do an excellent job, they often are at risk themselves, through dehydration, heat exhaustion, or even anxiety. Time is also often lost when a dog must return to the handler to inform the handler that they have found a person and/or body.  Students will be given the challenge of designing a wearable sensor system to help rescue dogs remain safe, while enabling the dogs to find the victims faster during the mission. Students must consider the physical challenges that the dogs face during their mission and what technologies would help the dog stay safe, as well as what technologies would enable the dog to find survivors faster. Using the design process will be fundamental for the students to solve these design challenges. Students will conceptualize the design and then design a prototype of the design or a rendering of the product using a 3D modeling software. To make the lesson more realistic, you can invite a volunteer from a search and rescue dog organization to work with the students. Most states have search and rescue dog organizations and before you begin the lesson contact the organization to see if you can have a volunteer come in throughout the project to work with students. Ideally, at the end of the lesson, a rescue dog and its handler can come to the class so that the students can meet the dog, hear from the handler, and present their designs to the handler to see if their design would be beneficial for rescue dogs. |
| **Real Science Application** | Search and rescue dogs are a vital part most rescue procedures, but the rescue missions can be physically grueling and dangerous for the dogs. Wearable devices and sensor system technology is advancing at a rapid pace and a few universities around the country (North Carolina State University & Georgia Tech) are finding ways to incorporate these technologies into prototypes of packs for search and rescue dogs. During their missions, rescue dogs can face dehydration, overheating, rapid heart rate, or hypothermia, not to mention potential cuts and abrasions from traversing ruble. Off lead dogs (some rescue dogs are off lead and some are required to be on an extended lead) also have difficulty letting their handler know that they have found a victim. Developing sensors systems that the dogs can use to inform the handler that they have found a person can save critical time during the rescue. Sensor systems can include sensors that monitor the dog’s body temperature, the hydration level of the dog, or a GPS tracker to help monitor the dog’s location. Sensors can also be used to detect danger in the environment the dog is working in, such as gas sensors or vibration sensors. |
| **Curriculum Alignment** | This section contains the curriculum alignment of the lesson to the North Carolina [NC Essential Standards](http://www.ncpublicschools.org/acre/standards/new-standards/).   |  |  |  | | --- | --- | --- | | Content Area | Grade Level | NC Essential Standards | | Tech Ed | 6-8 | 6.TT.1- Use technology and other resources for the purpose of accessing, organizing, and sharing information | | Tech Ed | 6-8 | 6.RP1- Apply a research process for collaborative or individual research | | Tech Ed | 6-8 | 7.TT.1.2- Use appropriate technology tools and other resources to organize information | | Tech Ed | 6-8 | 8.RP.1-Apply a research process to complete project-based activities | |
| **Learning Outcomes** | * Students will research the jobs of rescue dogs and determine problems that rescue dogs could potentially encounter on their mission. * Students will analyze how these problems might affect the outcome of the mission and determine what technological sensors could be used to both monitor the dog’s health and the environmental surroundings (examples: temperature, humidity, vibration, gas, etc.). * Students will utilize the engineering design process to design and prototype a product that help a rescue dog more successfully accomplish the mission. * Students will research a multitude of sensor systems and determine how to design a housing unit for these sensors to help the rescue dog. * Students will articulate and defend their design and the design process they used by presenting their design concepts to a rescue dog handler. |
| **Time Required and Location** | This lesson will take anywhere from 7-10 45 minute class periods, depending on the depth of the student’s research and their product design. |
| **Materials Needed** | Teacher Materials   * Computer for every three students for research (with SketchUp or another CAD program already downloaded if students are creating 3D renderings) * Projector with sound to watch dog rescue clips. <http://www.youtube.com/watch?v=RlYj54GKsQE> <http://www.youtube.com/watch?v=Pin_AM9z-cM> * 5 sheets of large presentation paper, each paper labeled as the following: Design, Sensors, Urban, Rural, Avalanche * Dog cards (attached to the lesson), laminated if possible * Printer (to print pictures of the sensors students select)   Student Materials   * Large sheets of paper for templates (at least one per group, poster sized paper works well) * Markers * Copies of the dog coloring pages * Scissors * Needles for sewing * Thread * Stapler & staples * Fabric (Call around to local fabric and sewing stores to see if they will donate fabric for your project, many will. Also, if there is a university or community college nearby with a textiles program they will often donate fabric.) * Glue * Recycled materials used to represent the sensors (bottle caps, corks, Christmas lights, fabric scraps, plastic bottles cut into pieces, etc) * Poster board * Duct tape |
