Curriculum topics:

- Biodiversity
- Ecosystem Dynamics
- Human Impacts on Environment
- Species Richness

Subject:

Life Science, Earth/Space Science

Grade range: 5 – 12

Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience through affordable "hands-on" activities that engage students and inspire the joy and discovery of learning.

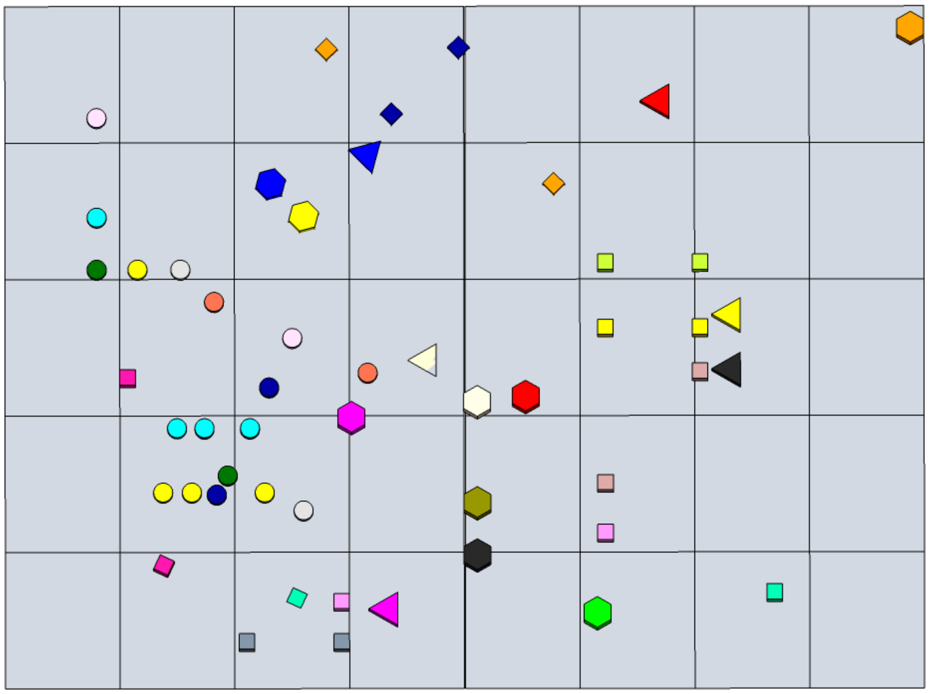
For more ideas and to see RAFT Locations

www.raft.net/visit-raft-locations

UNDERSTANDING BIODIVERSITY

Quantifying the richness of life!

Everything that lives in an ecosystem, including humans, contributes to the biodiversity of the planet. Many species interact and depend upon one another for things like food, shelter, and oxygen. Students learn how to measure biodiversity in terms of species richness (the number of species living in a particular area) by sampling "species" in a simulated ecosystem and graphing and analyzing data.



Materials required

For each group of 1 to 4 students:

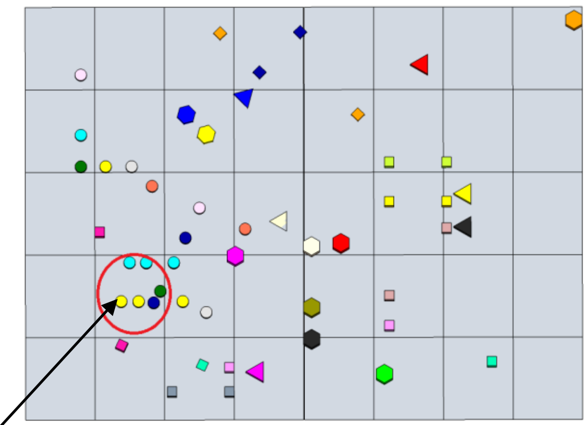
- 25 different small objects in a variety of colors, shapes, sizes, and texture, (e.g. beads, game tokens, buttons), 20 identical specimens of each
- Container large enough to hold all objects
- Paper or poster board, ~60 cm x 91 cm (2' x 3')
- Meter stick or equivalent
- 2 20-sided dice
- Understanding Biodiversity Data table & graph (at http://www.raft.net/raft-idea?isid=698)

How to build it

1. Draw a grid on the paper (ecosystem) with 40 squares. Number the squares (1-40) from left to right.

   Note: For younger students use a 20-square grid and one 20-sided die.

