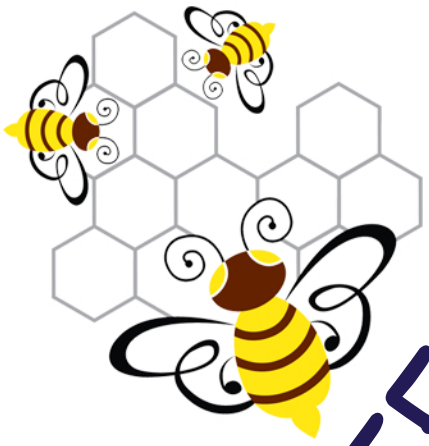
ENGINEERING DESIGN



5 eyes
6 legs
2 sets
of wings

BEES

A SCIENCE @ HOME ACTIVITY

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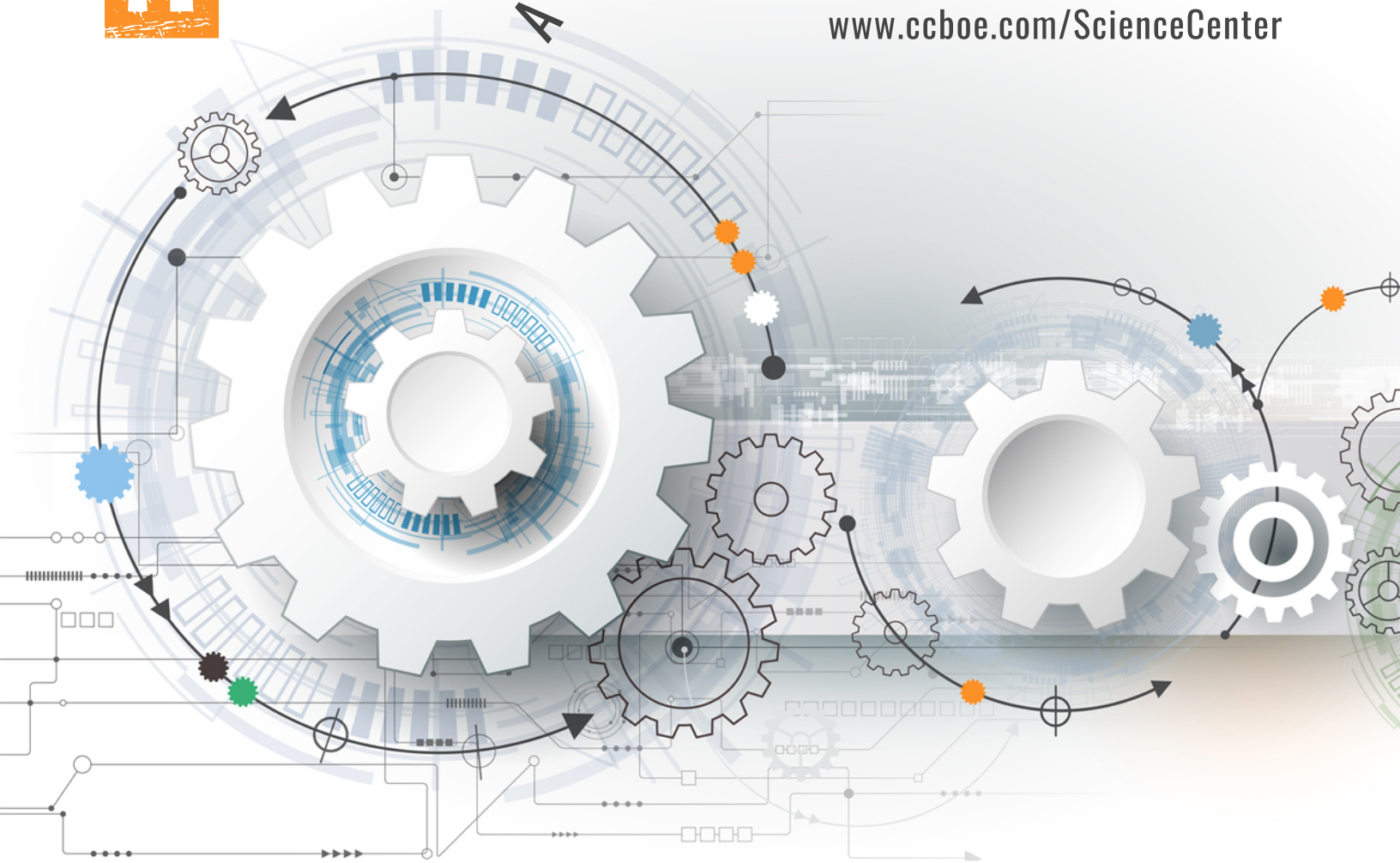


