

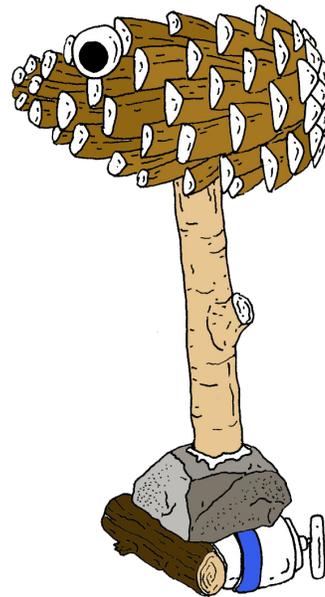
NATURE BOTS

AFTER-SCHOOL EDUCATOR GUIDE

Nature Bots are motorized creations—made from natural materials and simple electronic components—that move and dance in interesting ways. We like to introduce Nature Bots after Scribbling Machines to deepen investigations of balance, movement, and sculpture. This activity builds on students' familiarity with the offset movement produced by the hobby motors used in Scribbling Machines and expands their understanding to include properties of new materials. For example, joining the smooth, aluminum bodies of motors and batteries with textured, irregular, and brittle natural materials foraged from local parks and walkways poses new and exciting challenges and opportunities for building and creating. The activity can also be done without doing Scribbling Machines first but youth might benefit from a little extra time exploring the motors before building.

Nature Bots bring art, technology and the natural sciences together through an organic process that put students in conversation with their surroundings. This activity can spur impassioned discussions about human-nature relationships, cause us to notice nature in unexpected places, and connect the the process of building and design with making observations and discoveries about the world around us.

This guide is written to help educators get started facilitating Nature Bots with groups of students in settings such as after-school programs, libraries, camps, or enrichment groups. For tips on constructing a Nature Bot, check out our Nature Bot Building Guide.



MATERIALS AND TOOLS

for 20 participants:



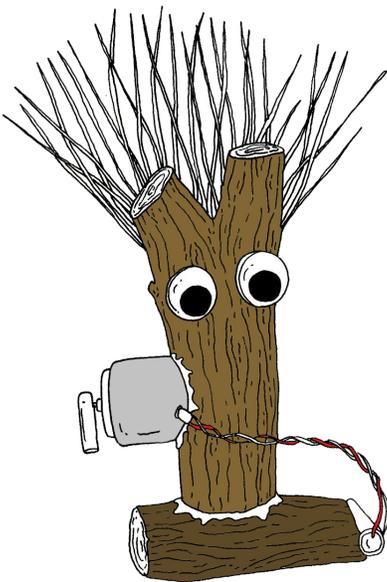
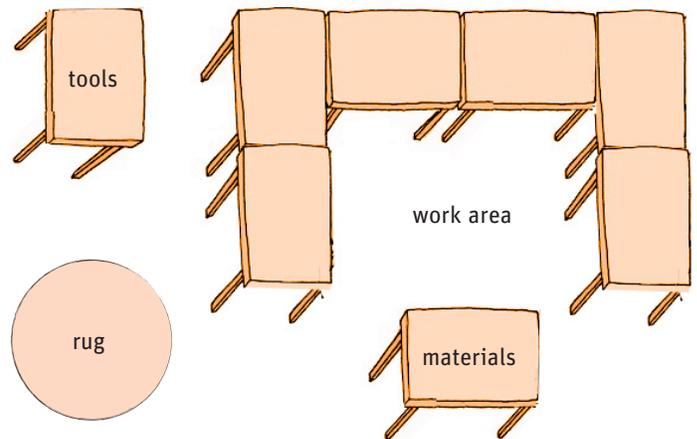
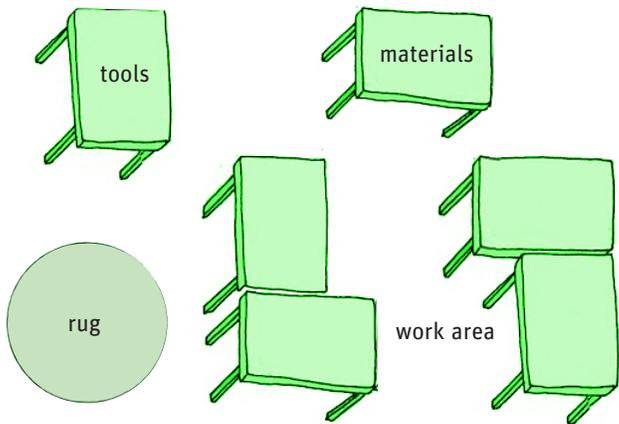
Try adding:

- Hand saw
- Safety glasses
- Vice or clamps
- Drill and drill bits
- Mallet or hammer
- Needle nose pliers

the tinkering studio

SET UP YOUR SPACE

Create an inviting, comfortable space with separate areas to support different modes of interaction. A rug or floor area is a good place to gather everyone together so you can introduce the activity and spark initial conversations. Rugs are also perfect for hammering during building time!



