Veterinarian: Animal Prosthetics Using 3D Printers
VETERINARIAN: ANIMAL PROSTHETICS USING 3D PRINTERS

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GOAL
Your goal is to provide important information to pet owners and people working with animal shelters, zoos, and aquariums. Your team of veterinarians has decided to open a new clinic specifically designed to help animals that have lost limbs. Your team wants to do this through the use of a 3D printer that can create prosthetics for a wide-range of animals.

ROLE
You are a veterinarian who has passion for helping injured animals. You have met a number of animal doctors with similar beliefs. You have all decided to open a clinic that specializes in creating prosthetics for these animals. Part of your team will include a biomechanical engineer who will be important in the creation of the prosthetics through the use of a 3D Printer.

AUDIENCE
Your audience will be pet owners who care deeply about their pets. People working and managing zoos, aquariums, and animal shelters will also be included within your potential audience. Everyone will need to be educated regarding how the prosthetics work and how they can be created through 3D printing. Your team will need to persuade everyone that your clinic can help provide a better life for these animals. You must help them understand that a 3D printed prosthetics can work as well as any others while providing the animal with a functional prosthetic allowing them to perform important functions in their life.

SITUATION
Prosthetic limbs are objects that can be created using this process. Prosthetic limbs are important to people who have lost a limb as they allow the individual to regain capabilities they may have lost. These limbs can also be used by a variety of animals including cats, dogs, and even birds!

3D printing is a process of making three-dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the entire object is created.

Your team will want to identify one animal that you can create a technical drawing and a prototype prosthetic to help them lead a functional life. You may want to consider a dog, cat, bird, dolphin, or any other animal that interests your team.
**MAGAZINE ARTICLE**

Your team will need to create an article that can be published in local and national magazines. The article will need to inform and persuade the readers to consider your 3D printed prosthetics. The article will need to inform the readers about how these prosthetics function and can provide a good quality of life for the animals. It should also provide information about the 3D printing process and how different materials can be used to create the prosthetic based upon the needs of the animal. If valuable, your article may include a picture, diagram or other visual to help the reader learn about the process and begin to trust the veterinarians in your clinic.
VETERINARIAN: ANIMAL PROSTHETICS USING 3D Printers - Magazine Article (level 3/4)
Like humans, many animals have lost a limb and are struggling with mobility because of it. Prosthetic limbs have been available for humans for years. The cost of these limbs vary and for some people, high quality, prosthetic limbs may be too expensive. Thanks to technology and years of advances in human prosthetics, the ability to replace a lost limb is not just a dream, but a reality! This technology now makes it possible and economical to provide prosthetics for pets. This makes it possible to provide prosthetics for pets that are more affordable.

3D printing is making the creation of limbs for a variety of pets a reality. The number of prosthetics for animals is growing. More and more pets are using artificial limbs to live a more normal and active life. Owning a pet with a prosthetic device can be very challenging. It takes a dedicated person to take the prosthetic on and off, clean it, and teach the animal how to use it.

So what is 3D printing? To begin the process, a person must create a three-dimensional image of the item they want to create. This is created using software. The “printing” process involves using a material and spraying it repeatedly over the three-dimensional image. Any number of materials can be used based upon the properties wanted for the final product.
3D printers can use plastics, metals, resins and ceramics. Each of these materials have different properties that can make them valuable for certain products. Plastics are the most common materials used for making products. Metals can be beneficial when a great deal of support is needed. Resins are a type of plastic that can typically be heated and cooled many times. The type of printer and the purpose are important for the decision making process.

The material selected for the prosthetic must be able to support the pet. A horse is much heavier than a duck. A duck’s leg would need to be water resistant and also be able to paddle.

For a prosthetic leg on a horse, the material must be able to support the weight of the horse while also being flexible enough that the horse can walk and maybe run.

When creating the prosthetics the designer must be sure to use accurate measurements of the animal’s leg. The design must be precise so that it fits on the animal and also is measured in a way that is not uncomfortable for the animal. The prosthetic will not be helpful if it does not function appropriately. The length and width of the prosthetic must be tested and changed as needed to create a perfect match.