LESSON OVERVIEW FOR PARENTS

What has 5 eyes, 6 legs and 2 sets of wings?

It is that time of year when there is more activity among flying insects, including bees. Most of us are wary of bees because of the fear of being stung. For a number of us, this can be more than just a painful inconvenience but may lead to a severe life or death allergic reaction. Bees play a critical role in each of our lives and we must do our part to understand and protect the bee population. This week's lesson will help us understand bees.

Lesson objectives

- Explain the major external morphology of a worker bee.
- Explain the function of the external morphology of a worker bee.
- Identify and label parts of a bee

Outcomes

- Students demonstrate an understanding of the major external morphology of a worker bee.
- Students demonstrate an understanding of function of the external morphology of a worker bee.
- Students will create a 3-D model of a bee.
- Student will label the model of a bee's major external body parts.

Resources

- **Is a Bee an insect?**

  Insects have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and one pair of antennae. Since bees have all of these attributes, **Yes** they are insects.

- **Is honeybee one word or two?**

  You may notice that dictionaries list "honeybee" as one word. However, entomologists (a scientist who studies insects) use the two-word naming convention "honey bee." Both are correct!

- **Anatomy of a Worker Bee KEY**

  https://naitc-api.usu.edu/media/uploads/2015/01/20/AnatomyofaWorkerBee_Answers.pdf

- **'Save the Bees' campaign**

  https://towardsdatascience.com/whats-buzzing-with-the-bees-99f9be0bc4c6

- **Dancing Bees- How Bees Communicate**

  https://clever.discoveryeducation.com/learn/videos/232d0127-aa09-4886-9ed9-37a694eed85/