We like to set things up so that there is enough room for everyone to sit around a table (or two or three, depending on the size of your group) with materials for building Nature Bots placed in the middle. This helps create an environment in which learners can collaborate easily as they gather parts and share discoveries, materials, tools, frustrations, and ideas.

A sturdy table or workbench off to the side is a great way to provide a safe area for facilitators to help students use tools like saws, drills, or hot glue guns.

Tips for Tool Use

As you prepare the workshop space, you should think about how important it is that your students engage with tools during building and how to ensure safety. When we work with tools, we only set up as many tools as there are facilitators so that they can assist students. We also place them so that there is enough space to operate the tools, and a safety plan in place in case of accidents.



OPENING DISCUSSION PROMPTS

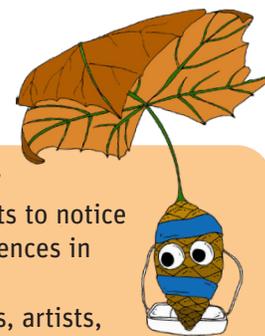
When you introduce the Nature Bots activity to students, it's a good idea to give them a chance to ask questions and share ideas. Here are a few prompts that can help kids start thinking about using natural materials for building:

Where do you see nature in your everyday life? Do you have plants at home (inside or out)? Who takes care of them?

What do you all think we should keep in mind when collecting plants outside? Is there anything we shouldn't do or should be careful about? (they will likely think of this themselves, but we like to suggest we only take things that have already fallen on the ground rather than cutting live plants)

When thinking about the weight of the materials we used for Scribbling Machines (larger, wider containers for bases, long stiff popsicle sticks, etc.), what kinds of natural materials might work well for a Nature Bot?

USING EXAMPLES AND FRAMING THE ACTIVITY



When introducing Nature Bots to students for the first time, it's helpful to have several finished or in-progress examples with you during the opening group discussion. We like to encourage students to notice how they work and move, share ideas about how they think they were made, and notice any differences in their designs. This helps them to start thinking about building.

The words we use shape how kids approach the work intellectually. We often talk about inventors, artists, designers, or engineers to help kids get into the spirit of making and tinkering. This might include phrases like: "You will step into the shoes of inventors and engineers today!"

"Watch how the motors move and experiment with making it dance and balance in different ways."

"This branch reminded me of a reindeer antler, so I designed it to look like one."

"Mirá como se balancea con solo tres patas."

We encourage the use of all languages spoken by students and educators during making and discussion.

COLLECTING MATERIALS



In planning the materials collection walk with your students, you might consider:

- Even in urban environments, we've found that most people are surprised by how much nature they do find once they start looking. However, if a walk with youth is not possible, you could do some pre-collecting in a local park or plaza. If you don't find heavier base pieces like branches and pine cones, you could use recycled containers and cardboard. A replacement for leaves could be making imitations of known flowers and leaves out of tissue paper and pipe cleaners.
- As you walk through the neighborhood, do you notice anyone growing food in their yard? This can be a good conversation starter that students may relate to their own family gardens.
- In noticing the plants in your area, what do they tell you about how nature is represented in your landscape? Is it valued and cared for by the municipality? What might be the natural history of your area?
- What are some ways students and their families relate to nature? Can you make opportunities to let them take leadership during the walk to share their knowledge?
- One way to teach and model respect for living plants is to collect only materials that have already fallen to the ground (especially where they are sparse).
- How will you bring materials back to your site? You might choose to have students carry their own paper bags or put materials into a communal bin.



GETTING STARTED

Ask students to experiment by putting together a motor, a battery, and a glue stick and feeling the movement in their hands. Then encourage them to pick out a few natural objects that seem interesting and start imagining what they might build. This is a great opportunity to use science journals or sketching paper.

Many students like to begin by spreading materials they like out in front of them, making observations, sketching some designs, then building.



OPPORTUNITIES FOR VARIATION

Attachment methods: Try finding different ways of joining motors to branches, branches to branches, leaves to pine cones, etc. Hot glue, rubber bands, or string are all useful. You can also use tools like saws and drills to make it easier to join parts together.



dowel



notch



rubber band



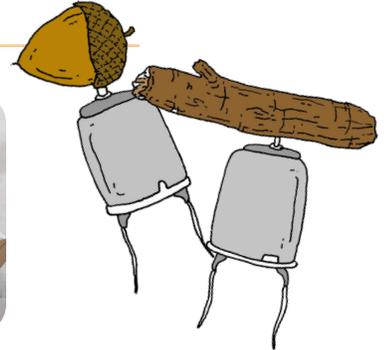
waxed thread



wire

Generating motion: Use different materials to offset the weight on the motor or even have the motor touch the table directly.

