

**Teacher’s Guide**

**Bugs and the Future of Meat**

***April 2022***

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Activate students’ prior knowledge and engage them before they read the article.

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These questions are designed to help students read the article (and graphics) carefully. They can help the teacher assess how well students understand the content and help direct the need for follow-up discussions and/or activities. You’ll find the questions ordered in increasing difficulty.

[Graphic Organizer 5](#bugsorganizer)

Thishelps students locate and analyze information from the article. Students should use their own words and not copy entire sentences from the article. Encourage the use of bullet points.

[Answers 6](#bugsanswers)

Access the answers to reading comprehension questions and a rubric to assess the graphic organizer.

[Additional Resources 9](#bugsresources)

Here you will find additional labs, simulations, lessons, and project ideas that you can use with your students alongside this article.

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# Anticipation Guide

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions: *Before reading the article*,** in the first column, write “A” or “D,” indicating your **A**greement or **D**isagreement with each statement. Complete the activity in the box.

As you read, compare your opinions with information from the article. In the space under each statement, cite information from the article that supports or refutes your original ideas.

|  |  |  |
| --- | --- | --- |
| **Me** | **Text** | **Statement** |
|  |  | 1. The edible bug market is growing.
 |
|  |  | 1. Our bodies can produce all 20 of the amino acids needed to stay healthy.
 |
|  |  | 1. Raising insects requires more resources than raising cattle, pigs, and chicken.
 |
|  |  | 1. Insects are a good source of micronutrients such as iron, zinc, calcium, and magnesium.
 |
|  |  | 1. Unlike most organisms, insects provide iron in two forms.
 |
|  |  | 1. Mexico, India, and China have a high number of recorded edible insect species.
 |
|  |  | 1. Insects are a good source of polyunsaturated fatty acids, which are healthier than saturated fatty acids.
 |
|  |  | 1. Saturated fatty acids contain both double and single bonds between carbon atoms.
 |
|  |  | 1. Insects provide very little fiber.
 |
|  |  | 1. Harvesting and eating insects to control the damage they cause to crops has been successfully done in several countries around the world.
 |

# Student ReadingComprehension Questions

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions**: Use the article to answer the questions below.

1. What is the definition of entomophagy?
2. What chemical group(s) are the main components in an amino acid? How many amino acids does a person need for their body to stay healthy? How many does the human body make on its own? How do we get the rest?
3. What roles do proteins have for our bodies?
4. Explain the difference between saturated and polyunsaturated fats.
5. Define micronutrients. Give some examples. Why do we need these micronutrients?
6. Compare/contrast the nutrition information for both meats from animals and from insects. Are insects a good substitute for meats? Why?
7. State/explain why some people believe that harvesting and eating insects is a replacement for pesticides.
8. The average amount of protein a person needs is about 56.0 grams/day (mayoclinichealthsystem.org). Calculate the water footprint and land use for 1 person’s protein intake for 1 year using the data from insect protein and one animal protein.
9. Why are unsaturated fats considered unhealthier than polyunsaturated fats?
10. Examine the models of the molecular structures of chitin and cellulose. What makes chitin a good substitute for cellulose for a person’s fiber intake?

#  Student Reading Comprehension Questions, cont.

**Questions for Further Learning**

***Write your answers on another piece of paper if needed.***

1. Choose a country from the map in the article, and research on what insects are considered edible.
2. Research some common recipes for edible insects. Are there any you may want to try?

# Graphic Organizer

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions**: As you read, complete the graphic organizer below to describe how insects can be part of a healthy diet.

|  |  |
| --- | --- |
| **Protein** | Insect Advantages: |
| Chemical example: |
| **Fats** | Insect Advantages: |
| Chemical example: |
| **Fiber** | Insect Advantages: |
| Chemical example: |

**Summary:** On the back of this sheet, state whether you would consider adding insects to your diet and why. Also write three new things you learned from the article.

# Answers to Reading Comprehension Questions & Graphic Organizer Rubric

1. What is the definition of entomophagy?

Entomophagy is the practice of people eating insects.

1. What chemical group(s) are the main components in an amino acid? How many amino acids does a person need for their body to stay healthy? How many does the human body make on its own? How do we get the rest?

The 2 main components (functional groups) in amino acids are the amino groups (-NH2) and carboxyl groups (-COOH). A person needs 20 amino acids, and our bodies can only produce 11 of the 20. The other 9 must come from foods, mainly protein based foods (meats, nuts, and some vegetables).

1. What roles do proteins have for our bodies?

The main use of proteins is to build muscle. They help with many reactions in our body, by providing structure and moving molecules to the right places in the body.

1. Explain the difference between saturated and polyunsaturated fats.

Saturated fats are long hydrocarbon chains with 12-20 carbon atoms, all containing single bonds. These are called “fatty acids”. Monounsaturated fats and polyunsaturated fats are carbon chains that contain one or more double bond in its chain.

1. Define micronutrients. Give some examples. Why do we need these micronutrients?

Micronutrients are minerals that are in very small amounts in our body, but are still needed for us to be healthy. Some of these micronutrients are iron magnesium, zinc and calcium.

1. Compare/contrast the nutrition information for both meats from animals and from insects. Are insects a good substitute for meats? Why?

