Berry-Picker Design Challenge: Trunk Function Cards

Twist and Turn!

Just like our tongues, elephant trunks move in many different ways, like twisting and curling. Compare the movements and shapes of your tongue versus your arm. Which one wins? *Will your berry picker be flexible or stiff?*

Berry-Picker Design Challenge: Trunk Function Cards

Lift It!

Elephants trunks can lift things as heavy as 700 pounds! The average trunk is 8-13 feet long. One inch of trunk can lift 4 pounds! Using 1 inch of your finger, what is the heaviest item you can lift? *Will your berry pick-er be strong like an elephant's trunk?*

Berry-Picker Design Challenge: Trunk Function Cards

Grab it!

African elephants have 2 finger-like parts at the tip of their trunks. Asian elephant trunks do not. Try to pick up objects with 2 fingers, like the African elephant trunk! Now try to pick up the objects with a cupped hand, like the Asian elephant trunk. *Which method will your berry picker use?*

Making the Biomimicry Connection in Cleveland Metroparks Zoo

The Zoo setting provides an opportunity for guests to observe unique features, functions, behaviors, and processes that make nature exceptional. While biomimicry is often accomplished by, first, starting with a problem, then looking to nature for a solution, it can also be done in reverse: by observing interesting aspects of nature and investigating ways in which humans can solve a particular problem using this interesting feature. This 'backwards biomimicry' is common practice in the zoo setting. Nature is ready to be observed. We need, merely, to observe what is unique about the biological organisms (plants, animals, i.e.) around Zoo grounds, and think, "How could I use this interesting fact to solve a problem or meet a need?"

The most well-known example of 'backward biomimicry' is the development of Velcro ®. A Swiss engineer, George de Mestral, was inspired by the burrs that clung to his clothing and his dog's fur after a hike on his property in 1948. The unique ability of this plant to disperse its seeds and genes far from itself (the parent plant) provides an evolutionary advantage that allows higher survival rates and species success. de Mestral recognized that this function had value and started making keen observations of the structure of the seeds and of how the seeds behaved or functioned. Under the microscope, de Mestral was able to see the intricate hook-like structures that allowed the burdock (*Arctium spp*.) seeds to cling to fur and fabric. While many of us get annoyed with these burrs that stick to us after a walk in the woods or fields, de Mestral was, instead, inspired to use this unique feature for solving problems or meeting a need outside of nature and seed dispersal. He realized that if he created a *mimic* of it, he could use it as a fastener. By developing 2 strips of fabric, one with the burdock's 'hooks' and one with loops for the hooks to catch onto, Velcro® was born. First, it was touted it as the "zipperless zipper" (1950's) because it could replace traditional fastening devices like zippers and buttons. Business really blasted-off when NASA, in the 1960's, installed Velcro® in shuttles and on uniforms to keep items in place once in orbit. The world now saw this nature-inspired design as a Space Age fabric; everyone had to have it! [1,2]

Swearingen, Jake. 2016, *accessed 2017*. An Idea That Stuck: How George de Mestral Invented the Velcro Fastener. *Retrieved from* https://www.velcro.com/blog/an-idea-that-stuck-how-george-de-mestral-invented-the-velcro-fastener.

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Elephant Berry Picker Design Challenge Cards

To lead your class in a biomimicry exercise, we have provided the **Elephant Berry Picker Design Challenge Cards** to prompt your students to consider the *unique* feature of the African elephant, the trunk, as an inspiration to think about fun ways that the trunk's structure and function could meet a need by solving a problem or a design that improves life for humans. Remember that this exercise is all about having fun with nature, creativity, and design! There are rarely 'wrong' answers when creativity is invoked. If you aren't quite sure of the connection between the elephant trunk and the suggested design, as leading questions of the student so the class clearly understands.

The Lesson Plan suggests asking your students about their observations of the elephants at Cleveland Metroparks Zoo or in the provided video. What behaviors or processes involving the elephants' trunks do they recall?

Introducing the cards:

⇒ **Grab It!** African Elephants (Cleveland Metroparks Zoo) have two fingerlike, prehensile projections at the tip of their trunks. This allows them the ability to pick up minutiae (similar to humans using two fingers to grab via pinching), that would be out of their grasp without these prehensile projections. The students may have noticed the elephants using this feature! Contrastingly, Asian elephants do not have the prehensile projections and must form a 'cup' with their trunk to pick up items. The **Elephant Berry Picker Design Challenge Cards** ask the students to try to grasp items in two ways. First, the students should try to use a pincher-like grasp with two fingers, mimicking the African elephant's prehensile trunk. Next, they should try to scoop up items with a cupped hand, mimicking the Asian elephant's trunk without the prehensile projections. In this exercise, the students should decide which method makes the most sense to mimic for their Berry Picker Design. Have the students explain their reasoning and let classmates weigh in with their thoughts. There is not necessarily a correct answer. The choice will depend what function they want in their Berry Picker.

⇒ **Lift It!** The trunks of elephants are amazingly strong! There are eight major muscle groups and hundreds of thousands of muscles in each trunk! Each elephant, like each human, has different strength capabilities, but, on average, elephants have lifted between 300-700 pounds, using their trunks alone! The average length of an African elephant's trunk is between 8-13 feet long, resulting in the ability to lift up to ~4.5 pounds per inch! The **Elephant Berry Picker Design Challenge Cards** ask the students to use one inch of one finger (this might be the tip to the middle joint, for example), to hold objects. The idea is to show the difference between what one inch of our bodies can lift and hold compared to one inch of an elephant trunk. Keeping in mind that elephant trunks can hold a lot of weight but still be soft and flexible, the students should consider what this means for their Berry Picker design. Do they want something that can move flexibly, but still be strong, or do they want something that is stiff and inflexible? There is no wrong answer, but the student should communicate their reasoning with their peers. Classmates should also give feedback and ask questions.

Twist and Turn! It is likely that students saw the African elephants at Cleveland Metroparks Zoo using their trunks in a variety of ways, or the students may have read books or seen a television program with images of elephants. If asked what ways an elephant can move its trunk, students will respond with ideas like: up high to reach leaves in a tree, curling inward toward its mouth to put in food and water, moving side-to-side, and other ways. Trunks are very flexible! All those muscles allow an articulation that is important for the trunk to be functional for the elephant. On the human body, our tongues are the most analogous to the elephant trunk in terms of structure and function. The **Elephant Berry Picker Design Challenge Cards** ask the students to compare the articulation of a flexible body part like their tongues versus a more rigid body part like their arms. After their investigations, what do the students think would be the best fit for their Berry Picker Design? Do they want it to have the ability to move more freely, perhaps going under and through different obstacles (i.e. under the bed or couch, through the ducts of the furnace, down and into the sink drain). Do they want it to be less flexible and more structurally sound? Again, there is no wrong answer. Ask the students to explain their reasoning and allow feedback from the group. This is all about being creative and thinking in a new way!