

Lesson Plan Title: Robotic Hand vs. Sled Dog Paw

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Adapted from post by Kto6Science.blogspot.com

**Discipline / Subject:** STEM, writing, research

**Topic:** Create a robotic hand with direction and then design the robotic paw of a dog

**Grade Level:** 3rd – 8<sup>th</sup>; life science, biology

**Resources / References / Materials Teacher Needs:**

Drinking straws, larger diameter straws, five colors of yarn, card stock, tape, visuals of dog paws and anatomy, article on sled dog paw circulation

[https://upload.wikimedia.org/wikipedia/commons/6/6d/PSM\\_V68\\_D343\\_Images\\_of\\_normal\\_and\\_polydactyl\\_structure\\_of\\_skeletal\\_elements\\_of\\_dogs.png](https://upload.wikimedia.org/wikipedia/commons/6/6d/PSM_V68_D343_Images_of_normal_and_polydactyl_structure_of_skeletal_elements_of_dogs.png)

<https://infovisual.info/en/biology-animal/skeleton-of-a-dog>

[https://upload.wikimedia.org/wikipedia/commons/a/a6/Hind\\_limb\\_dog\\_corrected.JPG](https://upload.wikimedia.org/wikipedia/commons/a/a6/Hind_limb_dog_corrected.JPG)

<https://www.nps.gov/dena/learn/education/upload/Science-of-Sled-Dogs-EFT-2011.pdf>  
pages 11, 16

**Lesson Summary:** Students will create a robotic hand under direction of teacher. Following that activity, they will create a STEM robotic sled dog paw based on research of dogs' anatomy

**Standards Addressed: (Local, State, or National)**

**CCSS.ELA.Literacy.W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**3.8** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

**4.2, 4.8, 4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic.

**CCSS.ELA.Literacy.W.5.2, 5.7, 5.8, 6.2, 6.7, 6.8, 7.2, 7.7, 7.8, 8.2, 8.7, 8.8**

**Virginia:**

**BIO.4** The student will investigate and understand life functions of Archaea, Bacteria

and Eukarya. Key concepts include: how the structures and functions vary among and within the Eukarya kingdoms of protists, fungi, plants, and animals, including humans

BIO.6 The student will investigate and understand bases for modern classification systems. Key concepts include structural similarities among organisms

21<sup>st</sup> Century Skills – cooperation and creativity

**Learning objectives:**

1. The student will research the anatomy of a dog paw
2. The student will use science and engineering thinking to create a robotic dog paw, working cooperatively in a group
3. The student will clearly write about his/her thinking during the engineering process

**Assessment:**

Student writing about the engineering and thinking process creating the robotic dog paw

**Procedural Activities**

**DAY 1:**

1. Discuss robotics and how that field is helping people who have lost limbs. Read an article together and discuss.  
Create a robotic hand with students using the following guidelines.
2. Trace hands on cardstock. Cut out a little larger than the tracing line if fingers are narrow.
3. Draw lines for finger joints. Fold on joint lines as though hand is closing.
4. Cut straws for each section of each finger. Leave space between the end of one straw and the next to allow the fingers to be more flexible. Tape to fingers.
5. Thread different colored yarn through each finger's straw sections. Tape one end of yarn to back of each finger. [Note: wrapping a narrow band of tape around one end of yarn helps the students better thread it through the straws. It compares to a shoelace.]
6. Have five longer straws to represent bones on the palm of the hand. Tape to the palm. Thread yarns through the longer straws from each finger.
7. Have one wider straw that all five yarn pieces go through, taped at the wrist. Thread all five yarns through the wrist straw.
8. Students can now control the fingers by pulling on one, or multiple yarn pieces!

**DAY 2:**

1. Create a web quest or images into Google Classroom of dog paw anatomy
2. Instruct students to research the differences between a human hand and a dog's paw with articles linked to an assignment. Include information from Denali National Park on paw adaptations.  
<https://www.nps.gov/dena/learn/education/upload/Science-of-Sled-Dogs-EFT-2011.pdf>
3. Students, with the background knowledge from creating the robotic human hand, work in partners or small groups to create a design brief for engineering a robotic sled dog paw.
4. Students must submit their design ideas and a strong explanation of their engineering thinking written into correct paragraph form. This will be the assessment of their STEM knowledge as well as their research and written composition skills.

**Materials Students Need:** cardstock, straws, yarn, web articles on dog paw anatomy, scissors, tape, wooden shish-ka-bob skewers for helping push yarn through straws

**Technology Utilized to Enhance Learning:**

- Google Classroom linked articles and images or other web links available for students to use in research
- Older students can have more freedom to research online

**Other Information**

These activities take a lot of time. If time is short, perhaps have students create one finger on the hand that will move. They may complete the rest at home. Younger students may have difficulty with the fine motor skills needed for taping on the smaller straws. Perhaps a larger- than-life hand could be made so that straw pieces are larger and thus, easier to manipulate.

**Modifications for special learners/ Enrichment Opportunities:**

Straws and hands can be pre-cut for easier creation. Knuckle lines can be drawn onto fingers ahead of time.

Enrichment: students could create another Alaskan animal's foot such as a moose or bison, an animal that a dog team might meet along the Iditarod Trail.