



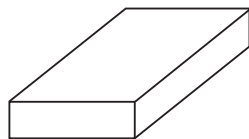
WELDING with CHOCOLATE

BRIDGE BUILDING - Bridges are made of all kinds of **materials**, wood, stone, steel, bamboo or concrete. The best material is the one that is cheaply available, and which will perform its required function.

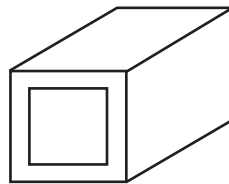
The simplest bridge is a plank that spans the distance to be crossed. A box girder bridge is made from a long beam in a box shape instead of simply a plank, and the box shape makes the beam much stiffer.



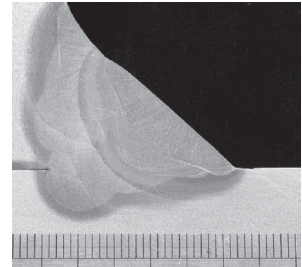
Bridge



Plank



Box girder

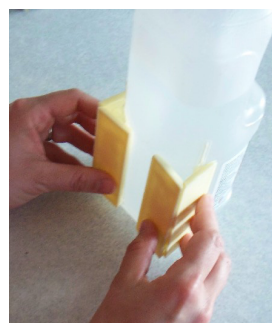


Fillet weld

Welding your chocolate box girder bridge

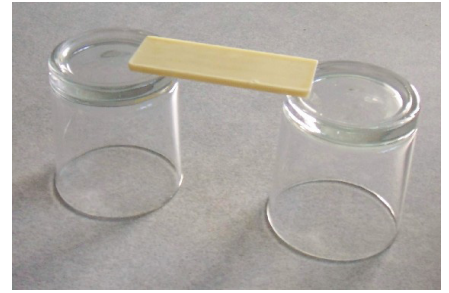
You can use welding to make a chocolate box girder bridge from single bars. The heat source we use is hot water (from a kettle) in a bottle.

1. Hold the edges of your chocolate bars against the bottle of hot water until they melt slightly.
2. Press the melted edges together in a right angle, and leave to cool. This is half the box section. Make another half-section in the same way.
3. When the half sections have cooled, melt the remaining long edges and press them together to form the box section. Leave to cool for at least 20 minutes, or put it in the fridge.



Experiment 1 - Chocolate Plank Bridge

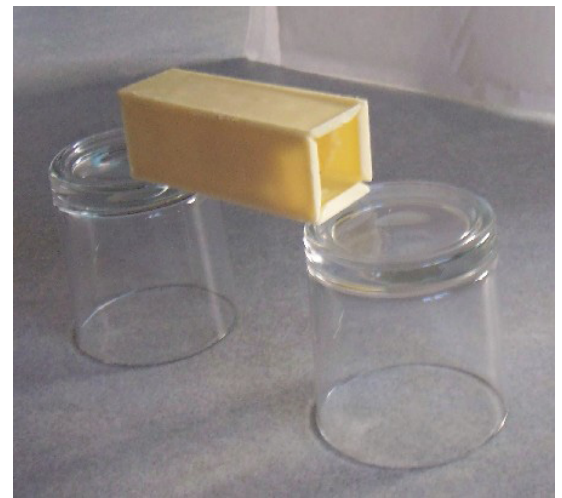
See how strong a plank bridge is. Unwrap one chocolate bar and place it between the two span points.



Now begin to load your bridge, carefully adding a little at a time. You can use weights if you have them, or load coins into a yoghurt pot. Just make sure that the bridge is loaded in the free span part of the bridge. How much load have you added when the bridge breaks? Does another chocolate bar break at the same load?

Experiment 2 - Chocolate Box Girder Bridge

Once your box girder has properly cooled and solidified along the edges then it's time to test it. First take some time to look at your box girder. Has it melted and joined perfectly all along each edge? Are there places that haven't stuck or holes along the joints? Is there some distortion so that the beam is not a perfect square in section? Do you think these factors might affect how strong the bridge is?