Balance and stability: Scribbling Machines are built using markers and containers that are fairly uniform, while Nature Bots are not. The inconsistency of natural materials poses a good challenge for experimenting with balance and stability.



GOOD PROBLEMS

Some of the ways young people might feel stuck are also great opportunities to encourage testing, observation, and the sharing of ideas. Some of the common fruitful problems we've seen are discussed below.

“What if?”: If the machine doesn't work out the way they planned, use “what if” questions to help students imagine and try multiple possibilities. They may be surprised and encouraged by the outcomes.

“I can't”: Students may struggle with certain physical tasks, such as getting the rubber band around the battery, slipping wires under the rubber band, and nesting natural materials together. These moments deserve attention and can be opportunities to provide guidance to help students learn new skills together with facilitators.

Conflicts in our relationship with nature: In our experience, Nature Bots can lead to some ethical, cultural, and environmental conversations about human-nature relations. These discussions are part of science as well! Some topics can be easily addressed but others are harder to resolve. We like to honor students' thinking about these topics by engaging in the conversation, hearing their concerns, ideas and ways of knowing, and inviting them to navigate conflicts as they work.

Decomposition!: The impermanent nature of live plant materials poses a good problem as well. The things kids collect may rot or dry between building days. This can lead to discussions about the life cycle and reproduction of plants or ideas for collecting different types of materials. Students can also build models of fragile objects like flowers with tissue paper or other materials, blending scientific observation with artistic activity

Iteration: We like to encourage students to build “drafts” of many Nature Bots. Different materials will behave in different ways; making several versions helps students develop a facility with many types of materials and de-emphasizes the importance of creating a “perfect” bot.

CONNECTIONS TO CULTURE & EQUITY

Drawing on the work of Doug Medin and Megan Bang, we have found it helpful to consider the cultural assumptions about human-nature relations that may be embedded in an activity like nature bots. Depending on how the activity is organized and facilitated, what might we be communicating about how humans relate to nature and what nature is for? For example: Western approaches to science may tend to treat nature as something separate and external to humans, as a commodity or something that exists solely for human use, or as a passive entity. These definitions may conflict with indigenous ways of knowing, many of which view humans as part of nature and treat plants and animals as relatives. Similarly, it is a cultural practice in some communities to use front yards for veggie gardens or workshops rather than flowers or shrubs. We have included a number of places in this guide where conversations about culture and nature may be fruitfully engaged with students, and suggest ways of facilitating the activity that are respectful of various ways of knowing. For additional ideas and resources see: <http://indigenouseducationtools.org/bf/01> and <http://stemteachingtools.org/brief/15>



DOCUMENTATION

There are many ways to reflect on and share the process of making a Nature Bot. Here are a few suggestions:



- **Make a music video:** Help students record videos of their bots dancing to a song they choose, or put many bots in one scene to create a dance party. You can see an example Nature Bots music video online
- **Write a story :** Students might give their bot a name, describe its origins, where it lives, how it came to be, and what it eats. Sharing the stories with each other adds to the collaborative nature of the activity. We have noticed students creating characters based on observing how their bots move and interact with other bots.
- **Take a portrait in the natural environment:** If you can, take a walk back to where the materials were collected and take portraits of the bots in the place where it's pieces came from. For example, one of our students made a butterfly bot and took a photo of it perched on a branch high up in a bush.
- **Investigate materials more deeply:** Have students closely observe the materials that make up their bot and draw or diagram them in their notebooks. You might bring magnifying glasses or handheld microscopes for a closer look.

SCIENCE JOURNALS IN ACTION



Using science journals for planning before building is especially useful when youth have already had hands-on experience with concepts and materials. When Nature Bots is done after Scribbling Machines for example, students can do some prediction in their design process such as what kind of supports their sculpture will need for balance. It can also be a good place to reflect on the changes they had to make while building. This student used her journal to both plan and reflect on the process and the artistic representation (it changed from a wolf to a dog):

"I am going to first get a long thick stick and cut it to a shape of a wolf body and add a pine cone for the head and for the ears I put some small leaves and I put some thin sticks for the legs and that didn't work and I put some very thick sticks and the front ones were ok but the back ones I had to glue it again and it still didn't balance so on the front legs I put a small piece of popsickle stick and it worked and it ended up looking like a dog."

FACILITATOR DEBRIEF PROMPTS



- What conversations around nature and the natural environment did you overhear?
- What surprised you or your students about working with natural materials?
- Did you notice any similarities in design or solutions that were carried over from Scribbling Machines?
- Have you noticed any shifts in the ways that youth manage disappointment or problem solving? What do you think contributed to this?
- Was idea generation a challenge for any of your students? What kinds of facilitation support is helpful in the creative process?

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