

Let's Talk Science hands-on activities

Green Energy – How does a Windmill work?

Objective:

To understand how windmills generate electricity by building your own generator.

What you need:

- 4 ceramic magnets (1 x 2 x 5 cm)
- 1 miniature light bulb (~ 1.5 V 25mA)
- allen key
- sandpaper
- 200 feet of #30 magnet wire
- sturdy cardboard (8x30cm)
- tape

What to do:

1. Score and crease the cardboard strip at 8cm, 11.5cm, 19.5cm, and 22.5cm.
2. Fold over the cardboard strip into a hollow box and tape it securely.
3. Poke a hole through the middle of the two biggest sides with the allen key. It should spin freely inside the hole, but not be too loose.
4. Wind all the wire around the box. Leave 10cm of wire sticking out at both ends.
5. Use sandpaper to scrape the enamel off the last 2cm of the wire at both ends. Twist the scraped end of each generator wire securely around the silver tip of each wire from the light bulb.
6. Stick the Allen key back into the hole. Place 2 magnets on each side of the allen key, inside the box. Make sure it can spin freely and tape the magnets securely to the key.
7. Test your generator: Spin the magnets REALLY fast using the allen key and the bulb will light dimly. Try spinning it in a dark room so you don't miss the dim glow.

What's happening:

All materials contain electric charges called electrons. Metals are special because their electrons don't stay connected to the atoms that make up the metal; instead, they can move around inside the metal and form a type of electric "liquid" inside the wires. The moving magnets attract the electrons and make them move around inside the wire – when these charges pass from the copper wire into the thin light bulb filament, they heat it up and make it glow. If this was a windmill, the windmill blades would be attached to the allen key to make it spin, instead of having to make it spin by hand – that's how we can use the wind to generate electricity!



Let's Talk Science hands-on activities

Introduction to Bioinformatics: Do we need to save the monkeys?

Objective:

To introduce youth to using the combination of science, math, and technology to solve problems by learning about evolution, speciation and how to apply these concepts to a biodiversity conservation problem.

What you need:

A computer with the following applications or services:

- Basic text editor (PC – Notepad or Unix – Vim, Emacs)
- SSH (Secure Shell) program (PC - PuTTY or SSH Secure Shell)
- Internet access

What to do:

The bioinformatics workshop is composed of two exercises: (1) building a web page and (2) using this web page as a tool that accepts and generates data that can be used to learn about evolution, speciation, and how to apply these to solve a real-life biodiversity conservation problem about monkeys on the island of Sulawesi in the Indonesia archipelago.

Exercise 1:

1. Using a basic text editor, build a web page by cutting and pasting pre-defined html statements into a blank html template. The page may be personalized according to student preferences.
2. Once completed, the web page file is uploaded to a server, using a secure shell program, where it is activated and can be used as an online software tool by the student.

Exercise 2:

1. Ask student to open a browser and direct them to the url of the web page they just uploaded.
2. The student will submit pre-prepared biological sequence data to the web page and submit it for processing.
3. The web page accepts the data and manipulates it using software not visible to the student.
4. The generated results are returned to the same browser window for use by the student to answer questions pertaining to the geographic location of the monkeys on the Indonesian island, how geography may affect the processes of speciation, and if a conservation strategy is needed to maintain the ecosystem in which the monkeys live.

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let's talk 
science
inspiring discovery

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Introduction to Bioinformatics: Do we need to save the monkeys?

What's happening:

The generated results include a map of the island Sulawesi containing black dots, where each dot represents a monkey of a particular species, an evolutionary tree describing how these monkey species are related, and numerical data representing the biological robustness of each monkey species to thrive in its current ecosystem.