Place the box girder bridge between the span points the same as the plank bridge. The box girder is made from four bars so it ought to hold at least four times the load that the plank bridge broke at, right? Does it?

How much more load can you add to your box girder bridge compared to the plank bridge? If you manage to break the bridge, how does it break? Were the welds the weak points of the bridges that broke? Imagine how much stronger they would be if the welds and joints were perfect quality.

Question...Why is your chocolate box girder bridge stronger?

To find out more about materials and joining or careers in our industry contact us at...

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ABOUT THE GAME

Architecture has played a significant role in human history, but humans are not the only ones to build impressive structures. Some animals go to great effort to engineer their perfect dwelling. It becomes especially obvious as we try to learn their techniques and replicate their work. Using this pack, students will learn about ten animals and the amazing structures they build, then attempt to build their own versions of these specific dwellings.

The game includes 40 cards:

- 10 challenge cards: “Can you build a house for this animal?”
- 10 house cards giving information on what dwelling or structure this particular animal usually lives in or uses for some other purpose
- 10 engineering idea cards suggesting how to build a model of this structure
- 10 cards with pictures/schemes of animal houses/structures

Note: Having little animal figurines of the appropriate structure-building species can make these activities even more fun. You can also cut paper animals from the designs provided. Aquatic animals cut from paper benefit from laminating.

WHAT MATERIALS TO USE?

Many of the engineering cards suggest working with natural materials, like branches, leaves and sand. That doesn't mean that the challenges can only be completed outside. Bring branches, rocks, and leaves inside, and work with kinetic sand instead of real sand. Use the engineering cards for inspiration, but don't let them limit the students. They can build caves with wooden blocks or floating islands with LEGO blocks.

HOW TO DO ANIMAL ENGINEERING CHALLENGES

It is best not to complete all the challenges at once, but rather to do a couple of cards at a time.

First, we recommend working with challenge cards without giving any other instructions. Ask the students for ideas on what the house for every particular animal will look like. Variants of answers at this point may be, “A house for a bear should be big!” or “A bird will live high in the tree.” Attempt to construct a house, based on their proposed plan and using the most readily available materials.

Next, look at the picture and read the description of the proposed construction. Ask the students if the first house they built answered the requirement for the perfect house for this particular animal. If yes, move onto the next challenge. If not, ask for the ideas on how they can improve it and build a new model.

If the students have difficulty coming up with a solution, take a look at the engineering cards that give suggestions for building a model of this house while learning interesting engineering techniques.

Can you build a house for

A BEAVER?



BEAVER'S LODGE

Beavers settle on the banks of rivers and streams where they build a dam to create a pond and build a lodge for themselves.

A beaver's lodge starts as a dome constructed from branches, rocks, leaves and mud. It is often located in the middle of the pond. Once the dome is built, beavers dig and chew out two tunnels with underwater entrances and a chamber in centre of the dome that is located above water. They live there all winter. They eat, sleep and have kits when spring comes.

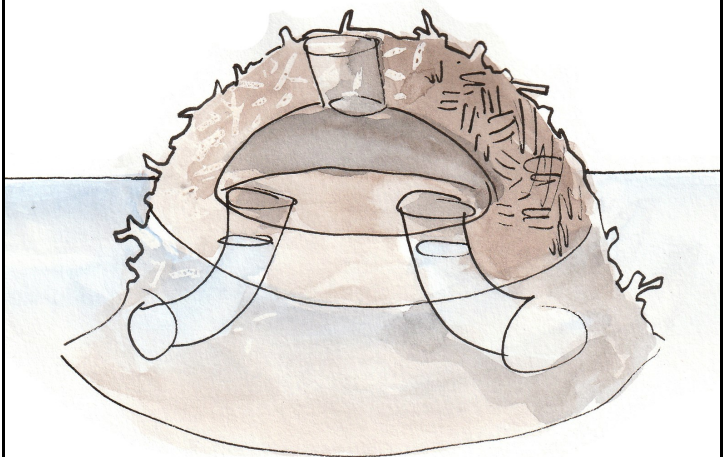
HOW TO BUILD A BEAVER'S LODGE

Take a little tub and fill it with water. This will be the pond.

