SI Biology - Full Discipline Demo

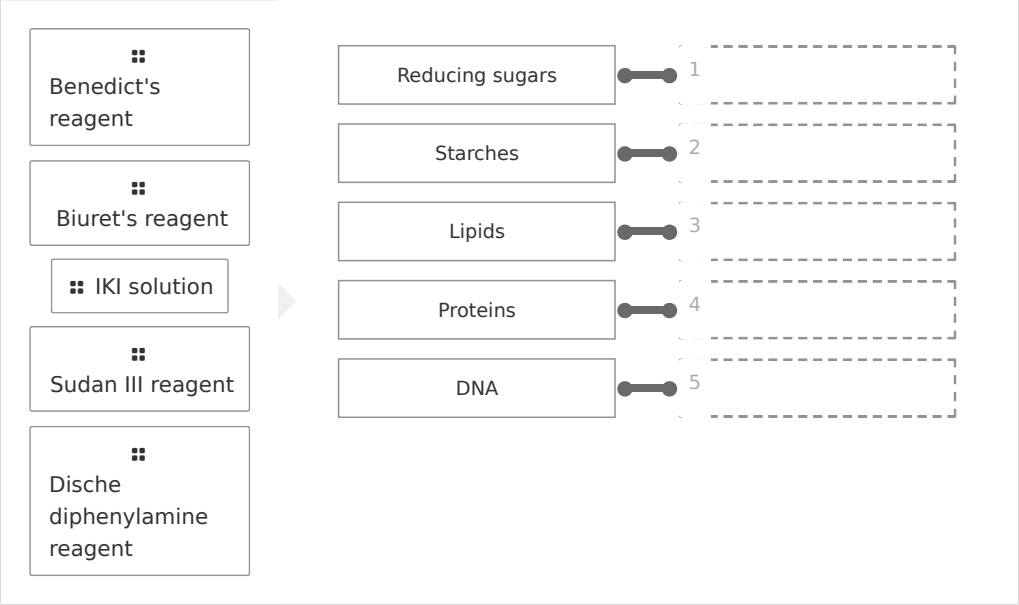
Biological Macromolecules - Digital

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Biology - Full Discipline Demo
Course	SI Biology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each reagent to the macromolecule it identifies.

