

STEM Lesson: Bird Nest Engineering

Purpose: The purpose of this lesson is to explore the construction of bird nests. This lesson utilizes STEM (Science, Technology, Engineering, and Mathematics) through the usage of the Engineering Design Process.

Lesson Objectives:

Students will learn that different bird species build different types of nests.

Students will learn that nests are built in a variety of places, depending on the bird's surrounding habitat.

Students will learn that different bird species use different materials to build their nests.

Students will absorb that by looking at the size of a nest, bird size can be determined.

Students will gain understanding in the purpose of a bird's nest.

Students will learn about the five main types of bird nests.

Students will use the Engineering Design Process to design and build a bird's nest.

This lesson will address the following common misconceptions about bird nests:

1. All birds build nests. *This is not true as some birds lay eggs in scrapes in the ground (most terns and gulls, shorebirds, quail and many ducks and falcons) and some lay eggs in the nests of other birds (cowbirds, cuckoos).*
2. Most birds live in their nests year round. *Nests are used only for laying eggs and raising young and are not used after the brooding season is over.*
3. Nests are made only of natural materials. *This is false as nests can also be made of man-made materials.*
4. Bird nests are only found in trees. *Bird nests can be found almost anywhere—in trees, on the ground, in burrows, on the sides of cliffs, on the water, or on man-made structures.*

Lesson STEM Challenge Question:

How does the design of a bird's nest meet the needs for a particular bird species? *(To answer this question . . . materials used, shape of nest, location of nest, and nest size should all be considered.)*

Target Learning Group: Fourth Grade

Estimated Time:

Teacher Preparation: 1 hour to review lesson, make copies, and gather materials

Student Involvement:

Day 1: 50 min. (Now & Later: 10 min.; short discussion & read about 3 nests: 10 min.; walk: 20 min.; record findings: 10 min.)

Day 2: 50 min. (directions given & short video: 10 min.; station work: 40 min.)

Day 3: 40 min. (continue station work)

Day 4: 50 min. (collect materials: 10 min.; build nests: 30 min.; clean up: 10 min.)

Day 5: 45 min. (observe nests: 10 min.; complete Design Process booklets: 15 min.; Now & Later: 10 min.; class discussion; 10 min.)

Science Content Background Information:

See attached for helpful background material:

- *Bird Nest Engineering Now & Later KEY*
- *Five Major Types of Bird Nests Reference Guide*
- *The Engineering Design Process Guide*

Vocabulary and Concepts:

Brooding: The period immediately after hatch when special care and attention must be given to newly hatched birds to ensure their health and survival.

Burrow: A hole or excavation in the ground made for shelter and habitation.

Construction: The building of something, typically a large structure.

Engineering: The branch of science and technology concerned with the design, building, and use of engines, machines, and structures.

Engineering Design Process: a series of steps that engineers use to guide them in solving problems. Students will be using this process to investigate the construction of bird nests. A copy of the process steps is attached. More information about this process can also be found on the <http://www.eie.org/content/engineering-design-process> website.

Habitat: A place where animals or plants get what they need to survive: food, water, cover, and a place to raise young.

Incubate: When the bird sits on its eggs for the purpose of hatching.

Lichen (lahy-kuhn): A fungus and a form of algae or special bacteria living together; it looks like moss and grows in patches where there is no soil.

Moss: A small green or brown plant without flowers that grows in soft, thick clumps on rocks, trees, and wet ground.

Mud: Soft, sticky, wet earth.

Nest: A structure birds use as a safe shelter for laying eggs and raising their young.

Salivaria: A clear liquid made by glands in the mouth to help us chew and digest food.

Scrape: A type of simple bird nest that is little more than a shallow depression on the ground.

Types of bird nests (5 major types): see attached reference for more detail and pictures

Cavity nest: A nest in a hollowed out opening in the trunk of a tree.

Cup nest: A cup-shaped nest; the outside is made with thick materials and the inside is usually soft to protect the eggs.

Pendulum nest: A nest built into a pendulum shape, or hanging saclike shape, usually suspended from a small tree branch.

Platform nest: A nest that is mostly flat and supported by tree limbs.

Spherical nest: A nest built into a globe or ball shaped, with a single-hole opening on one side.