Cut off the dome-shaped bottom of a plastic bottle. This will be the lodge. Cut out two underwater entrances.

Using hot glue, cover the rest of the bottle with branches, leaves and rocks.

Put the lodge inside the pond.



Beaver's Lodge

Can you build a house for

A SQUIRREL?



SQUIRREL'S DREY

If a squirrel cannot find a suitable tree cavity to live in, it constructs a leaf nest, called a drey. A finished drey is a hollow sphere, about a foot or more in diameter, with branches loosely woven on the outside. Inside, it is lined with a variety of finer materials, such as grass, moss, leaves, shredded bark or pine needles. Dreys are usually located in the fork of a branch for added stability.

HOW TO BUILD A SQUIRREL'S DREY

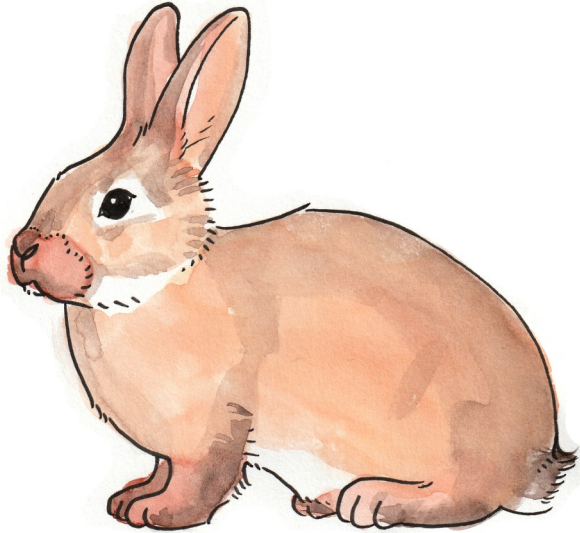
Blow up a small balloon. Cover it with a layers or glued grass, followed by leaves and twigs, leaving an entrance hole around the stem of the balloon. After the glue has dried, the balloon can be deflated and removed.



Squirrel's Drey

Can you build a house for

A RABBIT?



RABBIT'S WARREN

The European rabbit is one of the most widely spread and populous rabbit species in the world. They create their homes by tunneling into the ground and creating a network of interconnected burrows, called a warren. It usually has several exits and entrances, and it covers a large area.

HOW TO BUILD A RABBIT'S WARREN

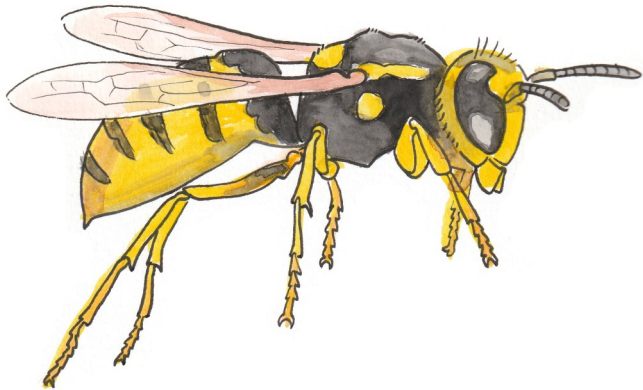
Dig a burrow in the dirt. Dig another one close by. Connect them with an underground tunnel. You've just started a warren!



Rabbit's Warren

Can you build a house for

A WASP?