2. Mix objects (species) thoroughly in container.
3. Scatter species randomly onto ecosystem as shown at right.

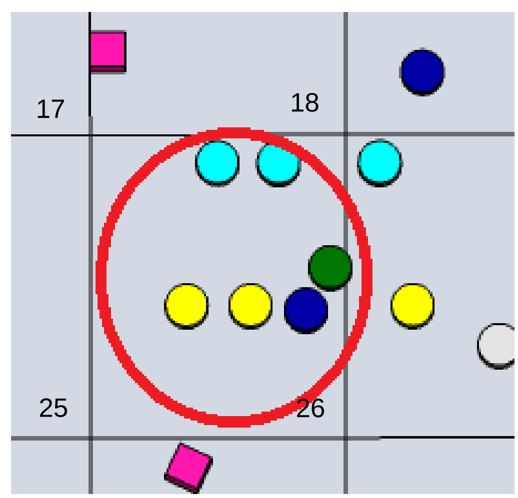


Square 26

To do and notice

1. Roll the dice and add the results – the sum is the number of the first sample square.
2. Count the number of *different species* (NOT individuals) in the 1st sample square. For example, square 26 (above) contains four species, light blue, yellow, green, and dark blue. Record results in data table.

   Note: Objects are considered different species based on any one attribute such as color, shape, size, translucence.



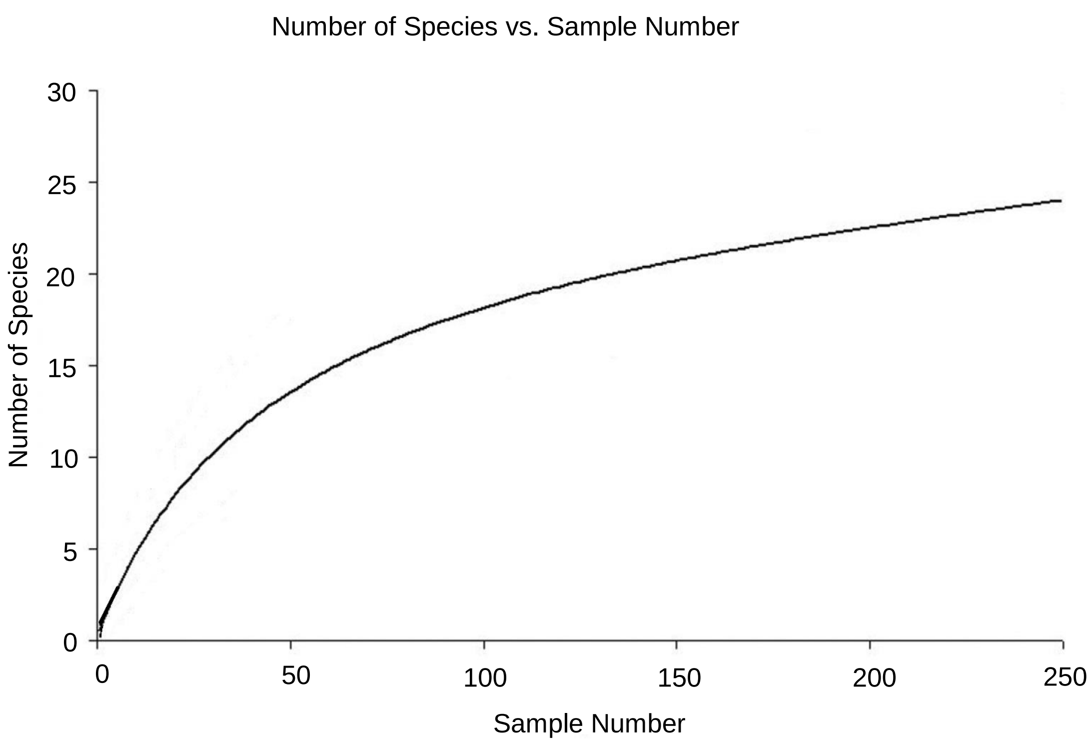
3. Each species in the ecosystem is only accounted for one time. Suggestion: remove and set aside 1 example of each counted species to avoid double-counting a species in future samples.
4. Repeat steps 1 and 2 for 20-25 more squares counting **new** species or until the group agrees all species are found.
5. Graph the data with the sample number on the x-axis and number of species on the y-axis.
6. Observe the shape of the curve. Use the curve to determine the total number of species in the ecosystem. Compare result with that of another group (if available), including the number of samples collected.