| **Safety** | If you have students choose to design a prototype using materials vs. a CAD software, supervision and instructions will be required for using things like needle and thread or the hot glue gun. |
| **Student Prior Knowledge** | Students need to have prior knowledge of the engineering design process and the ideation process. Students need to know how to design on a CAD software otherwise they can design the product by hand. |
| **Teacher Preparations** | Teacher needs to have contacted a local agency that would be willing to bring in a rescue dog and handler to talk to the students and evaluate their design. |
| **Activities** | **Day 1**  Before class starts, place one large brainstorming paper on each table with markers.  Warm- up: Write one paragraph answering the following questions. *What is a rescue dog? What does the dog do? Where is the dog sent on rescue missions? \*Remember if you do not know the answer to this take an educated guess.* (Some students will not know the answer to this warm-up, but it is helpful to have students explore these concepts even before discussing the answers. Plus this will help the teacher understand where students stand with this subject.  *Discuss the jobs of rescue dogs. What obstacles do the dogs face? What could hinder the health of the dog?*  After the discussion watch the rescue dog clips “The New Zealand Search and Rescue Dogs Part 1 & 2”. (See YouTube Links in Materials Section)  Say:*Today we are going to be starting a product design project. Can someone tell me what they think we will be designing?* Discuss. *We will be designing a system to help rescue dogs both stay safe and reach the survivors faster. Someone tell me the three different rescue locations that the dogs are trained for that were mentioned in the video.* Discuss (urban, rural, avalanche). *What is a sensor? Give me some examples of different types of sensors and how we can use these sensors.* Discuss (Depending on the class, this subject might need some context clues; some students will have ideas of what sensors are, but the teacher will probably have to go over many. If students seem lost start listing sensors such as hydration, GPS, heart rate, vibration, temperature, etc. and have the students discuss what these sensors would detect*). I have placed large brainstorm papers on each table with markers. You will have 3 minutes per station to brainstorm as many ideas as you can think of that we need to consider in designing in these products (the timer will be on the board). If someone has already written something you think should be included you can put a check mark next to it.* Discuss unit vocabulary and give a few examples for each station, such as ‘what would be a concern for dogs working an avalanche that dogs working a urban or rural disaster might not face?’ or for a sensor ‘why would a camera be helpful for the dog and handler?’ In general, students will come up with a wide range of sensors that can be used in each category, but if any group is struggling the teacher can help prompt more ideas.  Activity: Students will rotate every three minutes per station and write down all of their ideas about each category. After the last rotation, bring the class back to their seats and discuss the responses as a class. For the sensor section, emphasize which sensors might work better for which location and why.  **Day 2**  Warm-up: *Write 2-3 sentences about what characteristics a dog must have to become a search and rescue dog (most were talked about on the video we watched yesterday).* Discuss the students’ answers as class.  Say: *I am going to pass out your dog cards. Each group will have a different search and rescue dog.* The groups need to consist of 2-3 students, more than that and it will be too easy for one person not to partake in the project. *Read over your dog card and as a group discuss what types of things you need to research. When researching, you need to find out if your dog is a dog that would wear a pack or does not like wearing packs, does your dog have thick fur, what size is your dog, what is the temperature at the disaster location, is your dog a dog that needs to stay on a leash during the mission, etc* (emphasize that students need to find out if the their breed of dog is typically on or off leash during a rescue mission, for example most hounds are dogs that have to be on lead). *You need to consider the scenario your dog is working in to determine what sensors we need. Yesterday we discussed some sensors. Someone raise their hand and tell me a sensor and what it helps to measure.* Discuss. After the discussion hand out the rubrics for the project and explain the rubrics, this way students will know the required number of sensors*. As you research write down the sensors in your journal. Will your dog be wearing something more like a backpack or a device on a collar? Think about the size of the dog, the location, and your rescue scenario.* Have students discuss and brainstorm ideas for the next 10-15 minutes depending on their level of discussion.  