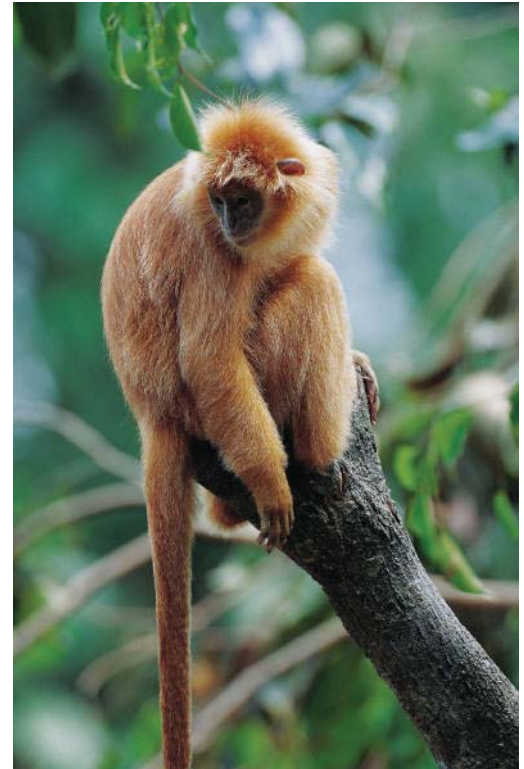
Using this map, the students identify where particular monkey species live on Sulawesi. The students visualize the relationship between monkey species in the form of a tree that could not be determined by looking at the biological sequence data of the monkeys and could not be easily generated by hand. The construction of this tree by the computer should show the students the benefits, namely accuracy and speed, of using technology.

When we compare the geographical map to this evolutionary tree, we can see that the separation of the ancestor between these monkey species on remote parts of the island has caused these monkeys to speciate and show how geography may affect speciation.

Lastly, we look at the values indicating the biological robustness of each species to thrive. A low biodiversity value may mean a species is threatened and should indicate to the student that a conservation strategy is needed.

Website:

<http://info.mcmaster.ca/~mlou/lts/intro.html>



Let's Talk Science hands-on activities

Human Health - How do the bones in our hands work?

Objective:

To familiarize students with the bones in your hand, and how they help us to move (our fingers).

What you need:

- 1 piece cardstock
- Coarse string (ligaments) (5 pre-cut at ~45 cm long)
- Straws (Phalanges) (14 pre-cut, 1-1.5 cm pieces)
- Straws (Metacarpals) (5 pre-cut, 2-3 cm pieces – metacarpals)
- Scissors
- Pencil
- Clear tape (narrow)

What to do:

1. Trace your hand and wrist. Make sure to spread your finger out! Cut it out.
2. Tape 3 phalanges to one finger. Use the tape across the straw! Leave about a ½ cm space between the straws.
3. Do this for each finger.
4. Do the same for the thumb but with only 2 phalanges on the thumb.
5. Tape 5 metacarpals to the palm of the hand.
6. Take one piece of string. Tie a knot in the end.
7. Thread the string through the phalanges and out the metacarpal.
8. Using new pieces of string, do the same thing for each finger and thumb.
9. Pull the strings at your wrist to make the fingers move.



What's happening:

The average human adult skeleton has 206 bones joined to ligaments and tendons to form a protective and supportive framework for the attached muscles and the soft tissues which underlie it. Bones are held in position and controlled in movement by tough bands of white, fibrous, slightly elastic tissue (ligaments). Bones are moved using muscles. The muscles that lift your fingers are not in your hand. They are in your arm and the tendons come down to your hand from your arm. See if you can see your tendons when you wiggle your fingers. Your fingers would be fat if you had all of these muscles in them! Place your hand on the desk so your middle finger is tucked in. All your other fingers should be sticking out. Try lifting your thumb, index finger, and pinky. Now try lifting your ring finger. There is an inter-tendon connection between your middle finger and your ring finger. This restricts their ability to move on their own. If you take your hand model and tie a loose knot in the ligaments at the hand end of the middle and ring finger, you will see that it is more difficult to move your ring finger without moving the middle finger too.