Design a Prosthetic Leg STEM Activity...for Animals!

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Looking for an engaging STEM activity that builds empathy? Read below for a Stage 2 STEM engineering activity that challenges students to learn about and design an interchangeable prosthetic leg. Students then apply concepts for a prosthetic for their favorite animals!

Waddle, clunk, waddle, clunk, waddle, clunk. What on earth is making this sound? Waddles the duck has a new fangled body part. Check out this cutest little duck in the world in the video below.

History of Prosthetics

The world of prosthetics is making many technological advances to support those in need of prosthetic limbs. In the early days of prosthetics they were seen as just a replacement for the body part and usually made of wood or metal. Envision the Tin Man and you wouldn’t be too far off!

After merely being a replacement, unfunctional body part, early surgeons in the 1500’s began experimenting with springs and catches to allow movement in hands and bending in joints like ankles. This allowed the amputee to have movement and grasp things like a horse’s reins.

Fast forward to the 20th century where prosthetists now have their own career field which designs and engineers prosthetics. Prosthetics are now being custom fit to individuals which makes for ease of wear and comfort. This advance also allows for individuals to continue to conduct active lifestyles. The prosthetist assesses the patient's needs and lifestyle. Then they work to create the best prosthetic for their patients daily mobility. If the patient is really active, like a runner, the prosthetist will create more than one prosthetic for the amputee to change depending on the activity they are doing.

Today, the field of prosthetics is helping individuals in any activity that they would like to keep doing, and we now have the technology to create many different types of prosthetics. Check out this runner who lost her leg to cancer. Jacky Hunt-Broersma became a runner AFTER losing her leg. She is now an ultramarathon runner who has completed 102 marathons in 102 days! She is also focused on helping others afford running blade prosthetics (costing $10,000 - $20,000!) AND need to be replaced yearly with wear and tear. This is a woman on a great mission to help amputees live healthy, active lifestyles and she can speak first-hand to the challenges of wearing, maintaining and thriving in the prosthetic running world.

Or how about a man who couldn't find a prosthetic to suit his pro snowmobile racing lifestyle after losing his leg in an accident, so he BUILT HIS OWN! (see video below) With his knowledge of his sport and affordable parts, he built a fully functional snowmobile racing leg in his garage! The technology to make prosthetics is slowly becoming more affordable and computers are allowing us to create more advanced designs and builds, just like pro snowmobiler Mike Schultz did.

What is the future of prosthetics? Ummm…maybe a high schooler has an answer to that question. Benjamin Choi created a mind-controlled prosthetic arm. As if that feat isn't amazing enough, he did this for $300! Affordability is a huge aspect of prosthetics, as one individual needs different types of prosthetics for different activities and they need to be replaced often; just like we replace our clothes and shoes as they wear out or our body and feet grow. Controlling prosthetics with the mind is a growing field. Looks like Benjamin Choi has packaged both mind-controlling and affordability into one amazing prosthetic hand!

Which now leads us to a whole different area of prosthetics - animal prosthetics. Remember super cute Waddles and his 3-D printed prosthetic leg? Well, many other animals have received prosthetic body parts from dogs and cats to goats and birds, and even an elephant.

Prosthetic Leg STEM Challenge

Now that you have learned all about prosthetics, are you ready to jump into a fascinating STEM design challenge with your students? This challenge is not only for your students to create a prosthetic limb to help their classmate but in part 2, students design a prosthetic for an animal too. Using the engineering design process, teams of students design, create and test prosthetic legs. Your classroom will then become a prosthetist testing lab!

For this challenge you will need to gather some supplies that will encourage students to brainstorm up the necessary parts of a prosthetic leg of structural support, comfort to the wearer and secure attachment. The supplies could be:

Duct tape, masking tape & hot glue gun with glue sticks

- String, rope or twine (enough to attach the prosthetic)
- Thick wooden dowels, 1 x 2 wood pieces, broomstick handles, cardboard tubes, plastic pipes

- Strong cardboard & regular cardboard
- Sponges, pool noodles, bubble wrap & old cloth pieces
- Velcro and brass fasteners
- Screwdriver (to punch holes in cardboard)
- Scissors or a small handheld saw

The Build

For this activity, students will need to focus on structural support and weight bearing material designs. They will also need to securely attach the prosthetic to a shoe, make it interchangeable for other classmates to wear and walk 5 steps. Some examples would look like this:

Make an Animal Prosthetic

As an extension research activity, we tasked our students with choosing an animal to investigate. The mission is to understand how the limb of that animal works and to then design a prosthetic leg. This is a great connection to science standards focused on structure and function of animal body parts!

Real-World Connections

Since this career field is growing in leaps and bounds, literally, with computer advancements, students would benefit from the following links which share more great prosthetic STEM connections. Here are some great websites and videos to share with your students!