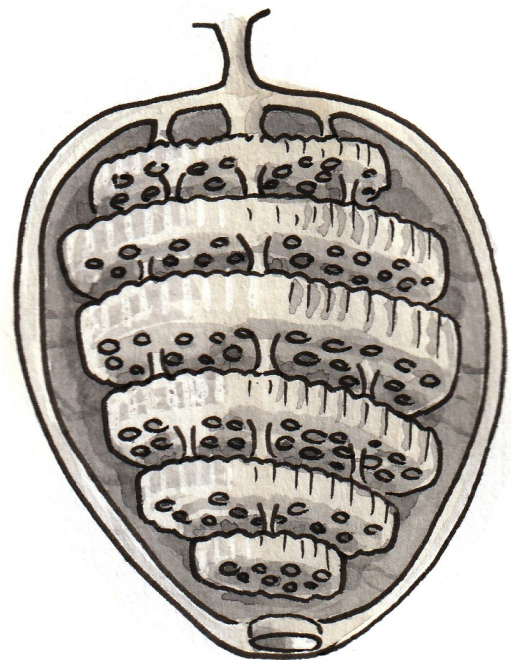


WASP'S NEST

Most wasps don't build nests, but social wasps like yellowjackets and paper wasps do. They chew wood and plant fiber, mixing it with saliva, and create — paper! Then they construct their nest, layer by layer. The nests have combs for the brood, just like bees, only made from paper instead of wax. The layers of combs are all enclosed by a paper shell called an envelope, with an entrance hole near the bottom.

HOW TO BUILD A WASP'S NEST

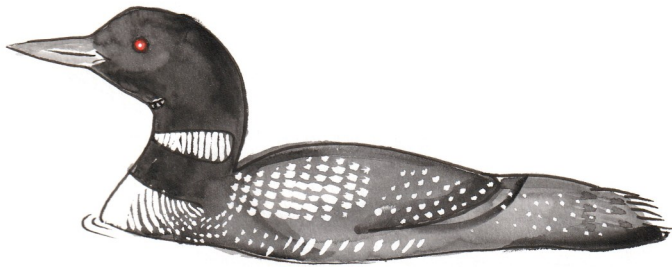
A wasp's nest can be made the same way wasps make them—from paper! Combs can be made from circles of card with brood chambers added from small cups of paper, glued on. Make the cups of paper by pressing a small circle of paper over the eraser of a pencil, then dab it in glue and press it to the comb. The envelope can be made of papier mache applied over a balloon, which can be cut open when dry, and the combs put in.



Wasp's Nest

Can you build a house for

A LOON?



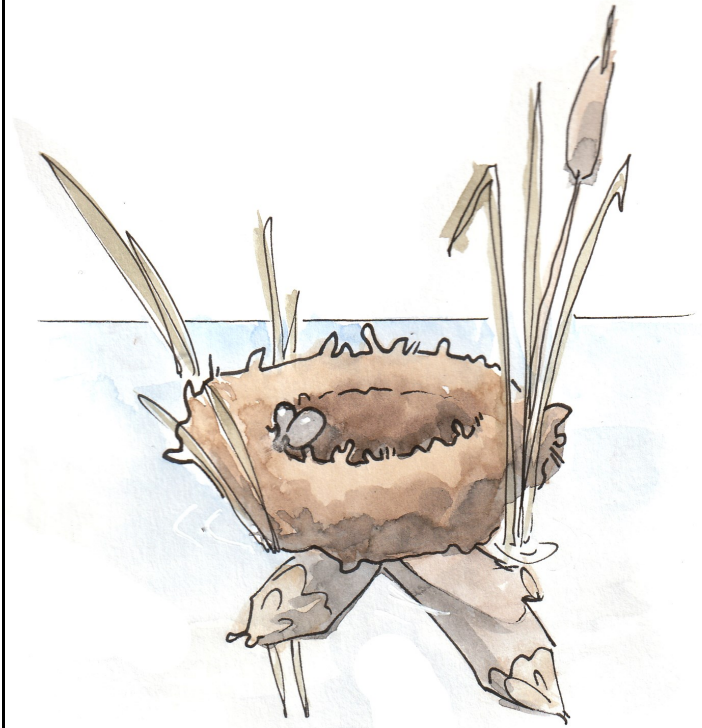
LOON'S NEST

Loons like to build their nests on the water, often on a small island or half-submerged log. Because of the changing levels of water, loons often lose their nests. There has been an attempt among naturalists to help by constructing floating rafts for loons to nest on.

HOW TO BUILD A LOON'S NEST

Construct a raft in natural colours and pile twigs, leaves and moss on top. Test it in water.

Real rafts built for loons are 5x5', but start by building a smaller model!