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eie.org (2013). *The Engineering Design Process*. Retrieved March 29, from <http://www.eie.org/content/engineering-design-process>

Observing Series by homeschool bits (2010). *Observing: A Bird's Nest*. Retrieved March 23, 2013, from <http://ecolederang.files.wordpress.com/2012/03/hb-nest.pdf>

Discipline-based Michigan Science Content Expectations:

Science Grade Level Content Expectations:

Process GLCEs:

- S.IP.04.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IA.04.13 Communicate and present findings of observations and investigations.
- S.RS.04.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

Content GLCE:

- L.EC.04.11 Identify organisms as part of a food chain or food web.

Technology: 3-5 Research and Information Fluency

- 3-5.RI.1 Use digital tools to find, organize, analyze, synthesize, and evaluate information.

Engineering Standards:

Engineering Design ID7: Problem solving and that not all problems can be solved with engineering design.

Common Core: Mathematics

Fourth Grade: Represent and interpret data.

4. Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

Materials:

Plastic bags for collecting items
Small Ziploc baggies for collecting dirt/mud
Plastic spoons
Binoculars
Plastic gloves (optional)
Books, magazines, other reference materials about bird nest construction
Bird nest specimens (if possible)
Plastic tarps (5 tarps, 4 – 6 students per tarp)
Cardboard pieces (24" x 24" min., one per student)
Small containers for water (5 containers, 1 per tarp)
Bird nest building materials (children will bring in from home & collect at school)

Safety Considerations:

When children go outside to collect nesting items, plant safety should be reviewed. Students should know what poison ivy looks like and should avoid touching it. It needs to be communicated to never eat any part of an unknown plant or anything that may be found on the ground. Children should wear plastic gloves or wash hands immediately after the nature walk and after the nest building activity.

References:

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<http://watch.birds.cornell.edu/nestcams/breeding.jsp>

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eie.org (2013). *The Engineering Design Process*. Retrieved March 29, from <http://www.eie.org/content/engineering-design-process>

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STEM LESSON

Engage and Pre-assessment:

Day 1:

Tell students, "This week we will be learning about bird nests and how they are built. At the end of the week, your CHALLENGE will be to build your own bird's nest! Today, we will be going on a nature walk in the school yard. On this walk, we will take on the role of detectives and will be looking for bird nests." *The walk should take place in early spring (April), and, hopefully, on a nice day. Students should look on trees, fences, the school building, lights, anywhere that a nest may be—they may be surprised where they find one! Also, they should watch for birds with something in their mouths (grass, string, etc.)—if spotted, they should try to follow the bird with their eyes to see where it goes (it is most likely in the process of making a nest).*

Before going outside and beginning to explore, each student will complete a Now and Later (attached) to assess how much prior knowledge the student has about bird nests. The teacher will review these assessments and adjust some of the future lesson discussions accordingly, if need be.

After collecting the Now and Later, the teacher continues by asking her students, “Have any of you ever seen a bird’s nest?” If a student answers yes, then ask, “What did it look like? What was it made of? Where was it located?” Read about three nests of common birds found in Michigan (American Robin, Northern Cardinal, and the Blue Jay) from the book, *Birds, Nests & Eggs (Take Along Guide)* by Mel Boring. By starting to build up the child’s knowledge base about bird nests before going on the nature walk, the student will be more engaged and enthusiastic while outside.

Students now get their coats and go outside for the walk. The teacher will bring along a few pairs of binoculars for the class to share. (Make it clear to the class that they will not be collecting any nests—only observing, from a distance, if they are lucky enough to spot one).

When students return to the classroom, children will record their findings in their science journals and a short discussion will be had about what they observed.

For homework (and a **Real World Connection**), tell students to keep looking for bird nests— in their own yards, nearby parks, etc.—and to be collecting bird nesting materials that they find (the items must be found outdoors). Students should also bring in a large piece of cardboard (approximately, 24” x 24”). Students should bring in their nesting materials and cardboard by Thursday.

Review recordings in student science journals and the “Now” part of the Now & Later to assess Day 1 on the Bird Nest Engineering Rubric (attached).

Procedures:

Day 2:

Explore:

Challenge: Present the students with their challenge for the week: On Thursday, you will be building a bird’s nest of your own. The design of the nest must meet the needs of a particular bird species (*example: American Robin/cup nest; Great Blue Heron/platform nest*). The nest size, location of the nest, and the materials used in construction must also be considered.

Constraints: The materials used must all be items that have been found outside, if possible. The materials used must be realistic to the bird’s nest you are designing, if possible (*for example, robins do not use large sticks to build their nests, so if the student is constructing a robin’s nest, it should not contain any large sticks*). Natural items must be used for the glue (mud; weaving of grasses, twigs, weeds, etc.).