Both animal meats and insects are a good source of protein, which is essential for our bodies. However, insects contain more of the “good” polyunsaturated fats, as well as micronutrients our bodies need.

1. State/explain why some people believe that harvesting and eating insects is a replacement for pesticides.

Harvesting insects for eating is a new idea to prevent crop damage from insects. One issue is that pesticides used now can cause harm to other, more useful insects, such as bees. A benefit is that these harvested insects could provide an additional source of food for those in need.

1. The average amount of protein a person needs is about 56.0 grams/day (mayoclinichealthsystem.org). Calculate the water footprint and land use for 1 person’s protein intake for 1 year using the data from insect protein and one animal protein.

Land use from insects: 18m2/kg x 1kg/1000g x 56 g = 1.08 m2. (roughly 1m x 1m area)

Land use from beef: 201 m2/kg x 1kg/1000g x 56 g = 11 m2 (roughly 3.3m x 3.3 m area)

Water footprint from insects: 23L/g x 56 g = 1288 Liters (converting to gallons: 1288 L x 1 gal/3.79 L = 339.8 gal)

Water footprint from beef: 112L/g x 56 g = 6272 Liters (converting to gallons: 6272L x 1 gal/3.79 L = 1655 gal)

1. Why are unsaturated fats considered unhealthier than polyunsaturated fats?

Saturated fats could harm our heart and have other cardiovascular issues. Because they contain all single bonds, they are more stable and harder to break apart chemically. Polyunsaturated fats are the “good” fats, are needed in our diet for a healthy body. The double bonds make the polyunsaturated fats break down easier and provide more energy through the double bonds.

1. Examine the models of the molecular structures of chitin and cellulose. What makes chitin a good substitute for cellulose for a person’s fiber intake?

Some answers: They are both carbon based polymers. The molecular formulas are very similar. The structures are very similar as well (the –OH and O are in similar areas). Because of these similarities, the chitin could be a good substitute for fiber in our bodies.

**Graphic Organizer Rubric**

If you use the Graphic Organizer to evaluate student performance, you may want to develop a grading rubric such as the one below.

|  |  |  |
| --- | --- | --- |
| **Score** | **Description** | **Evidence** |
| 4 | Excellent | Complete; details provided; demonstrates deep understanding. |
| 3 | Good | Complete; few details provided; demonstrates some understanding. |
| 2 | Fair | Incomplete; few details provided; some misconceptions evident. |
| 1 | Poor | Very incomplete; no details provided; many misconceptions evident. |
| 0 | Not acceptable | So incomplete that no judgment can be made about student understanding |

# Additional Resources

**Labs and demos**

Power of Polymers

<https://teachchemistry.org/classroom-resources/the-power-of-polymers>

The right Polymer for the Job

<https://teachchemistry.org/classroom-resources/the-right-polymer-for-the-job>

Polymer Investigation

<https://teachchemistry.org/classroom-resources/polymer-investigation>

**Lessons and lesson plans**

Chem Matters article on trans fats

<https://teachchemistry.org/chemmatters/december-2007/the-solid-facts-about-trans-fats>

Chem Matters article on proteins:

<https://teachchemistry.org/chemmatters/april-2018/the-protein-myth-getting-the-right-balance>

**Other Resources**

Compound Chemistry: Different Types of Fats

<https://www.compoundchem.com/2015/08/25/fat/>

Compound Chemistry: A Brief Guide to the Twenty Common Amino Acids

<https://www.compoundchem.com/2014/09/16/aminoacids/>

# Chemistry Concepts, Standards, and Teaching Strategies

**Connections to Chemistry Concepts**

The following chemistry concepts are highlighted in this article:

* Structural formulas
* Functional groups
* Polymers
* Saturated vs. unsaturated

**Correlations to Next Generation Science Standards**

This article relates to the following performance expectations and dimensions of the NGSS:

|  |
| --- |
| **HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.**HS-LS1-6.** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. |

**Disciplinary Core Ideas:**

* LS2.B: Cycles of matter and energy transfer in ecosystems
* LS1.A: Structure and function

**Crosscutting Concepts:**

* Structure and function
* Energy and matter
* Stability and change
* Systems and system models

**Science and Engineering Practices:**

* Using mathematics and computational thinking
* Obtaining, evaluating, and communicating information

**Nature of Science:**

* Scientific knowledge is based on empirical evidence.
* Science is a human endeavor.

See how *ChemMatters* correlates to the[**Common Core State Standards** online](https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/teachers-guide.html).

**Teaching Strategies**

Consider the following tips and strategies for incorporating this article into your classroom:

* **Alternative to Anticipation Guide:** Before reading, ask students whether they have ever eaten bugs. Ask them what some advantages of eating bugs might be. Their initial ideas can be collected electronically via Jamboard, Padlet, or similar technology.
	+ As they read, students can find information to confirm or refute their original ideas.
	+ After they read, ask students what they learned about eating insects and whether they would be willing to try them.
* **Chemists Celebrate Earth Week (CCEW), April 17-23.** This article correlates well with the theme for CCEW: The Buzz About Bugs – Insect Chemistry. You can find more information and resources at <https://www.acs.org/content/acs/en/education/outreach/ccew.html>