

BEEing Informed

SCENARIO

You are a high school student who works at a local food market. Customers often comment that local honey is rarely available anymore. You decide to become more informed so that you can answer customers' questions as to why there is a shortage of local honey. To be able to answer the customers' questions, you interview four people: a biology teacher, a chef, the local agricultural extension agent, and a beekeeper. By asking these four individuals, you think that you probably will be able to find out the answer to the questions that you are being asked.

TASK 1. Interview with the Biology Teacher

At first you thought that there must be fewer bees to make honey and maybe bacteria were killing them. You decide to interview your biology teacher because you remember talking about bees in your biology class.

Questions to your teacher included "Why are the bees dying?" and "Could bacteria be the cause of bee deaths?" Your teacher responded by giving you a set of questions to research to help you find answers to the honey problem.

Activity 1. What Makes Us Alive?

Are bees and bacteria living things? This is the first part of our investigation. List five characteristics of living things.

1	
2	
3	
4	
5	

Activity 2. Cell Differences

Your teacher mentioned that bees are classified as eukaryotes and bacteria are prokaryotes. You realize you need to know the differences between the two. To help understand the differences, complete the table below by filling in the blanks.

<https://www.microscopemaster.com/organelles.html>

<https://www.guia.com/jg/2374864list.html>

<https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article>

Organelle	Function	Is it present in Prokaryotes?	Is it present in Eukaryotes?
Ribosome	produces proteins	Yes	Yes
Nucleus			
Cell membrane			

TABLE 1: ORGANELLES AND THEIR FUNCTIONS

Activity 3. How Are You Organized?

PART A. Using the word bank, fill in the graphic organizer below.

- organs
- organ systems
- organisms
- cells
- organelles

Figure 1. Biological Levels of Organization



PART B. Bacteria, bees, and humans seem to be very different. What are the different levels of biological organization in bacteria and humans? Write three differences of the levels of organization in the box below.

<https://biologywise.com/levels-of-biological-organization>

<https://sciencing.com/levels-organization-biology-8480388.html>

<https://www.youtube.com/watch?v=EtWknf1gzKo>

TASK 2. Interview with a Local Chef

Another possibility for the shortage might be due to so many people buying honey that it is in short supply. Since restaurants use honey in food preparation, you decide to interview a local chef to understand why local honey is so desirable. Why is honey important for food preparation?

Activity 1. Foods for Thought

A macromolecule is a large complex molecule that is important for living things, such as bees and humans. There are 4 major macromolecule groups found in living things. Name each macromolecule group list the function of the macromolecule in your body.

<https://www.youtube.com/watch?v=V5hrDFo8Vk>

<https://courses.lumenlearning.com/suny-wmopen-biology1/chapter/comparing-biological-macromolecules/>

<https://www.khanacademy.org/science/biology/macromolecules>

Macromolecule	Function In Your Body

Activity 2. Sugars for Honey

The chemical reaction below represents a process called dehydration synthesis, which is an important process within organisms that can provide energy.

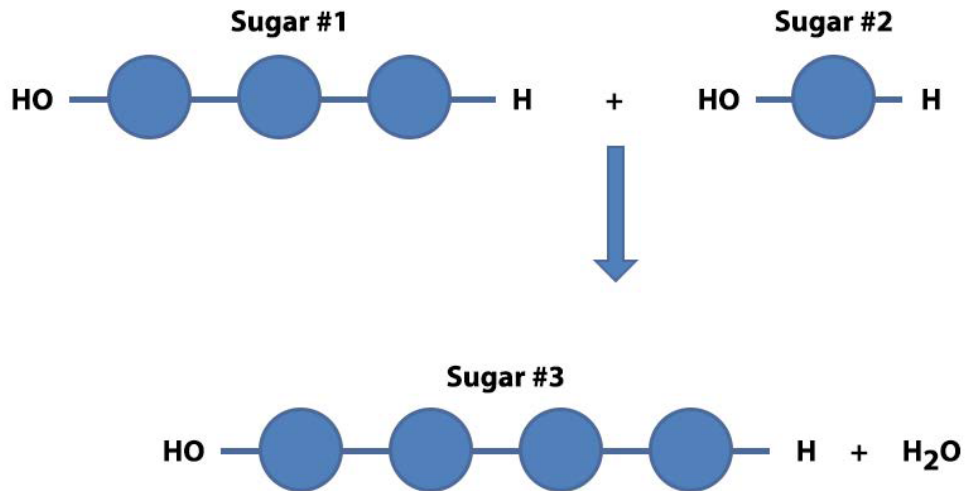


Figure 2: Dehydration Synthesis

When different sugars are combined, they change into a form that the body can use. Dehydration synthesis is the process to form another sugar that can be used. In the box below, describe how sugar #3 is formed using reactants and products.