Engineering Challenge

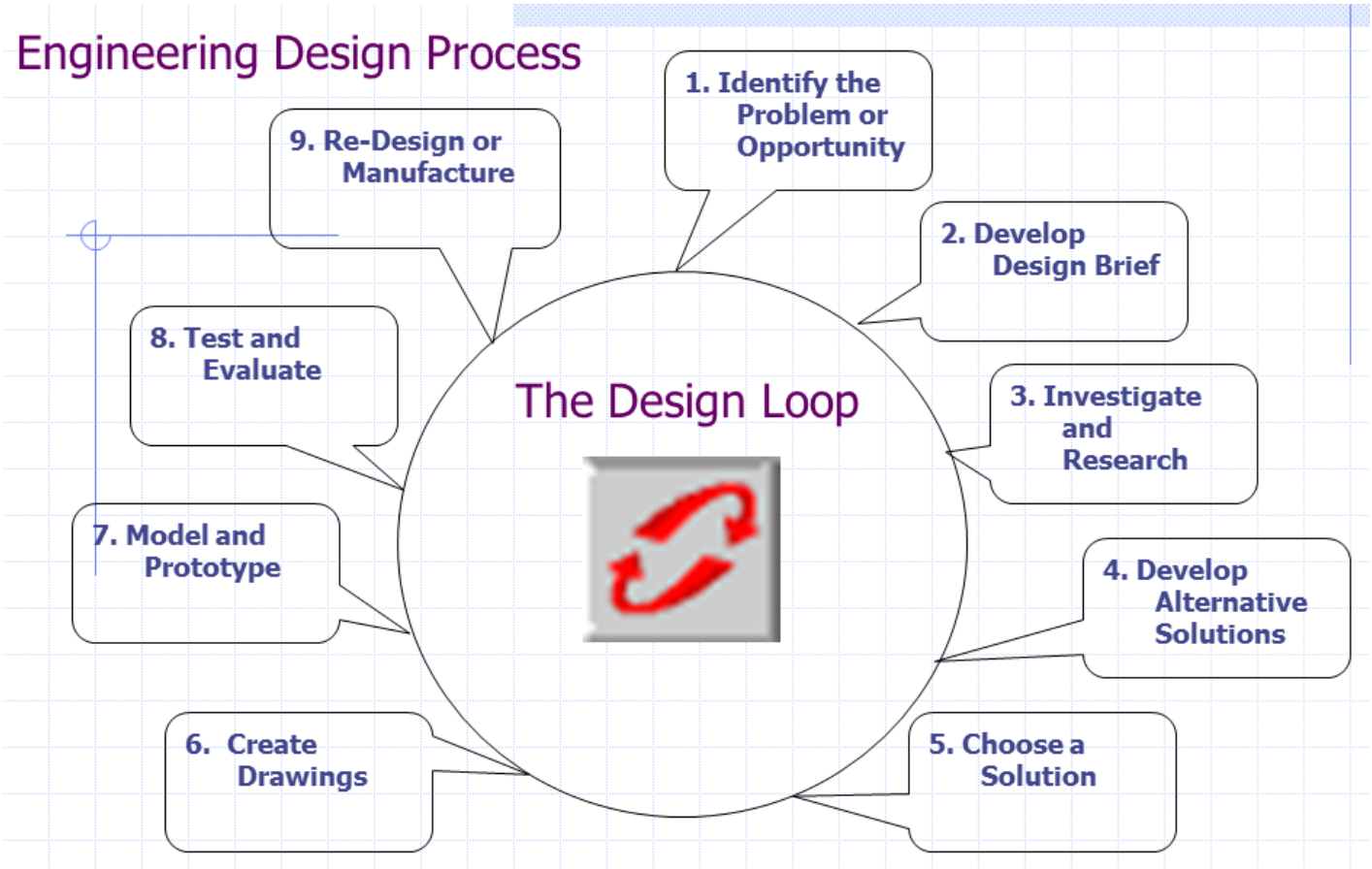
What has 5 eyes, 6 legs and 2 sets of wings?

PURPOSE

Engineering challenges are a fun and educational activity to solve a stated task. There is not a single solution or one correct answer for each specific challenge. Rather you are encouraged to try alternative solutions and use the Engineering Design process to meet each mini-lab or challenge for the optimal result.

ENGINEERING DESIGN PROCESS

The **engineering design process** is a series of **steps** that engineers follow to come up with one possible solution to a problem. Often the solution involves **designing** a solution that accomplishes a certain task and/or meets certain criteria. However, one very important aspect of the design process, is the feedback loop. This is used to look at outcomes and then make adjustments to develop a solution that is more successful at meeting the task.



What has 5 eyes, 6 legs and 2 sets of wings?

The answer may not be one you are thrilled with because it is a bee and many of us are wary of bees because of the fear of being stung and for a fair number of us this is more than just a painful inconvenience but may lead to a severe life or death allergic reaction. But bees do serve a critical role for human existence.

