

### Objectives

Students will:

- recognize that carbonaceous chondrite meteorites contain amino acids, the first step towards living plants and animals.
- conduct experiments that simulate how the carbon material and water from carbonaceous chondrites may have helped early life on Earth.

### Background

People have repeatedly asked the questions “How did life begin?” and “Are we alone in the universe?”. The exploration of our solar system has shown that Earth is the only body currently capable of supporting surface life. However, there is fascinating evidence that other bodies may have been habitable in the past or below the surface. Mars may once have been capable of supporting surface life. In places on Mars where volcanic and impact heat interacted with water, hot springs may have formed. On Earth thermal springs harbor microbial life. Mars may still be capable of supporting simple life in subsurface groundwater, ice, or cracks in rocks. Scientists have found intriguing evidence that may be fossil bacteria in cracks in an ancient martian meteorite, but that interpretation is still hotly debated. Other habitable environments might include a possible liquid ocean under the ice of Jupiter’s moon, Europa, or some of the newly discovered planets around other stars. If conditions were right, could life have developed elsewhere? Meteorites provide the evidence that the building blocks of life were available to other worlds.

Carbonaceous chondrites contain the two essential components for life, water and complex carbon compounds. Some of the carbon compounds are amino acids, the building blocks of DNA molecules, which contain hereditary information for all life on Earth. Detailed studies of the amino acids in meteorites show that they were not formed by living things. This means that inorganic processes in the solar nebula, or later within the rock itself, were able to make complex carbon compounds from simple molecules containing carbon, hydrogen, oxygen, and nitrogen. Carbonaceous chondrites may have delivered these building blocks of life to various bodies in the solar system. Some scientists believe that the beginnings of life on Earth partially depended upon availability of water and carbon compounds from carbonaceous chondrites. These materials would certainly also have been delivered to early Mars.

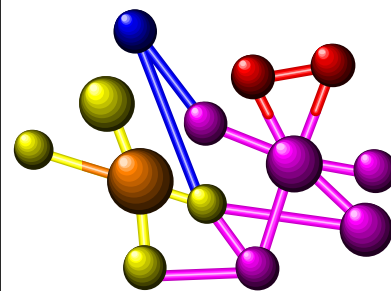
“How did they form?”

### About This Lesson

The team activities in this lesson explore the important materials carbonaceous chondrites brought to Earth. A jumbled letter activity leads students to look at the amino acids found in carbonaceous chondrites as the building blocks of life. Students also experiment with growing yeast in mediums that represent carbonaceous chondrite material.

### Vocabulary

amino acids, DNA, carbon, carbonaceous chondrites



## Activity A: Alphabet Soup

### About This Activity

Student teams try to discover the hidden words “amino acids” using cutout, jumbled letters. They progress to the analogy that just as the letters are essential to “building” words so are amino acids, found in carbonaceous chondrites, essential as building blocks of life.

### Materials for Activity A

- individual letter sets for each team (*press cut-outs, etc.*) see Advanced Preparation
- envelopes large enough to hold approximately 20 letters (*1 per team*)
- paper and pencil for each team
- Student Sheet (*pg. 12.5*)

### Objective

Students will:

- recognize that carbonaceous chondrite meteorites contain amino acids, the first step towards living plants and animals.

### Procedure

#### Advanced Preparation

1. Prepare one envelope for each classroom team. Envelopes should each have the letters necessary to spell “amino acids” and an appropriate number of additional letters to challenge the students.

#### **Suggested letter groupings:**

- #1 - aminoacidsbeghlmnust
- #2 - aminoacidsabffjklmmr
- #3 - aminoacidscfijopprty
- #4 - aminoacidsceehjloor
- #5 - aminoacidsdgikllsuwz
- #6 - aminoacidsdeggmrtuy
- #7 - aminoacidsacegimnnqt
- #8 - aminoacidscffillnppu

***For more advanced students use the names of individual amino acids.***

*Glycine, Alanine, Valine, Leucine, Isoleucine, Serine, Cysteine, Cystine, Aspartic Acid, Asparagine, Threonine, Methionine, Glutamic Acid, Glutamine, Proline, Lysine, Arginine, Histidine, Tryptophan, Phenylalanine, Tyrosine*



2. The activity may be simplified by using one color for the letters that spell “amino” and another color for “acids” and different colors for the extra letters. No two collections should be the same in color or letters.
3. Copy Student Sheet.
4. Review the lesson background.

### Classroom Procedure

1. Divide class into teams and distribute envelopes with letters.
2. Using the letters, teams list words they can think of that could be made if **just one more** letter was available.
3. Teams spell words using the letters in the envelopes.  
A team recorder writes all words discovered.

*Note: Teacher should monitor the progress being made.*

*After appropriate “wait” times, teams will be instructed to progress through the remaining procedural steps.*

4. Teams compare letters with a nearby team. At teacher’s signal, sharing teams will compare with other teams, seeking common letters and words.
5. Exercise continues until students discover the term “amino acids,” with or without teacher intervention.