<https://www.khanacademy.org/science/biology/macromolecules/carbohydrates-and-sugars/v/dehydration-synthesis-or-a-condensation-reaction>

<https://study.com/academy/lesson/dehydration-synthesis-definition-reaction-examples.html>

<https://biologydictionary.net/dehydration-synthesis/>

<https://sciencestruck.com/dehydration-synthesis>



Activity 4. Macro-Functions

We know that macromolecules are complex molecules. Macromolecules also are polymers consisting of smaller subunits called monomers. The table below shows examples from three macromolecule groups associated with organisms. Complete the table below using the word bank.

amino acid energy genetic code monosaccharide nucleic
acid nucleotide protein transports oxygen polysaccharide

Monomer	Polymer	Polymer Example	Polymer Function
		DNA	
		starch	
		hemoglobin	

Table 2. Macromolecule Structure and Function

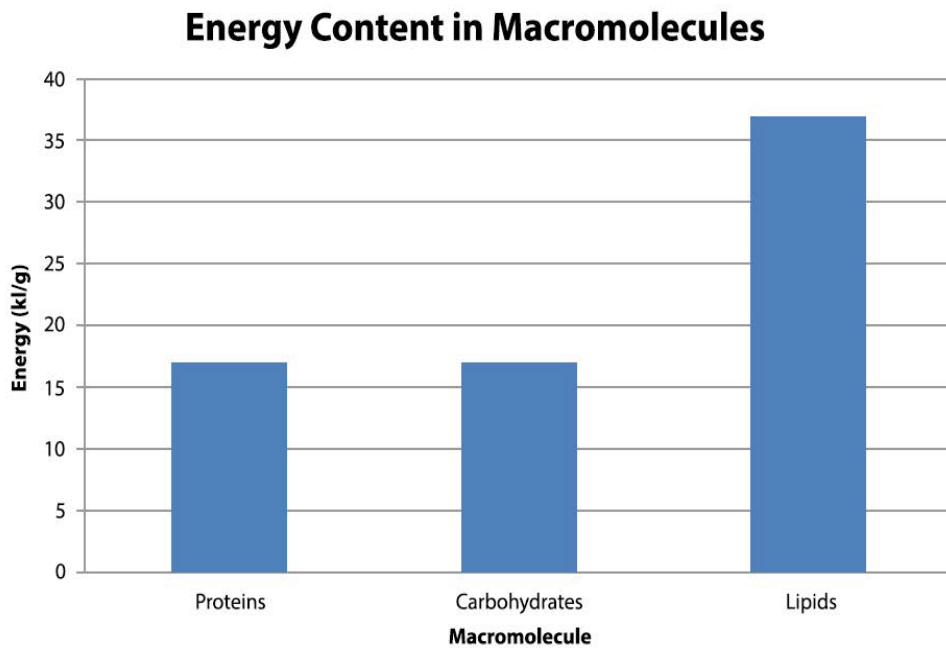
<https://study.com/academy/lesson/monomers-types-examples-quiz.html>

<https://sciencing.com/chemical-names-four-macromolecules-12166.html>

<https://sciencing.com/four-organic-molecules-found-living-things-22326.html>

<https://library.med.utah.edu/NetBiochem/macromol.htm>

Activity 5. Food for Bees



Proteins, carbohydrates, and lipids are all important in terms of food for living organisms. Bees and humans need proteins, carbohydrates, and lipids. From the graph above, what can you conclude about the function of lipids?

<https://sciencing.com/lipids-facts-and-functions-13714439.html>

<http://pressbooks-dev.oer.hawaii.edu/humannutrition/chapter/the-functions-of-lipids-in-the-body/>

<https://www.thoughtco.com/lipids-373560>

Activity 6. Being Busy Making Honey

The chef gave you different links to learn how bees make honey. These will help you answer the following questions.

<https://www.youtube.com/watch?v=nZIEjDLJCmg>

<https://www.perfectbee.com/learn-about-bees/the-life-of-bees/bees-make-honey>

<https://honeybee.org.au/education/wonderful-world-of-honey/how-bees-make-honey/>

He thought it would be a good idea to understand how bees make honey, and that might give you an idea as to why there is a honey shortage. Based on what you have read in this article, identify the enzyme, the substrate, and any products in the production of honey.