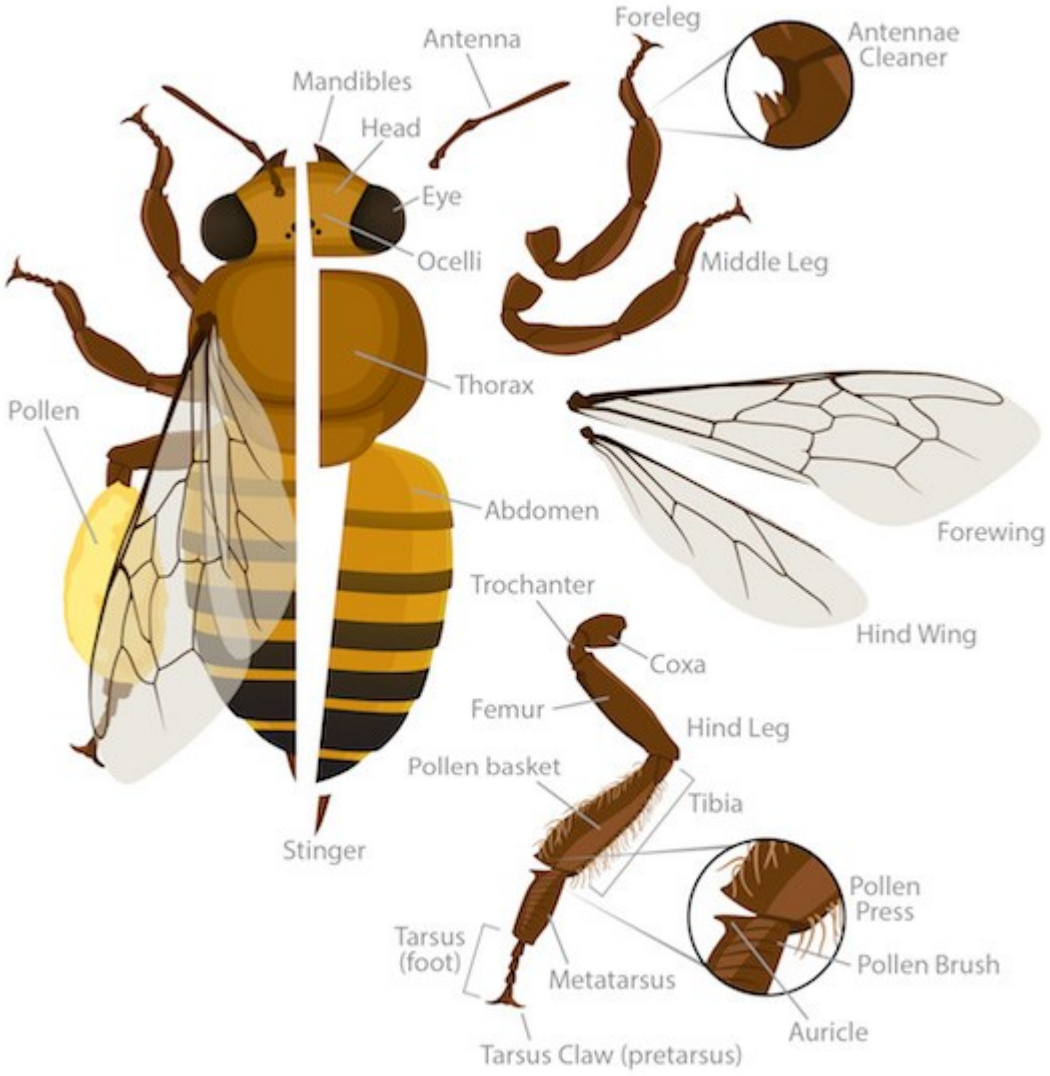
Bee Anatomy

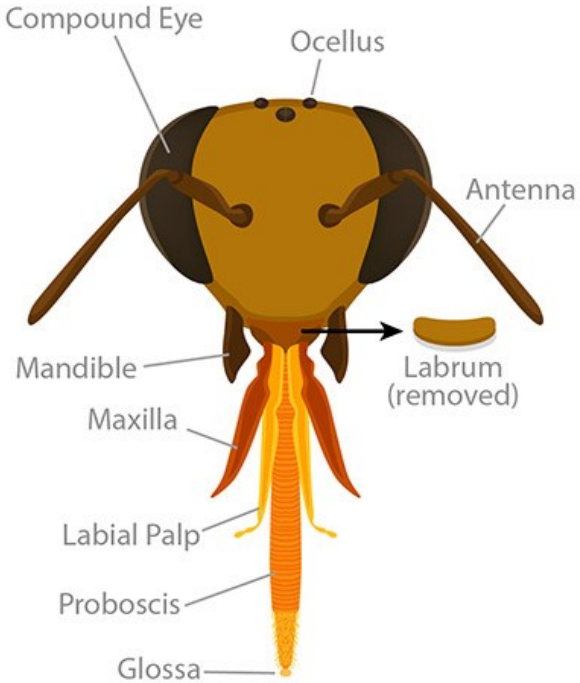
Honey bees are insects and have five characteristics that are common to most insects.