Say:*As a group, go to the computers and research different types of sensors. If you want a camera or a microphone, what type? Do you have a GPS sensor? An accelerometer? A hydration sensor? As a group create a Word document with a picture of each sensor, the name of the sensor (next to its picture), and what the sensor is sensing* (have a way for the students to turn this in so that the teacher can print the pictures for each group out, possibly the school shared drive or Edmodo). *Also include pictures of how you are going to house these sensors; will your sensors be part of a dog collar, a harness or a backpack? Remember you need to consider the environment that the dog will be in and choose a system that will meet the dog’s needs.* Have this information posted on the board and Edmodo (if using) so that students can easily refer to it. Students will work in groups for the remainder of class. Some groups may have trouble with researching, help students refer back to their dog card to make sure the sensors they are selecting will work in the location of the disaster and the specific dog breed.  **Day 3**  Warm-up: *Write down three things that you need to consider in the design of your product. How can these things affect the dog’s rescue mission?*  Say: *Today you need to finish the Word document with the sensors you have decided to use. Once you finish that, I have printed out dogs that are similar to your S&R dog.* Show the students the different dog coloring pages. *On these pages you are going to have to draw the sensor system that you are designing, so if you are designing a coat for your dog with sensors attached to the coat, draw the coat, draw the sensors and label each sensor on the dog, this will help when drawing your template tomorrow.* Students can move to the computers and complete their research. Once they have finished their research they can start their dog drawing. Walk about the room and help the groups conceptualize and sketch their designs.  **Day 4**  If possible for day 4, have a S&R dog and the handler come in and talk to the students about the job of S&R dogs. Set this up in advance and let the handler know exactly what to expect with the class and what you will be doing for this specific day. Let the students ask questions about their specific designs and ask about what the S&R dog wears on his/her mission. The handler can help during the design critique.  Warm-up: *Write down if your group has decided to design your product using SketchUp or design a mockup and why.*  Say: *Today we will start our design critique and then you can finalize your design and start creating your product. Remember that during a design critique we are not negative, but constructive. The purpose is to help the designer consider aspects of their design that they might not have considered.*  Have groups come up and present their design concepts to the class. As a class discuss the positive aspects of the design and what could be altered to improve the design.  After each group has completed the design critique, students will go back to their groups and begin finalizing their sketches. Once the sketches are finalized and approved by the teacher, the groups can begin working on their product. Students will continue working on this until the end of class.  \*If a dog handler can come in during this time the dog handler will critique the designs instead of the students.  **Day 5**  Warm-up: *Why is important to consider the materials you use for your design? What types of materials do you think would be best for the sensor system?*  Say: *Today, your groups are going to start on your designs. If you are building the prototype you will need to create a template. What is a template? Discuss. Students who are designing their product on SketchUp please go ahead and head to the computer, everyone else move towards me* (students must already be familiar with SketchUp or another 3D modeling software, this project would be a difficult introduction project for SketchUp; the majority of student will probably design a prototype). Show a demonstration of how to thread a needle and how to sew a few simple stitches and tie off the thread. Discuss needle safety. Discuss how to draw a template. Discuss how you will first draw your template on the large paper, then cut out the template and then trace it on the fabric. The students who are creating packs or jackets need to trace their template and the flip it over and trace again for that have one complete piece instead of having to sew them together (so that they are forming a pack that will drape over the dog instead of having to sew the middle seam). Once students have finished this they can begin picking out their fabric and sewing their prototype.  **Day 6**  Warm-up: *Write down what else your group needs to accomplish to finish your product.*Have students discuss their answers in their group and come up with a plan for the day.  Students will spend the entire class finishing their product. Take pictures of the students as they are working.  \*Students might need an extra day or two to finish their prototypes depending on the productivity during the previous classes.  **Day 7**  Warm-up: *Partner with someone from another group and explain your dog and your design in 3 minutes.*  Say: *Today you are going to finish any last minute touch-ups you need to complete your product. Once you are finished with your products, as a group you need to create a poster about showcasing your design. The rubric is on Edmodo, but you need to include pictures of your design* (the teacher needs to print these out from what the pictures he/she was taking while the students were working, or have students turn in a JPEG of their design from SketchUp on Edmodo), *information and pictures about your dog and disaster location, information about your sensors and descriptions of your design process.* Print the pictures for the kids and have them make a poster gluing their pictures and information on the poster.) Students will work on this for the remainder of class.  **Day 8**  Warm-up: *Collect your poster and if you have a physical product collect that as well and stand by your table.*  Introduce the dog handler again and restate the project. Then have each group present their design concepts to the dog handler and the class. The dog handler can critique the design and offer suggestions. At the end of class have students complete a group grading assessment. |