Enzyme	
Substrate	
Product in production of honey	
Product in production of honey	

Activity 7. Too Extreme for Bees?

Temperature might help explain what is happening with the honey. You wonder to yourself if too high or too low might impact the production of honey. How do changes in temperature and pH affect the performance of an enzyme such as invertase? Write your answer in the box below:

Activity 8. Water Drops for Honey

Honey is solution made up of water, fructose, and sucrose. Water is very important in many biochemical reactions, including the production of honey. Use the resources below to help you with answers for the following questions.

<https://science.howstuffworks.com/environmental/earth/geophysics/h2o7.htm>

<https://owlcation.com/stem/5-Properties-of-Water>



Part A: First, we need to understand the properties of water before talking about water and honey production. In the table below, name the property that causes water to form a drop and explain how the property causes water to form a drop.

Name of property	Describe how the property causes water to form a drop.

Part B: One of the properties of water is that it is a universal solvent. It is polar and readily dissolves other polar substances. Could something be happening to the water? Why is a water molecule polar? Explain why a water molecule is polar in the box below.

<https://www.khanacademy.org/science/biology/water-acids-and-bases/hydrogen-bonding-in-water/a/water-as-a-solvent>

<https://www.scienceabc.com/pure-sciences/water-polar-nonpolar.html>

TASK 3. Interview with a Local Agricultural Extension Agent

Your teacher told you that there is someone who works directly with farmers, who is called an agricultural extension agent. An extension agent is a person who specializes in various farming and helps farmers of all kinds. That person might have some ideas which will help you in your work. You also begin to wonder if pesticides are contributing to the decline in the numbers of bees. You decide to interview the local agricultural extension agent to see if pesticides play a role in the decline. The agent explained that pesticides enter the cells of the bees and disrupt normal cellular functions. This includes homeostasis.

Activity 1. Pest-icides of the Bees

Read the following articles

<https://bees.caes.uga.edu/bees-beekeeping-pollination/pollination/pollination-protecting-pollinators-from-pesticides.html>

<https://extension.entm.purdue.edu/publications/E-53/E-53.html>

List two ways to prevent bees from being killed by pesticides.

1.	
2.	

Activity 2. Cell Protectors

PART A. You realize that cells perform functions that protect organisms, and this might provide clues for the bees. What is the organelle that serves as a barrier for the cell?

<https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article>

<http://www.nslc.wustl.edu/courses/bio101/cruz/Organelles/Organelle.htm>

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PART B. You've learned about macromolecules and they also play a role in the cells. List the three types of macromolecules that comprise the organelle in part A above.

1.	
2.	
3.	

PART C. Now the question that comes to mind is how cells regulate the movement of both polar and nonpolar molecules into and out of cells. This will help you understand pesticides and bees. In the box below, describe how the structure of the organelle listed in Part A regulate the movement of polar and nonpolar molecules into and out of a cell?

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Activity 3: Deceptive Pesticides

You've discovered that certain herbicides enter the honeybee cells by mimicking, or acting like, naturally occurring molecules. This could be a clue as to what is happening with bees. There are two mechanisms of transport into cells, active transport and passive transport.

<https://www.khanacademy.org/test-prep/mcat/cells/transport-across-a-cell-membrane/a/passive-transport-and-active-transport-across-a-cell-membrane-article>

<https://www.khanacademy.org/science/high-school-biology/hs-energy-and-transport/hs-passive-and-active-transport/v/introduction-to-passive-and-active-transport>

PART A. Describe the two mechanisms of transport (active and passive) in terms of concentration gradients.

Mechanism of Transport	Description of Concentration Gradients
Active Transport	
Passive Transport	

PART B. Energy is required for the mechanisms to transport molecules in cells. In the box below, write how the energy requirements differ for these two active transport and passive transport.

Activity 4. Infiltrating Pesticides

Pesticides can enter cells different ways. Complete the table below to determine the different types of transports in terms of passive or active. Classify each type of transport as passive or active transport by placing an "X" in the appropriate box below.