Day 2 & Day 3:

Explain:

Tell students that for today and tomorrow (Day 2 & Day 3), their goal is to learn how birds build nests and choose a bird species/nest that they would like to model. They will complete *The Design Process* booklet through “Plan” (*the Create part will happen on Day 4; the Improve part will be on Day 5*), which includes making a chart for 5 different bird species, showing the nesting materials used by that bird (see attached for example). They will also be creating a line plot graph which will reveal the most common items used by birds in nest construction and completing math activities pertaining to their line plot. Show a short 8 minute video to the class of a robin nest build (<http://www.youtube.com/watch?v=tGPvf-M5h6k>) and then students will begin performing their own research at various stations.

Stations that each student will be visiting (20 min./station):

- Station 1: [The Design Process](#)
- Station 2: [Math Connection](#)
- Station 3: [Research Corner](#)
- Station 4: [Technology Research](#)

Station details:

Station 1: [The Design Process](#)

At this station, the STEM Design Process booklet will be completed through the Plan stage. Students may move back and forth to the 2 research stations to find any data that may be needed to complete this task.

Booklet Details (see attached for blank booklet and booklet with key)

Science Terms: *The definitions for 5 major types of bird nests (cup, cavity, pendulum, platform, and spherical) should be written here as well as any other terms that the student is learning.*

Ask:

What is the problem?

To design a bird's nest to meet the needs for a particular bird species.

What have others done?

Students will research the building of different bird nest types at the research stations and record their findings here.

What are the constraints?

The materials used must all be items that have been found outside, if possible. The materials used must be realistic to the bird's nest being designed, if possible. Natural items must be used for the glue.

Imagine:

What are some solutions?

*Students will make a chart of bird nesting materials for 5 birds and then develop 3 designs. When making the chart, **the student may do so on Excel (if the students have learned this program and the computer resources are available)**, they may fill in a blank chart that the teacher hands out, or they may create their own chart in their science journals. The student should make note here as to where their chart can be located. Three design solutions should be recorded here. If pictures need to be drawn, the student should do so in their science journals and again make reference.*

Brainstorm ideas.

Students will study their 3 designs in further detail and consider the materials needed.

Choose the best one. Why?

Students will select the best design and explain why.

Plan:

Draw a diagram. Include labels (and arrows) to identify parts.

Students will draw a diagram of the chosen bird nest they plan to model.

Make lists of materials you will need.

Students will list here the materials needed to make their selected nest.

Station 2: Math Connection

The activities at this station can only be worked on after the chart of nesting materials for 5 birds has been completed by the student. Each student will now use their chart to make a line plot of bird nesting materials. Again, the student may use Excel (*if the students have learned this program and the computer resources are available*) or they may create their own line plot in their science journals. After the bird nesting materials line plot is completed, the student will perform math activities pertaining to the line plot (see *attached*).

Station 3: Research Corner

At this station, students will research bird nest construction through books, pictures, magazines, and specimens of nests (if available). The teacher should obtain as many resources as possible for this area.

Some Suggested Resources:

- Books:
 - *How and Why Birds Build Nests* by Elaine Pascoe
 - *Birds, Nests & Eggs (Take Along Guide)* by Mel Boring
 - *Birds Build Nests* by Yvonne Winer
- Magazines:
 - *Birds & Blooms*
 - *Bird Watcher's Digest*
 - *Birders World*
- Other:
 - Handout (attached): Five Major Types of Bird Nests (make several colored copies and laminate)
 - *Nest Watch Pocket Guide* cards from the Cornell Lab of Ornithology
 - Real bird nests (the local nature center may be willing to loan some nests to the classroom)

Station 4: Technology Research

At this station, students will research bird nest building through the use of computers. The Internet will be the main tool used unless the teacher has access to some special nature/science software that has information about nest construction.

