



SETI INSTITUTE

Mission 10 Logbook Chemical “Tests” for Life

Tests for Carbohydrates and Proteins as Signs of Life

Testing for Carbohydrates - Directions

Starch

Starch is a complex carbohydrate. Though simple carbohydrates such as glucose can form from some nonliving chemical reactions, starch is too complex to form and persist in most natural situations. The presence of starch is good evidence that life is, or was, present, because it must have been produced by a living organism.

1. Obtain cornstarch, iodine, four test tubes, and four soil-sample carrying dishes. Follow all indicated safety procedures your teacher reviewed earlier.
2. Add a drop or two of iodine to one teaspoon of cornstarch in each beaker.
3. Look for a reaction. A change from yellow-brown to blue-black is a positive (+) result, meaning that starch is present. This indicates that life is, or was, present in the sample. In this case, the corn was alive. No color change is a negative (-) result. It means that starch is not present, or not detectable for some reason (the sample may not be ground up well enough for the iodine to reach the starch).
4. Rinse all test tubes with water (preferably distilled).
5. Use the four carrying dishes to obtain one teaspoon of each of the four soil samples.
6. Put each soil sample into a separate test tube, label the four test tubes, add a few drops of iodine to each, and look for a color change.
7. You may test other samples of your choice for the presence of starch, a sign of life. A slice of raw potato gives an excellent reaction. Some samples may need to be ground using the mortar and pestle before iodine is used. Be sure to clean the test tubes between samples.

Positive and Negative Tests: Interpreting the Results

Positive: Starch is a complex carbohydrate. Though simple carbohydrates such as glucose can form from nonliving reactions, starch is too complex to form and persist in most natural situations. The presence of starch is good evidence that life is, or was,

present, because it must have been produced by a living organism. A positive (+) result indicates that there is (or was) life present.

Negative: A negative (-) result does not mean that there is no life; it only means that there is no starch. Life may still be present, because not all living things produce or store starch. But life may also be absent. A negative result is inconclusive.



Chemical Tests for Life Tests for Carbohydrates and Proteins as Signs of Life

SETI INSTITUTE Testing for Carbohydrates - Worksheet

Name: _____ Date: _____

- Record the results of your iodine tests for starch as positive (+) or negative (-).

Table 10.3 Testing for Carbohydrates.

Sample	Is Iodine Test + or - ? Describe Color Change	Is Starch Present?	Was Life Present?
Cornstarch			
"Earth Sample #3"			
"Earth Sample #4"			
"Earth Sample #5"			
Earth Sample #6"			

- What does a "negative" iodine test look like? What does a negative result mean?
- What does a "positive" iodine test look like? What does a positive result mean?
- Why would an exobiologist care about starch?



Chemical Test for Life Tests for Carbohydrates and Proteins as Signs of Life

SETI INSTITUTE Testing for Proteins - Directions

Protein

Proteins are complex molecules. Though amino acids, the building blocks of proteins, can form from nonliving reactions, proteins are too complex to form and persist in most natural situations. The presence of proteins is good evidence that life is, or was, present, because they must have been produced by a living organism.

1. Obtain cooked chicken muscle or light-colored lunch meat, Ninhydrin solution, test tubes, and four soil-sample carrying dishes. Follow all indicated safety procedures your teacher reviewed with you earlier.

2. Prepare a hot-water bath.

Bath 1-Set up a beaker half full of water on a ring stand. Light a Bunsen burner and heat the water to 60-70° C.

Bath 2 (*optional*)--Heat water to 60-70° C with a hot plate or any other means. Pour into any container.

3. Add a drop or two of Ninhydrin solution to one teaspoon of a known protein, chicken muscle, in each test tube (the chicken should be mashed). Try to determine what a positive test for protein would look like.
4. Set the test tube into a hot-water bath (about 60° C; cooler temperatures will produce slower reactions) for about 5-10 minutes.
5. Wait for a reaction. A change to blue is a positive (+) result, meaning that protein is present. This indicates that life is, or was, present in the sample. In this case, the chicken was alive. No color change is a negative (-) result. It means that protein is not present or detectable for some reason. Rinse all the test tubes with water (distilled preferred).
6. Use four carrying dishes to obtain one teaspoon of each of the four soil samples.
7. Put each soil sample into a separate test tube, label them, cover each soil sample with Ninhydrin solution, put the four test tubes into the hot-water bath, and look for a color change. Test all four soil samples.

8. You may test other samples of your choice for the presence of protein, a sign of life. You may collect organic samples from yourself? Gently scrape some cells from the inside of your cheeks, produce some spit (saliva contains proteins), file your nails, or cut up a little bit of your hair. You may test other samples of your choice too. It is important to grind up things like hair in a mortar and pestle to free the proteins so that they can react.



Chemical Test for Life Tests for Carbohydrates and Proteins as Signs of Life

Testing for Proteins - Worksheet

Name: _____ Date: _____

- Record the results of your Ninhydrin tests for protein as positive (+) or negative (-).
Table 10.4 Protein Test Results

Sample	Is Ninhydrin Test + or - ? Describe Color Change	Is Protein Present	Was Life Present?
Chicken Muscle			
"Earth Sample #3"			
"Earth Sample #4"			
"Earth Sample #5"			
"Earth Sample #6"			

- What does a "negative" Ninhydrin test look like? What does a negative result mean?
- What does a "positive" Ninhydrin test look like? What does a positive result mean?
- Based upon the results of the protein test, did you reach the same conclusions about the presence of life in your soil samples that you did based upon your starch test? Explain any differences that you found.



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Chemical Tests for Life

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A Biochemical Search for Life—Worksheet

Name: _____ Date: _____

1. Imagine that your lander scoops up a sample of Martian soil from the Mariner Valley. The photographs show no obvious signs of life. You tell your lander to perform three chemical life detection tests. It sends you the following report:

Char Test:	Negative
Iodine Test:	Negative
Ninhydrin Test:	Positive

What is your analysis of this data? Is there life in the Mariner Valley?

2. Imagine that your lander scoops up a sample of Venusian soil from the Rhea Mons area. The photographs show no obvious signs of life. You tell your lander to perform three chemical life detection tests. It sends you the following report:

Char Test:	? (equipment malfunction)
Iodine Test:	Negative
Ninhydrin Test:	Negative

What is your analysis of this data? Is there life in the Rhea Mons area?

3. Imagine that you find a mysterious pink glob under your bed. It shows no obvious signs of life. You bring it to class and perform two chemical life detection tests. The iodine turns blue-black, and the Ninhydrin solution does not change color. What is your analysis of this data? Is (or was) there life under your bed?