Loon's Nest

Can you build a house for

A BEAR?



BEAR'S DEN

Bears den in a variety of places — in caves, rock crevices, and standing hollow trees. If they cannot find a suitable den, they can dig it into a hillside or under the root system of a tree. One distinctive feature of a bear's den is a leafy bed.

HOW TO BUILD A BEAR'S DEN

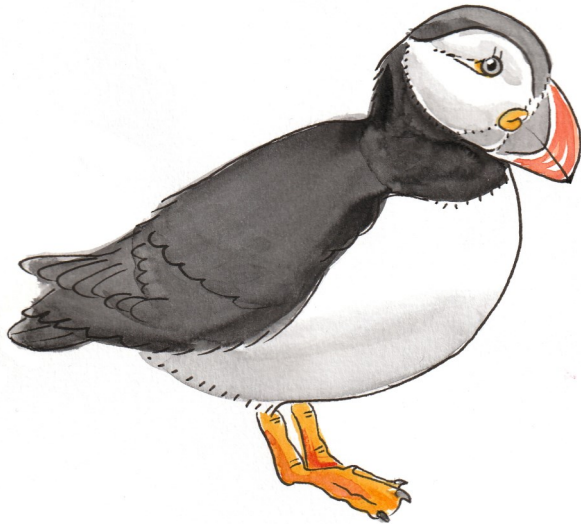
Dig a den or a cave and make a leafy bed for a bear.



Bear's Den

Can you build a house for

A PUFFIN?



PUFFIN'S BURROW

Puffins spend most of the year at sea. When ready to nest, they come ashore and dig out a burrow in a grassy bank or rocky crevice, using their sharp claws and beak. At the back of their burrow, they build a nest lined with feathers and grass where the female lays her egg.

HOW TO BUILD A PUFFIN'S BURROW

Make a nest at the back of a burrow. Bonus if you can use seagrass for building the nest!



Puffin's Burrow

Can you build a house for

A COOT?

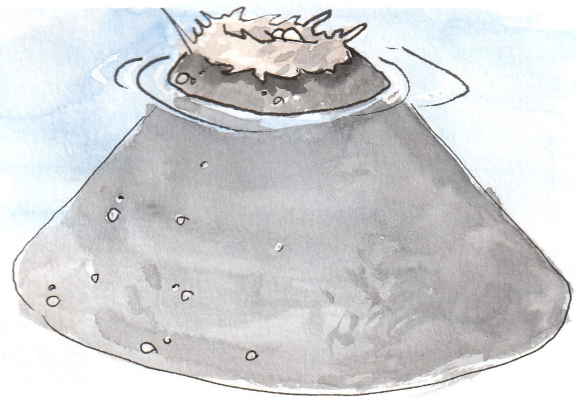


HORNED COOT'S ISLAND

Some animals put a lot of work into constructing their ideal house! The horned coot piles millions of pebbles to create an artificial island in a lake. That allows horned coots to build their nest away from the shore, but above the water surface. This island is then covered with algae to form the nest. It has been estimated that complete islands weigh 1.5 tons!

HOW TO BUILD A HORNED COOT'S ISLAND

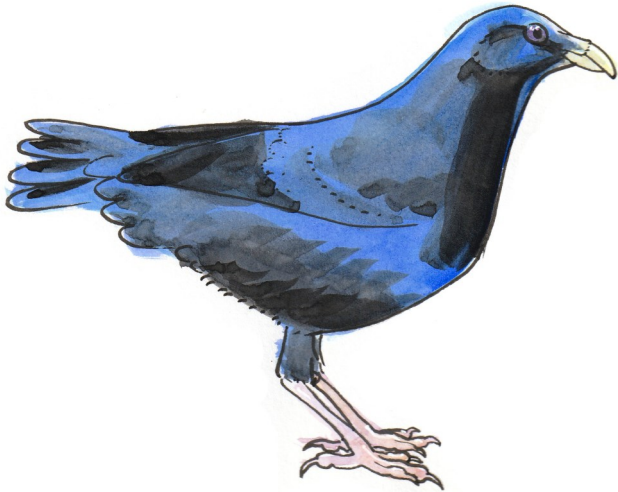
Pour 2 inches (~5 cm) of water in a little tub. How many rocks will you need to pile before there is an island above water?