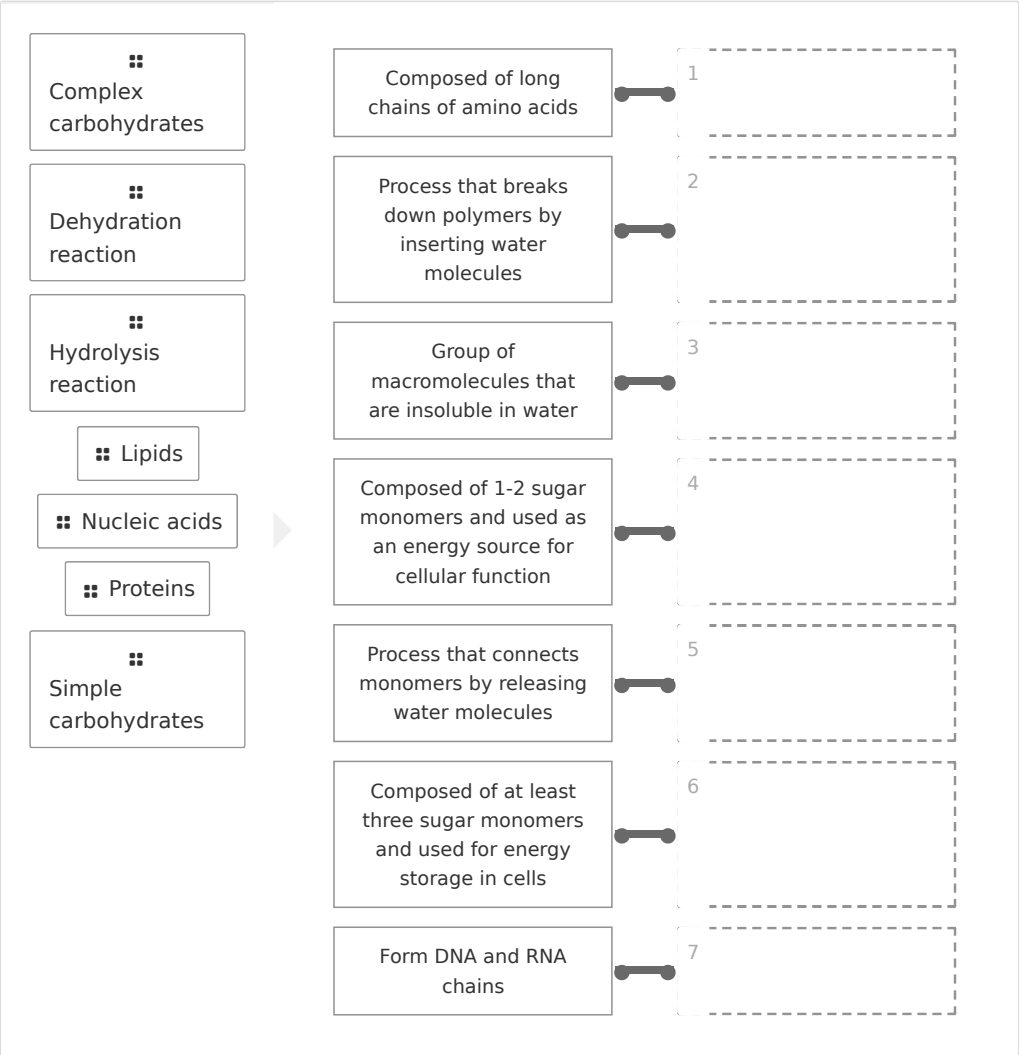


Correct answers:

1 Benedict's reagent 2 IKI solution 3 Sudan III reagent

4 Biuret's reagent 5 Dische diphenylamine reagent

Match each term with the best description.



Correct answers:

1 Proteins 2 Hydrolysis reaction 3 Lipids 4 Simple carbohydrates

5 Dehydration reaction 6 Complex carbohydrates 7 Nucleic acids

Exploration

Proteins are formed by long chains of _____.

- [x] amino acids
- [ ] lipids
- [ ] nucleic acids
- [ ] carbohydrates

Glucose is a _____ that serves as an energy source for many organisms.

- [ ] disaccharide
- [x] monosaccharide
- [ ] polysaccharide
- [ ] complex carbohydrate

IKI solution is used to detect _____.

- [ ] simple carbohydrates
- [ ] lactose
- [x] starch
- [ ] proteins

Lipids are a diverse group of macromolecules that are water soluble.

- [ ] True
- [x] False

Nucleic acids function for _____ in organisms.

- [ ] energy storage
- [ ] cell structure
- [x] genetic coding
- [ ] membrane transport

Exercise 1

What are the structural and functional differences between simple and complex carbohydrates?

Simple carbohydrates contain only one or two sugar monomers and function as energy for cellular processes. Complex carbohydrates are composed of at least three sugar monomers and may consist of hundreds of these units as with starch. Complex carbohydrates function as storehouses for energy, but these molecules must be broken down into simple carbohydrates before they can fuel cellular processes.

Did the Benedict's test of reducing sugars for the glucose and milk samples indicate similar sugar content? Reference Data Table 1 and Photo 1 in your explanation.

While both milk and glucose tested positive for reducing sugars as recorded in Data Table 1, the milk sample turned green indicating it had lower levels of reducing sugars than the 20% glucose sample which turned orange as shown in Photo 1.

Were reducing sugars or starch present in the unknown sample? Use your results in the data tables and phots to explain your answer.

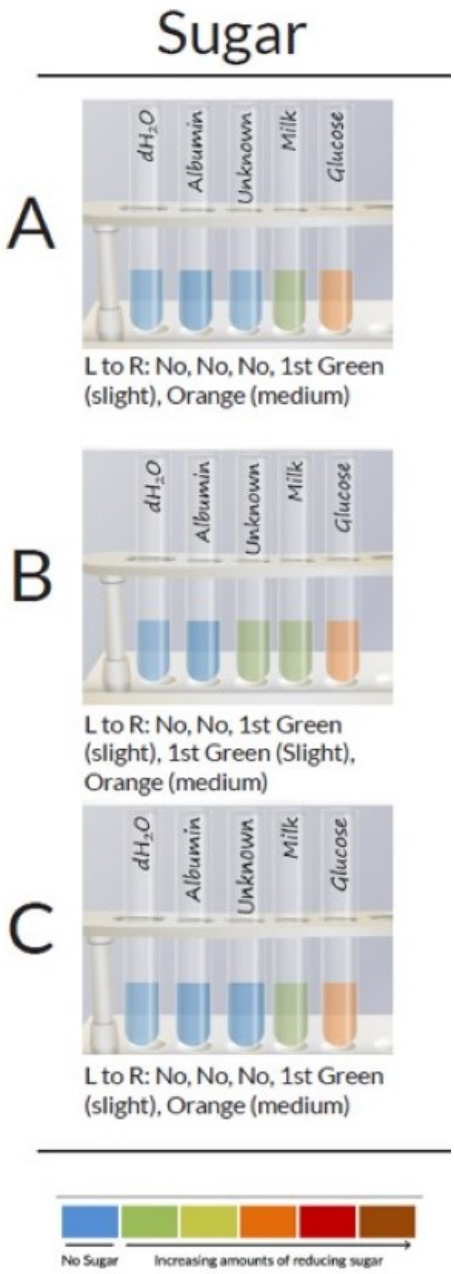
Reducing sugars were not present in the unknown, as indicated by the blue color when testing with Benedict's reagent as recorded in Data Table 1 and Photo 1. Starch was also not present, as indicated by the lack of an inky black color during the IKI test and as reported in Data Table 2 and Photo 2.