- They have a hard outer shell called an **exoskeleton**.
- They have **three main body parts**: head, thorax, abdomen.
- They have a **pair of antennae** that are attached to their head.
- They have **three pairs of legs** used for walking
- They have **two pairs of wings**.

Did you know? - Fun facts about bees

- Bees have 5 eyes
- Bees have 6 legs
- Bees have 2 pairs of wings and can fly about 20 mph (so you can't outrun a bee)
- Losing its stinger will cause a bee to die
- Male bees in the hive are called drones
- Female bees in the hive (except the queen) are called worker bees
- Number of eggs laid by queen may be as high as 2,000 per day
- Bees carry pollen on their hind legs in a pollen basket or corbicula
- An average beehive can hold around 50,000 bees
- Foragers must collect nectar from about 2 million flowers to make 1 pound of honey
- The average forager makes about 1/12 th of a teaspoon of honey in her lifetime
- The principal form of communication among bees is through chemicals called pheromones


Antenna
Foreleg
Antennae Cleaner
Mandibles
Head
Eye
Ocelli
Middle Leg
Thorax
Pollen
Abdomen
Forewing
Trochanter
Hind Wing
Coxa
Femur
Hind Leg
Pollen basket
Tibia
Stinger
Pollen Press
Tarsus (foot)
Pollen Brush
Metatarsus
Auricle
Tarsus Claw (pretarsus)


Compound Eye
Ocellus
Antenna
Mandible
Labrum (removed)
Maxilla
Labial Palp
Proboscis
Glossa

Exterior Anatomy of a Honey Bee

Head	**Location of the eyes, brain, where the antennae attach.**
Mandibles	**Strong outer mouthparts that help protect the proboscis.**
Ocelli	**One of two types of insect eyes used to detect motion.**
Eye (Compound)	**The second type of eyes made of many light detectors called ommatidia.**
Antenna	**Movable segmented feelers that detect airborne scents and currents.**
Thorax	**Midsection where the (6) legs and wings attach.**
Abdomen	**Hind part of the bee and where the stinger is located.**
Stinger	**Or sting, is a sharp organ at the end of the bee's abdomen used to inject venom.**
Forewings	**Wings closest to the head.**
Hind Wings	**Wings farthest from the head.**
Forelegs	**Legs closest to the head.**
Middle Legs	**Leg located between the foreleg and hind leg.**
Hind Legs	**Legs farthest from the head. In workers, these legs have a unique set of tools used to collect and carry pollen called the press, brush, and auricle.**
Tarsus Claw	**Claw found on the last segment of the leg.**
Maxilla	**Mouthpart beneath the mandible that can handle food items.**
Labial Palp	**Mouthpart used to feel and taste during feeding.**
Proboscis	**Tube-like mouth part used to suck up fluids.**

Engineering challenge – Design and Build a Worker Bee Model

Challenge:

Using the information you have learned, brainstorm a plan to develop, design and construct a moving worker bee model. Then construct the model following your best design.

Pre-Design Questions to Consider:

- How many parts does a real worker bee have (use page 3 as a reference)?
- What materials do I have available for my design?
- What materials do I have that will allow movement in my model?
- How will I join the pieces so that they will hold?
- What will I use to decorate my model?

Useful Resources:

- Videos
  - https://www.youtube.com/watch?v=hL0FKSrhiJA
  - https://www.youtube.com/watch?v=ta154f5Rp5Y
- Diagram of a Worker Bee (page 3)
- List of Worker Bee body parts and there purpose (page 4)

Design Notes:

Sketches of Your Design:

Now Build The Bee Model That You Have Designed:

Share Your Model:

- Post a picture of your model by tagging us at James E. Richmond Science Center on Facebook and Twitter.