More and more veterinarians are using this process, as persistent pet owners want their pets to have as normal a life as possible. The prosthetics can cost as little as a couple hundred dollars in many instances. Nikko is an example of one pet that has been helped through this process. He lost his four paws do to frostbite. Over time Nikko received prosthetics for each of his legs. He can now run, jump, and play with other dogs and his human friends.
Today 3D printers are very affordable and the products they produce make them valuable for business. Veterinarians can now purchase their own 3D printers and with training have the ability to produce prosthetics for a number of pets. These prosthetics can be of high quality and be affordable for pet owners. If your pet is need of a prosthetic limb you may want to ask your veterinarian for help.
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## PRODUCT ANCHOR: MAGAZINE ARTICLE RUBRIC WITH TEACHER FEEDBACK

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<thead>
<tr>
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<th>Achievement Lvl 1</th>
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<tr>
<td>Materials and Properties</td>
<td>Product demonstrates some understanding of the properties of possible materials.</td>
<td>Product demonstrates some understanding of the properties of possible materials.</td>
<td>Product demonstrates adequate understanding of the properties of materials and the</td>
<td>Product demonstrates strong understanding of the properties of materials and the</td>
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<tr>
<td>(x1)</td>
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<td>selection of the appropriate material based upon the structure and function</td>
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<tr>
<td>Engineering Design</td>
<td>Product demonstrates minimal understanding of the criteria and constraints of the</td>
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<td>design problem with regard to size, materials, and function of the product.</td>
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<td>Problem Solving and</td>
<td>The product minimally solves the problem by considering needs of the target</td>
<td>The product somewhat solves the problem by considering attributes, aesthetics</td>
<td>The product sufficiently solves the problem by addressing the attributes,</td>
<td>The product thoroughly solves the problem by addressing the attributes,</td>
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<td>Design Process (x1)</td>
<td>audience.</td>
<td>and needs of the target audience.</td>
<td>aesthetics and needs of the target audience through the guidelines and</td>
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<tr>
<td>Mathematical Modeling</td>
<td>The mathematical criteria necessary for a successful design are minimally applied</td>
<td>The mathematical criteria necessary for a successful design are somewhat applied</td>
<td>The mathematical criteria necessary for a successful design are adequately</td>
<td>The mathematical criteria necessary for a successful design are fully applied</td>
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<tr>
<td>(x1)</td>
<td>through the use of mathematical tools and precision.</td>
<td>through the use of some appropriate tools and consideration for precision.</td>
<td>applied through the strategic use of appropriate tools and attention to</td>
<td>through the strategic use of appropriate tools and attention to precision.</td>
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<tr>
<td>Informational Writing</td>
<td>The product minimally conveys ideas, concepts and information through the</td>
<td>The product conveys some ideas, concepts and information through the selection</td>
<td>The product adequately conveys ideas, concepts and information through the</td>
<td>The product strongly conveys ideas, concepts and information through the</td>
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<td>(x1)</td>
<td>selection and analysis of relevant content.</td>
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Materials and Properties - The article shares a number of potential materials that can be used to create an animal prosthetic. Brief descriptions of each material are provided. Strong understanding is not demonstrated based upon the lack of detail connecting the material and specific properties.

Engineering Design - 3D printing is explained and how it can help with the engineering process is described. Examples are provided of a number of animals and the functionality that the prosthetic was provided. The general attributes of animal prosthetics are provided and a consideration for the material selected is discussed. This is reinforced based upon the visual and brief discussion of the horse, duck, and dog.

Problem Solving and Design Process - The product does not deal with a specific animal. Examples are provided of a number of animals and the functionality that the prosthetic has provided. The general attributes of animal prosthetics are provided and a consideration for the material selected is discussed.

Mathematical Modeling - The importance of precision and accuracy is explained in terms of how the functionality of the prosthetic is tied to the measurements and creation of the prosthetic based upon the measurements and dimensions provided. This is not explained fully.

Informational Writing - The article provides a number of important details as to how the prosthetic could be created and the important design considerations. The functionality of the prosthetic for the pet is highlighted and the benefits of the prosthetic are shared.