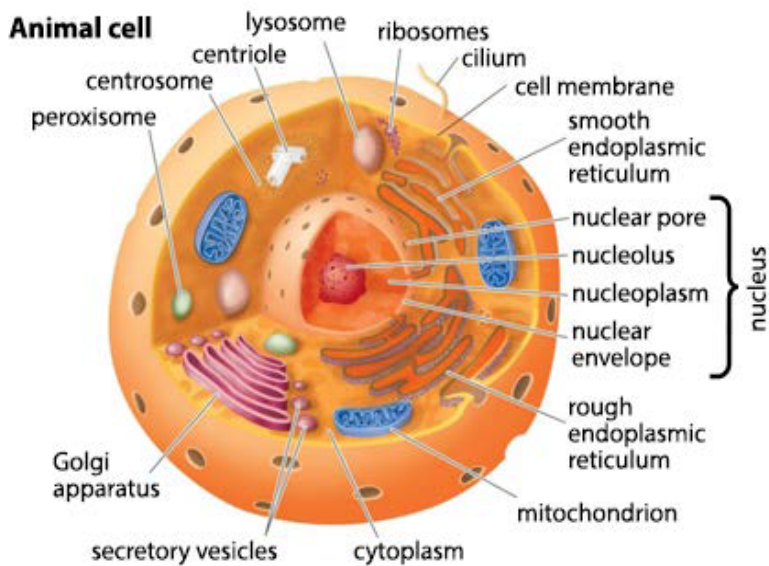
<https://courses.lumenlearning.com/suny-wmopen-biology1/chapter/kinds-of-transport/>

<https://quizlet.com/153854445/different-types-of-cell-transport-flash-cards/>

Type of Transport	Passive Transport	Active transport
Osmosis		
Facilitated diffusion		
Diffusion		

Activity 5: Mapping the Journey of Pesticides

You've learned that pesticides can travel through cells. Understanding the journey of pesticides from the cell membrane to the rough endoplasmic reticulum of a cell is important. Using the diagram of an animal cell below, describe the journey of pesticides from the cell membrane to the rough endoplasmic reticulum in the box under the cell. Include the organelles that are an important part of the journey. Refer to the cell diagram below to assist you in responding to this question.



Activity 6: Maintaining a Balance

Homeostasis is an important concept for all living organisms, which includes bees. If homeostasis is disrupted, bees might become at risk and die. You need to know what homeostasis is and how it is important in living organisms.

<https://www.scientificamerican.com/article/what-is-homeostasis/>

<https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-body-structure-and-homeostasis/a/homeostasis>

PART A. Define homeostasis in the box below and describe its importance.

PART B. The local agriculture extension agent gave you information to read regarding bees and climate. You wondered if bees might die during the winter. What is one-way honeybees maintain homeostasis in the hive during the winter months, which would explain why they don't die in the winter. Write your answer in the box below.

<https://agdev.anr.udel.edu/maarec/honey-bee-biology/seasonal-cycles-of-activities-in-colonies/>

<https://www.wonderopolis.org/wonder/what-do-bees-do-in-winter/>

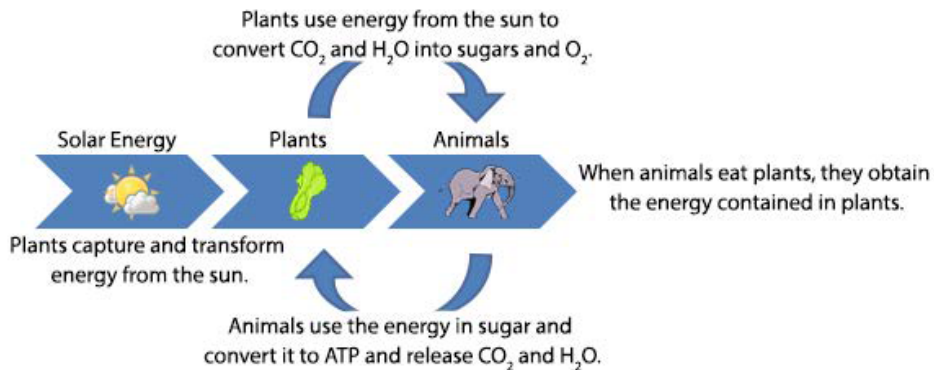
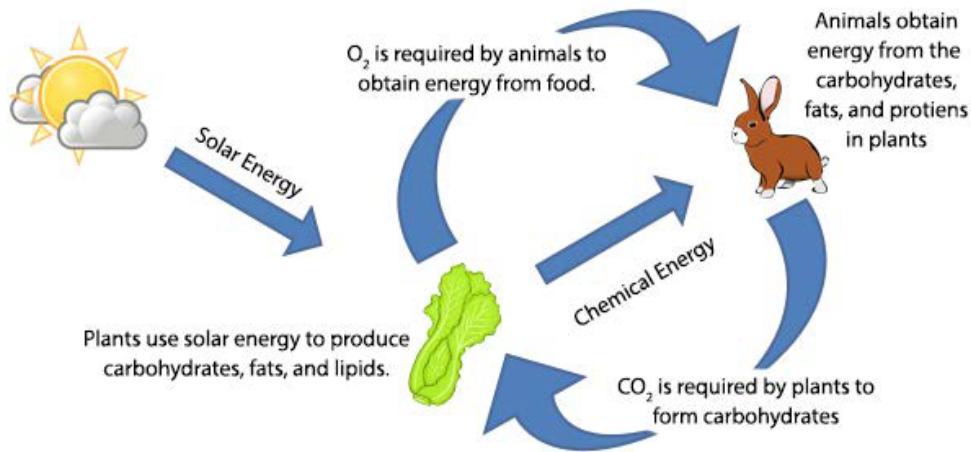
<https://www.thoughtco.com/how-honey-bees-keep-warm-winter-1968101>