Real-world Prosthetics:

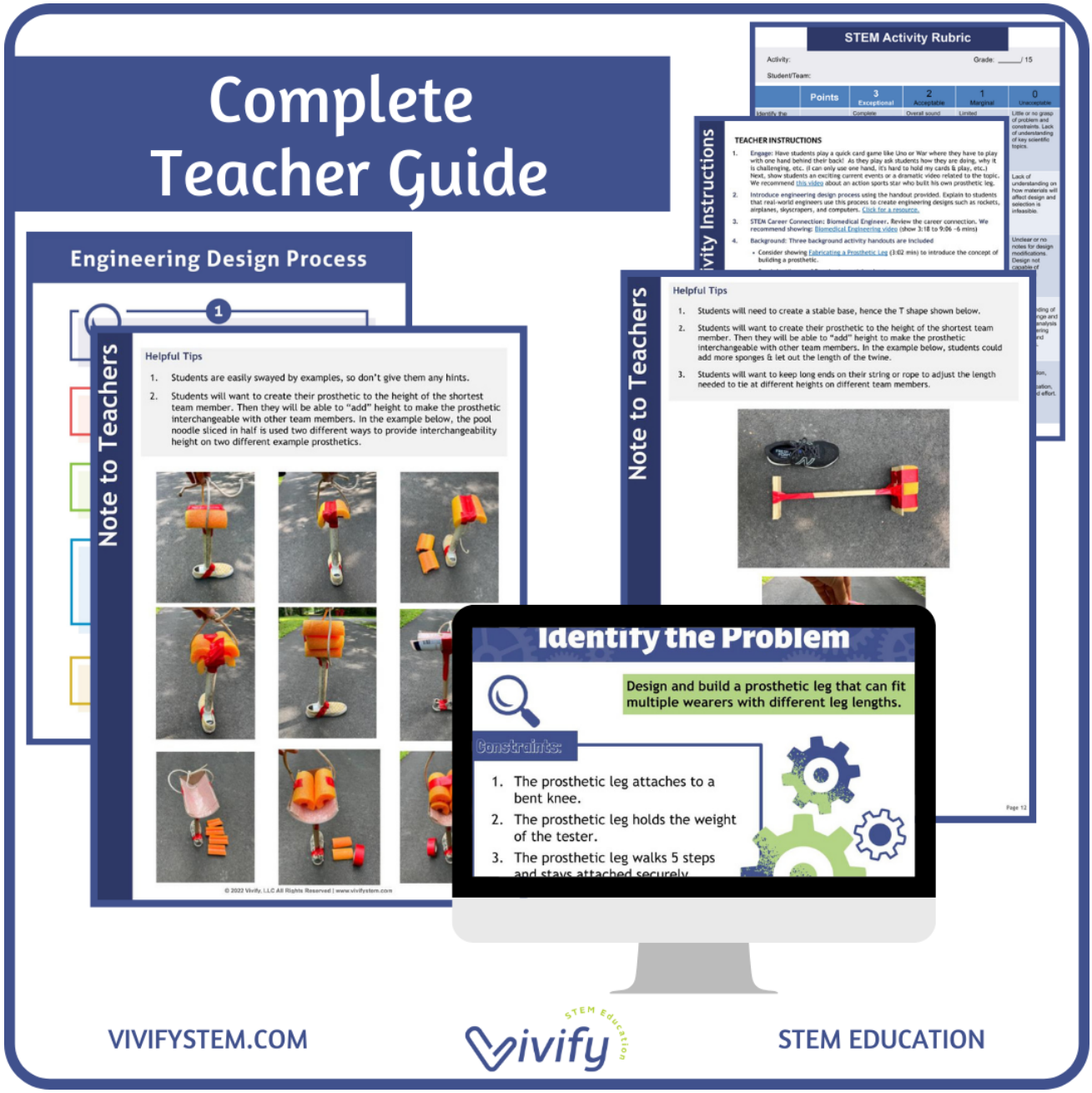
- Fabricating a Prosthetic Leg
- How An Action Star Made his own Prosthetic

STEM Career Connections:

- Biomedical Engineering video (show 3:18 to 9:06 ~6 mins)
- History of Prosthetics
- A Duck Gets A Prosthetic Leg (2:40 mins)

I hope you are inspired to share this social & emotional based STEM building challenge with your students. They will certainly leave this activity with a new sense of compassion for those who must utilize prosthetics on a daily basis. I know I sure did!

Want to implement this activity in your classroom or program? Check out our full teacher and student STEM guide here. This includes student handouts for each step of the engineering design process, tips on adapting the activity from kindergarten to middle school, and student STEM guides to civil engineering, psychology, and the science behind roller coasters.


Complete
Teacher Guide
STEM Activity Rubric
Activity:
Grade: _____/ 15
Student/Team:
Points
3
Exceptional
2
Acceptable
1
Marginal
0
Unacceptable
TEACHER INSTRUCTIONS
Engineering Design Process
Note to Teachers
Helpful Tips
1. Students are easily swayed by examples, so don't give them any hints.
2. Students will want to create their prosthetic to the height of the shortest team member. Then they will be able to "add" height to make the prosthetic interchangeable with other team members. In the example below, the pool noodle sliced in half is used two different ways to provide interchangeability height on two different example prosthetics.
Note to Teachers
Helpful Tips
1. Students will need to create a stable base, hence the T shape shown below.
2. Students will want to create their prosthetic to the height of the shortest team member. Then they will be able to "add" height to make the prosthetic interchangeable with other team members. In the example below, students could add more sponges & let out the length of the twine.
3. Students will want to keep long ends on their string or rope to adjust the length needed to tie at different heights on different team members.
Identify the Problem
Design and build a prosthetic leg that can fit multiple wearers with different leg lengths.
Constraints:
1. The prosthetic leg attaches to a bent knee.
2. The prosthetic leg holds the weight of the tester.
3. The prosthetic leg walks 5 steps
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