The science behind the activity

Biodiversity refers to the variety of all the different livings things in an ecosystem. Different types of animals and plants may live in various habitats but they all contribute to the biodiversity. Biologists measure biodiversity to determine the impacts of both natural occurrences and human activity on the environment. One of several measures of biodiversity that is useful to biologists is species richness, the number of species living in a particular area or habitat.

Biologists measure species richness by first dividing a large area into smaller, more manageable areas. Then they count the number of different species in each small area. In the first few samples the most common or abundant species are found with minimal effort. In general, spending more time collecting samples and/or covering a greater area will yield more species. To see how many different species are collected as a function of sampling effort, biologists graph the data while sampling. The x-axis is the sampling effort (measured as time, area, or sample number). The y-axis is the number of different species found. This graph is called a *species accumulation curve* (see below). The curve helps biologists to determine when they have found all or almost all of the species in an area.

Patterns in species richness help biologists understand the distribution of species. For example, species richness tends to be higher in tropical regions than at temperate or polar regions - a geographic pattern. The two most species-rich habitat types, rainforests and coral reefs, are located in tropical regions. In terms of island species, species richness is typically greater on islands that are nearer to a mainland. Similar patterns can be observed in "habitat islands" such as forested mountaintops surrounded by arid land. Species richness helps biologists recognize what is happening after natural events such as forest fires, landslides, floods, and tsunamis. It also helps policy makers to make decisions regarding human activities in the environment. For example, there might be a need for a dam on a river for electrical power but there might be undesirable environmental impacts resulting from its construction. Observing the species richness above and below the proposed dam site would be useful.



Accumulation curve for snakes recorded at the Lençóis Maranhenses National Park, Maranhão, Brazil (2011)

Curriculum Standards:

Measuring and maintaining biodiversity (Next Generation Science Standards, Middle School, Life Science 2-5)

Biodiversity and human activities (Next Generation Science Standards, High School, Life Science 2-7)

Influences on the biosphere (Next Generation Science Standards, Grade 5, Earth & Space Science 2-1)

Human impacts on the biosphere (Next Generation Science Standards, Middle School, Earth & Space Science 3-4)

Science & Engineering Practices (Next Generation Science Standards Grades 5 – 12)

Additional standards at: http://www.raft.net/raft-idea?isid=698

Learn more

- Vary the number of species between groups
- Increase the number of squares on the grid
- Add different habitat types (e.g., streams, mountains) and create rules for each habitat in terms of the species allowed to live there. Adjust the species distribution before sampling.
- Compare published *species accumulation curves* from several geographic regions. Identify the resources which might impact the curves

Related activities: See RAFT Idea Sheets:

Ample Samples –
http://www.raft.net/ideas/Ample Samples.pdf

Bug Pooter -
http://www.raft.net/ideas/Bug Pooter.pdf

Evolution by Natural Selection -
http://www.raft.net/ideas/Evolution by Natural Selection.pdf

Salmon You Can Count On -
http://www.raft.net/ideas/Salmon You Can Count On.pdf

Resources

Visit www.raft.net/raft-idea?isid=698 for "how-to" video demos & more ideas!

- **Biodiversity topics, data, and research** – http://biodiversity.europa.eu
- **Global biodiversity information**– http://www.gbif.org/
- **Biodiversity terms and areas of importance** – http://www.biodiversitya-z.org
- **Conservation & biodiversity hotspots -** http://www.conservation.org/where/priority_areas/hotspots/Pages/hotspots_main.aspx
- **Mapping species richness** – http://www.emnrd.state.nm.us/SPD/documents/MappingSpeciesRichness.pdf