Horned Coot's Island

Can you build a house for

A BOWERBIRD?



BOWERBIRD'S BOWER

A bower is an avenue-type house made of two walls of vertically placed sticks. Male bowerbirds decorate them with shiny and colourful objects like shells, leaves, flowers, feathers, stones, berries, and even discarded plastic items, coins, nails, or pieces of glass. The effect is quite stunning! Female bowerbirds choose their nesting partner based on the bower they like best. Ironically, they often end up building the brood nest away from the bower.

HOW TO BUILD

A BOWERBIRD'S BOWER

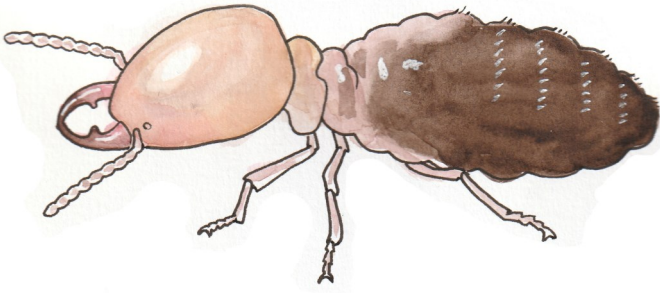
Place two rows of sticks in the ground. Decorate the ground around them with berries, petals, flowers and little recyclable objects. You can try to limit your colour palette for an additional challenge. Satin bowerbirds like blue and yellow, and great bowerbirds prefer to use green and white objects in decorating their bower.



Bowerbird's Bower

Can you build a house for

A TERMITE?

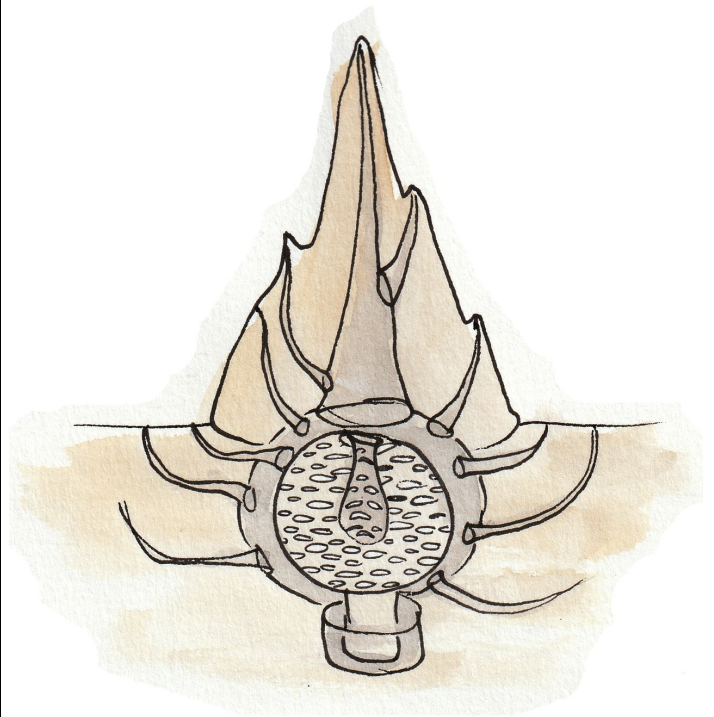


TERMITE'S MOUND

Mound-building termites create elaborate structures that sometimes reach over 9 m (30') tall. The mounds are made of sand, soil, wood chips and other natural materials fastened with the saliva of termite workers. Interestingly, after putting a tremendous amount of work into their mounds, termites don't live inside of it, but build their nest underneath it. According to the latest scientific theory, the mound helps create the cool and humid environment that termites need inside of their

HOW TO BUILD A TERMITE'S MOUND

Mix sand or soil with a little water and see how tall a structure you can build.



Termite's Mound