name_____ sn____ date_____ per._____

Coacervate Formation: Pre-Lab Worksheet

Under certain conditions, proteins, carbohydrates and other materials in a solution can come together to form irregular volumes bounded by a membrane-like interface to the surrounding medium. These organized clusters of droplets are called coacervates, and they have some of the properties of living cells. Consequently, such structures may represent one of the early stages in the origin of life. In this activity, you can produce coacervates, study the conditions under which they form, and observe some of their life-like properties.

Before doing this lab, be sure to review material you've learned about pH (acids and bases). Also, be sure to review material in your text that discusses different hypotheses about the chemical origin of life. On notebook paper, copy the outline format shown on this sheet, including the heading and title above, the letter and heading for each part, and the information called for in each part. This will become your "Lab Report"]

A. PURPOSE: [Briefly explain why are we doing this lab? What are we trying to do? (see intro above)]

B. PROCEDURE: [copy the steps below into your lab report]: First, put on goggles and apron.

1. The "mix" is already in the beaker (a 5:3 ratio of gelatin and gum arabic). Half fill a tiny test tube with this mix. Notes that the mix is clear; there are no coacervates in the mix. Using short thin straw, transfer a tiny drop to pH paper, record this initial pH in table ("0" drops).
2. Carefully add one drop acid (0.1M HCl) from dropping bottle. Place finger over mouth of test tube, turn it upside down so acid mixes gently with the "Mix". If it doesn't get real cloudy, repeat. Should require no more than one or two drops of acid. Cloudiness indicates presence of coacervates.
3. When cloudy, use short plastic straw to transfer one drop to pH paper, and one drop to clean slide. Read and record pH in table. Place cover slip on drop, and observe under scope. Look for coacervates (see example). Small diaphragm opening works best for this. When you find good coacervates (similar to prediction), sketch a few in your table.
4. After sketching coacervates, add another drop of acid to mix in test tube, turn it upside down to mix it in, and repeat until the extreme cloudiness disappears, and the mix becomes relatively clear again (should take only 2-3 additonal drops of acid to do this). When this happens, check and record the pH. Do not observe in scope, unless you have the time (coacervates should be gone).

C. PREDICTIONS: [copy the 4 items below, and do as indicated in brackets]

1. Coacervates expected: [copy here the picture of coacervates as shown below]
2. Expected pH levels: (see "pH of Mix Predict." column in the "Results" table below). [Assume pH of the original mix will be about 5; indicate (in that column) the pH expected as acid is added...]
3. Coacervate formation expected at pH level: _____
4. Coacervates expected to disappear, as more acid is added, at pH level:_____

Example of Coacervate	Predicted Coacervate
	

D. RESULTS: [Copy this data table into your Lab Report.]

Drops HCl Added	pH of Mix Predict.	pH of Mix Actual	Appearance of Mix: (clear, cloudy)	Sketches of coacervates formed at pH _____ seen at _____x in microscope
0	5			
1				
2				
3				
4				
5				
6				

E. DISCUSSION: [Read ALL questions BEFORE the lab; After the lab, list their numbers, and answer each briefly, based on your results and results of others. Answer #1 before doing the lab; this one does not require lab data to answer.]

1. How do the materials you used to make coacervates compare with those that might have been present in the ancient oceans?
2. In what pH range [at what pH] did the coacervate droplets form?
3. Did the pH change as expected (up or down, as a result of adding more acid to the solution between coacervate formation and clearing)?
4. When dilute hydrochloric acid was added beyond a certain point, the coacervates disappeared. What might you add to the test tube to make the coacervates reappear?
5. How might the coacervate droplets be made more visible under the microscope?

SAMPLE RESULTS **[REMOVE BEFORE DUPLICATING WORKSHEET FORM]**

To Predictions: expected...

2. pH of Mix as acid added: pH values get smaller as more drops of acid are added.
3. pH at coacervate formation level: about 4 or 3
4. pH when mix clears (coacervates disappear): about 2 or 1

To Discussion questions:

1. Similar; Simple protein and carbohydrate molecules could have existed in the pre-life oceans
2. about pH 4 (range of 3-4)
3. Yes (pH decreases)
4. NaOH, or some other base,...or add more mix (to dilute the acid)
5. use a dye, or use iodine to stain the membrane; or use a smaller diaphragm opening (makes the thin membranes appear thicker and darker).