| **Assessment** | Students will be assessed on their group’s actual design, the poster, as well as a group/individual assessment. The rubrics for the poster, the product design, and the presentation are attached. |
| **Critical Vocabulary** | * Wearable device: technology that can be worn to track information and send information back to the user (in this case the handler) * Hydration sensor: detects the level of hydration through skin contact * Rescue dog: a dog whose job it is to track missing people, finding people after natural disasters and wilderness tracking * Avalanche: when massive amounts of snow and ice fall down a mountain (*some students will not know this word, many will though)* * GPS: (Global positioning system) provides locations using satellites in space * Sensor: reacts to an input from the surrounding environment (examples include hydration sensor, heat sensor, light sensor, sound sensor, motion sensor, vibration sensor \**all of which can be used as examples that students might want to research for their design* * Accelerometer: a device used to measure acceleration (*could be helpful in monitoring a dog’s movements)* |
| **Community Engagement** | This lesson provides multiple opportunities for community engagement. The first opportunity is simply have search and rescue dog handlers come in and work with your students. You can also open the classroom to parents that day as well. Another great opportunity could involve taking students to a police or fire station that has rescue dogs to help students experience this lesson outside of the school. Finally, hosting a portfolio night for parents and community members to come in and see the students’ designs is an excellent way to involve the community. Students can also try corresponding with graduate students from universities that are currently working on wearable devices for search and rescue dogs. If there is a university nearby that is working on these projects, a field trip to the lab would be an excellent opportunity for the students. If you call and request materials from any local business, invite them to your portfolio night to see all of the work the students have completed with the supplies that were donated. |
| **Modifications** | As this is a group project with various job opportunities, modifications should not be required. The teacher might have to strategically assign jobs to meet the learning needs of the students, but the rubric and project does not need to be modified for different students, just the job assignment. |
| **Alternative Assessments** | Alternative assessments are not required, but the group assessment may factor differently for different students. For example, a self-contained student who cannot read might be given a very specific job from the teacher, and would then be assessed on if he can explain the project and accomplished the job, but this is an extreme circumstance. Part of this project is the ability for the students to be able to work as a design team, so not working in a group is not an option. |
| **References** | American Rescue Dog Association. (1996). *ARDA Search Dogs*. Retrieved from www.ardainc.org/about\_dog.html  Animal Den. (2014). *What dog breeds make the best search and rescue dogs*. Retrieved from www.animalden.com/seandredo.html  Canadian Search Dog Association. *What breed should you choose?* Retrieved from canadiansearchdog.com/training-info-2/what-breed-should-you-choose/ Lewis, T. (2014). Canine 2.0: Dogs in High-Tech Gear Could Aid Search-and Rescue Efforts. *Livescience*. Retrieved from http://www.livescience.com/45324-high-tech-search-and-rescue-dogs.html[Thibodeau](http://www.computerworld.com/s/author/265/Patrick+Thibodeau), P. (2014). Meet Diesel, a cute dog and organic robot. *Computerworld.* Retrieved from <http://www.computerworld.com/s/article/9249066/Meet_Diesel_a_cute_dog_and_organic_robot>Zanolli, L. (2014). Ctrl + Sit. Ctrl + Stay: Going High-Tech to Train Dogs. *Healthy Paws Pet Insurance and Foundation.* Retrieved from http://www.healthypawspetinsurance.com/blog/2014/07/01/ctrl-sit-ctrl-stay-going-high-tech-to-train-dogs/ |
| **Comments** | Many of the materials students can use can be found at a thrift shop or scrap exchange. If students do not have experience designing in 3D software platforms, then the teacher can alter the assignment so that all students are design a prototype instead of a virtual model. If the models do not look incredible, that is ok, the main point of this project is experiencing the design process and getting the students to articulate their design concept to a field expert (the dog handler). If you cannot get a dog handler to your classroom, try to find someone from an animal shelter or veterinarian’s office. The project becomes much more real to the students once they have an actual dog in the classroom. |
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