Some Suggested Internet Sites:

- <http://people.eku.edu/ritchisong/birdnests.html>
This site contains some wonderful short videos of different birds interacting with their nests. It also has information on nest types, materials used, and typical building times for various bird species
- http://www.fcps.edu/islandcreekes/ecology/lesson_11_bird_nest_materials.htm.
This site shows an example of a bird nest materials chart with 10 bird examples.
- <http://www.youtube.com/watch?v=tGPvf-M5h6k>
This is a wonderful 8 minute video revealing a robin nest build.
- <http://www.youtube.com/watch?v=fqgPmnW8yCU>
This is another amazing video of a robin building its nest (6 minutes).
- <http://watch.birds.cornell.edu/nestcams/breeding.jsp>
This is a very short video clip showing a Marsh Wren nest building.
- <http://www.youtube.com/watch?v=luwJVPM-DhM>
This is a 2 minute video of a House Finch nest building.
- http://cams.allaboutbirds.org/channel/16/Red-tailed_Hawks/
This is a live webcam on a Red-Tailed Hawk nest in Ithaca, NY.

Day 4:

Elaborate:

Today is the day that students will be constructing their nests! Hopefully, it is a nice day and this can be done outside.

Tarps will be spread on the ground and 4 to 6 students will be assigned to each tarp. Students will bring their cardboard piece, nesting materials that they have been collecting all week, and their Design Process booklets to place on their tarp area. Have a few helpers bring out the 5 containers of water and place one in the middle of each tarp.

Give the students 10 minutes to go out and collect items needed for nest building—this gives students who don't have enough materials or students who did not bring in any materials a chance to collect. Give each student a plastic bag for their collection of nesting materials, a small Ziploc baggie and plastic spoon to collect dirt/mud, and a pair of plastic gloves (optional).

After 10 minutes, students bring their materials back to their tarp and start constructing on their cardboard piece (30 minutes will be given for nest building). The water can be used to mix with the dirt in their baggie to make mud, if needed. Their nests should be built according to their plan in their Design Process booklet. This may be a messy project, so give students advance notice to wear old clothes on this day.

Allow 10 minutes for clean-up. Cardboard pieces with nests should be carefully brought back into the classroom and set in a designated area. Names and bird/nest type should be written on the cardboard.

Day 5:

Elaborate:

Give students a few minutes to look at their completed nest again. Also give time for students to walk around the classroom to observe and compare the nest buildings of their classmates. Students will complete their the Design Process booklets

Create:

Follow your plan and create it. Explain what you did.

Students will explain how they used their plan during the building process.

Test it out! What did it do?

Students will explain how they like the results of the completed nest. They will test the nest by lifting it up to see if it stays together.

Improve:

Talk about what works, what doesn't, and what could work better.

Students talk about what worked well and what didn't when they were building. They will also talk about ideas on how to improve their nest in future buildings.

Modify your design to make it better, what did you do?

Students will talk about how they would modify their plans to make a stronger nest.

Test it out, what did it do?

Students will not actually build another nest--they can make guesses as to how the improvement would test out.

Reflection:

Students should reflect on their overall experience of bird nest engineering.

Real World Connections:

All week long, students have been asked to be on the lookout for bird nests and collect nest building materials (outside in the school yard and at home).

Fun Activity: Ask students to make a container (berry baskets work well) filled with cut up colored yarn pieces, soft fabric scraps, pieces of straw, etc. They should place this container on their deck, hang it from a tree, or place it somewhere in their yard where they can easily view it. This should occur during the month of April. Students will watch to see if birds borrow objects from the basket for nest building. If lucky, a student may even observe a colorful nest that has been built in their own backyard!

Fun Place to Visit: For an exciting adventure, have students ask their families to take them to Holland Ponds in Shelby Township (located on the west side of Ryan Road between 22 Mile and 23 Mile Roads). Off of the nature trail on the south side of the park, there is an overlook to view a Great Blue Heron rookery. There are dozens of large platform nests built on top of dead trees. In the spring, it is an amazing sight to watch the herons sitting on these fabulous nests! Tell the children to take binoculars along!

Evaluate:

Post-assessment & Wrap-up:

Students will follow-up this week long lesson by completing the “Later” part of the Now & Later. The teacher will collect the Now & Later, the Design Process booklets, and science journals for final assessment. *A classroom discussion reviewing the Now & Later questions and the overall experience of being a bird nest engineer will be had. (A few possible questions here would be: Were you happy with your original design? What do you think would have worked better? Who built a nest that was strong? Did it look like the actual bird’s nest? Was it difficult to build a nest to look like the actual nest of your chosen bird species? . . . What was your claim? What did you discover? How does your evidence support your claim?)*

The teacher will use the items collected and the actual constructed bird nests to complete the Bird Nest Engineering Rubric (see attached) for the student post-assessment of this weeklong learning experience.