Task 4. Interview with a Local Beekeeper

After talking to your teacher, a chef, and the agriculture extension agent, you wonder how all this fits together and what other problems might happen due to a shortage of bees. You decide to interview a farmer the extension agent mentioned who also keeps bees. The farmer explained the process of photosynthesis and told you that bees assist in plant reproduction by serving as pollinators. Without photosynthesis, there would be no fuel for cellular respiration, and thus, life itself.

Activity 1: Food Food Food

You need to eat to get energy to survive. All organisms require energy, including bees. Review the diagram below. Write a general description of the flow of energy from the sun to the food you eat in the box after the diagram.



Activity 2: Being Connected

Plants require energy as well, and bees get pollen from plants. Bees get their pollen from plants, and this is important for making honey. There might be a problem with plants, so you decide to look at the connection between photosynthesis and cellular respiration. Describe the relationship between photosynthesis and respiration below.

<https://photosynthesiseducation.com/photosynthesis-and-cellular-respiration/>

<https://www.youtube.com/watch?v=0IJMRsTcwcg>

Photosynthesis is:
Respiration is:
How are photosynthesis and respiration connected:

Activity 3: Plant Food

PART A: Now that you know the processes of photosynthesis and cellular respiration, you know that energy is produced for plants. Name the form in which energy is packaged as a result of cellular respiration in the box below:

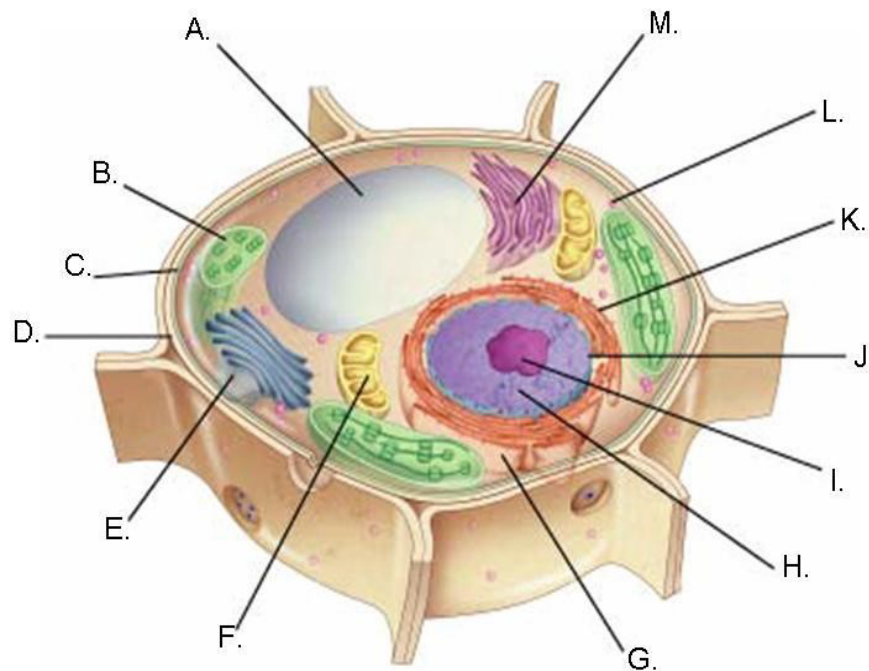
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PART B: Could this have an impact on the production of honey and bees? Give three examples of how bees use this energy for their life processes.