*Intervention “Hints” from broad to narrow:*

- “Do teams near you have any of the same letters?”
- “You’re looking for two words.”
- “Both words begin with the letter a.”
- “The words are associated with carbonaceous chondrites.”
- “The words represent something important to life.”
- “Here are the blanks to play Hang Man. What letters are common to all teams?”

6. Distribute Student Sheet.
7. Teacher leads a discussion based on the lesson background information and the questions on Student Sheet. Stress the comparison of letters as building blocks of words to amino acids as building blocks of life.



## Lesson 12 — Building Blocks of Life

### Activity B: Get a BANG Out of Life!

#### **About This Activity**

Students model the effects of meteorites bringing water and carbonaceous material to Earth. They experiment with growing yeast in mediums that represent carbonaceous meteorite material.

#### **Materials for Activity B** **Per Small Group or Class**

- 1 package bakers' yeast
- 0.20 liter warm water  
(110 °F/ 43.3 °C)
- 3-4 crushed chocolate  
snaps (*or other*  
*carbohydrate i.e., sugar*)
- measuring container
- large spoon
- 2 large clear containers  
(*liter jars*)
- thermometer
- Student Sheet (*pg. 12.6,*  
*per student*)

#### **Objective**

Students will:

- conduct experiments that simulate how the carbon material and water from carbonaceous chondrites may have helped early life on Earth.

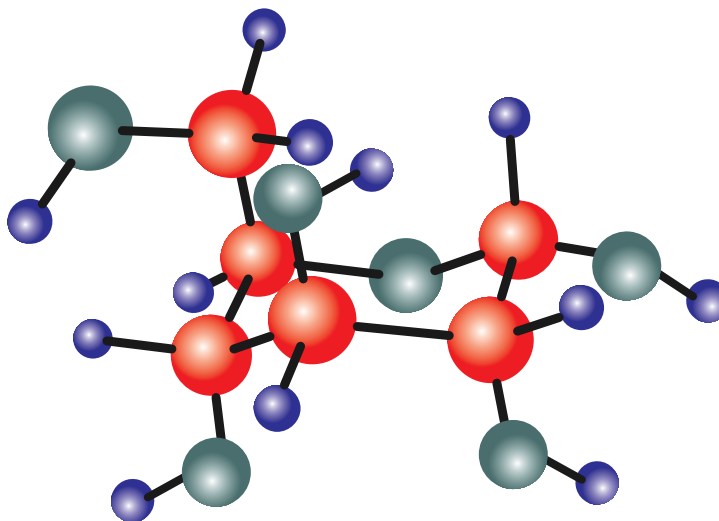
#### **Procedure**

##### Advanced Preparation

1. Gather equipment.
2. Copy Student Sheet.

##### Classroom Procedure

1. Students gather materials.
2. Measure 1/2 package of yeast into both containers.
3. Add 0.10 liter warm water to each container and stir.
4. Add crushed cookies to one container and stir.
5. Leave both containers in a warm place.
6. Predict what will happen in each container.
7. Observe how both batches of yeast react and grow.
8. Conduct class discussion on the effects of adding water or both water and carbon compounds.
9. Complete the questions on the Student Sheet.



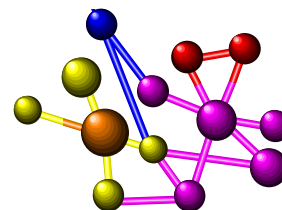
Lesson 12 — Building Blocks of Life  
Student Sheet: Activity A

**Questions**

1. What are some words you could have made if you had been given just one more letter.
2. What are some of the words you were able to make with your letters?
3. Fill in the blanks: We could not have spelled \_\_\_\_\_ if our envelope had not contained the letter “\_\_\_\_\_”?
4. **Extra:** How are amino acids the building blocks of life?
5. **Extra:** What is the significance of the discovery of amino acids in carbonaceous chondrite meteorites?



## Student Sheet: Activity B



### Procedure

1. Gather equipment
2. Measure 1/2 package of yeast into both containers.
3. Add 0.10 liter warm water to each container and stir.
4. Add crushed cookies to one container and stir.
5. Leave both containers in a warm place.
6. Predict what will happen in each container.
7. Observe how both batches of yeast react and grow.  
Record below.
8. Participate in class discussion on the effects of adding water or both water and carbon compounds.
9. Complete the questions below.

### Materials

- 1 package baker's yeast
- 0.2 liter warm water (110°F/43.3°C)
- 3-4 crushed cookies or substitute carbohydrate
- measuring container
- large spoon
- 2 large clear containers
- thermometer

### Prediction

### Questions

1. Sketch a close-up view of the results of your experiment.
  
  
  
  
  
  
  
  
  
  
2. How are the materials in this activity similar to carbonaceous meteorites and how are they different?
  
  
  
  
  
  
  
  
  
  
3. How did carbonaceous meteorites contribute to making life possible on Earth?
  
  
  
  
  
  
  
  
  
  
4. **Extra:** This experiment was designed to reflect how meteorites contributed to conditions that promoted life on Earth! How is the experiment similar and how is it different?