1.	
2.	
3.	

Activity 4: Shine on Me

PART A: We now know that organisms are comprised of cells. A plant cell is different than an animal cell. The following is a plant cell, which has chloroplast.



You know there is a connection between plants and bees. You need to dig deeper and look at cells and functions. What are two functions of chloroplast?

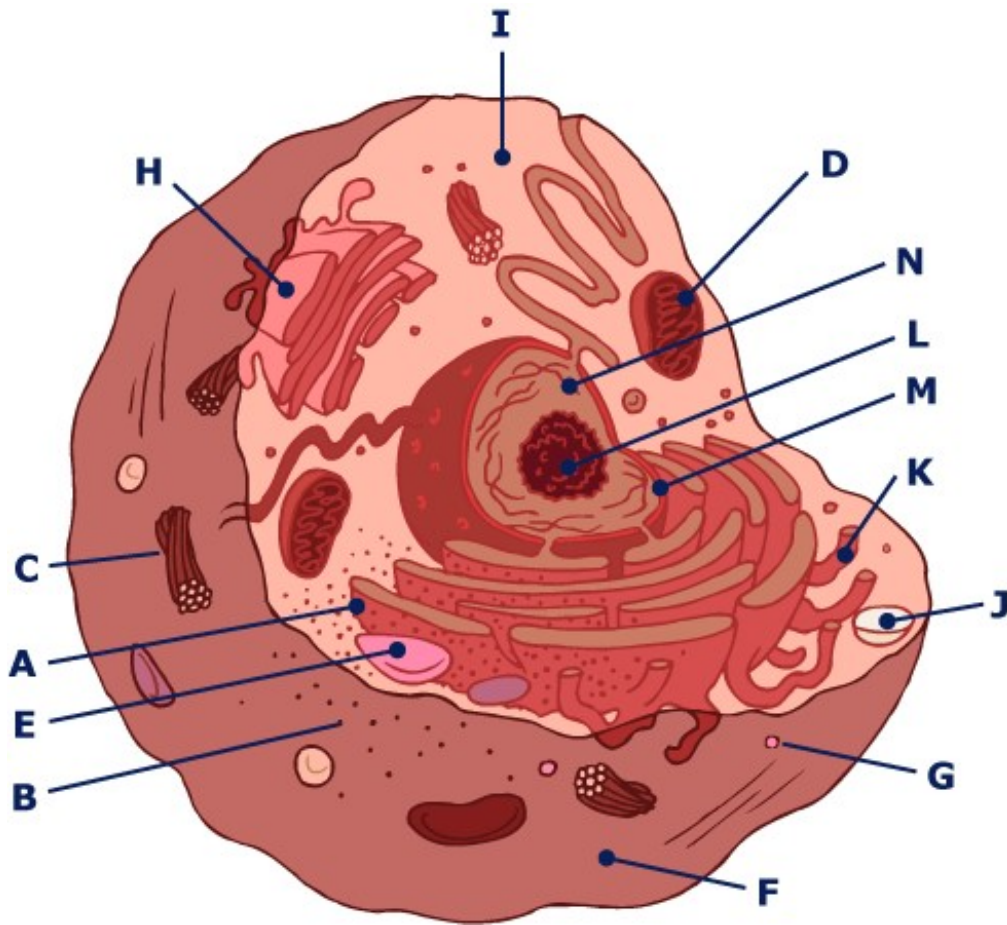
<https://www.sciencedaily.com/terms/chloroplast.htm>

http://www.biology4kids.com/files/cell_chloroplast.html

1.	
2.	

Activity 5: The Powerhouse

Mitochondrion plays an important role in cells. This could have an important aspect that may be contributing to the decline of bees. Because of this, you decide to find out more about the mitochondrion.



What are two functions of the mitochondria that are important for cells?

1.	
2.	

TASK 5 Conclusion

Now that you've interviewed your teacher, a chef, an extension agent, and a farmer, you need to come to a conclusion as to what might be causing a shortage of honey. In the box below, give a statement of your conclusion and four reasons as to how you came to your conclusion.

http://www.biology4kids.com/files/cell_mito.html

<https://www.britannica.com/science/mitochondrion>

<https://www.ncbi.nlm.nih.gov/books/NBK9896/>

Conclusion	
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Reasons to support your conclusion

1.	
2.	
3.	
4.	