Data Table 1: Benedict's Reagent Data
(SAMPLE ANSWER BELOW)

Sample	Initial Color	Final Color	Reducing Sugar Present in Sample? Y or N
dH_2O	Light blue	Light blue	N
Albumin	Light blue	Light blue	N

Unknown	A, B, C are all light blue	A=Blue, B=Green, C=Blue	A=N,, B=Y, C=N
Milk	Light blue	Green	Y
Glucose	Light blue	Orange	Y

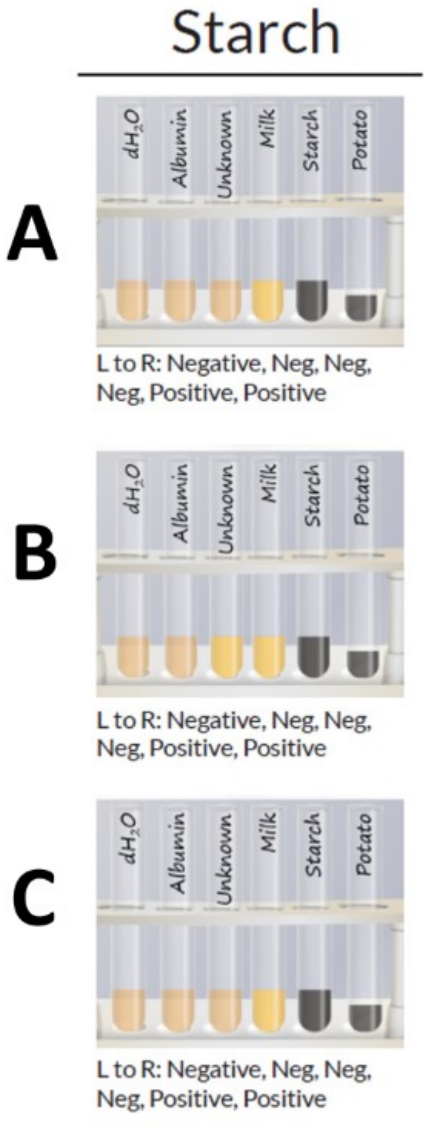
Photo 1: Benedict's Test Results
(SAMPLE ANSWER BELOW)



Data Table 2: IKI Test Data
(SAMPLE ANSWER BELOW)

Sample	Initial Color	Final Color	Starch Present in Sample? Y or N
dH_2O	Clear	Amber	N
Albumin	Clear with cloudy bits	Amber	N
Unknown	A, B, C all Clear	A, B, and C all Amber	A, B, C all = N
Milk	White	Amber	N
Starch	Clear	Black	Y
Raw Potato	Yellow	Black	Y

Photo 2: IKI Test Results
(SAMPLE ANSWER BELOW)



Exercise 2

Which of the macromolecules tested in this exercise (proteins, lipids, nucleic acids) were formed by dehydration reactions? Explain your answer by describing the structure of each macromolecule.

Proteins, lipids, and nucleic acids are all formed by dehydration reactions. Each of these macromolecules consists of small, repeated units, called monomers, bound together to form a chain. As each bond is formed in the chain, a molecule of water is produced.

The albumin for this experiment was sourced from an egg white. Would it have been possible to determine the identity of the unknown if a whole egg was used instead of only the albumin? Explain your answer noting that egg yolks contain lipids, proteins, and nucleic acids.

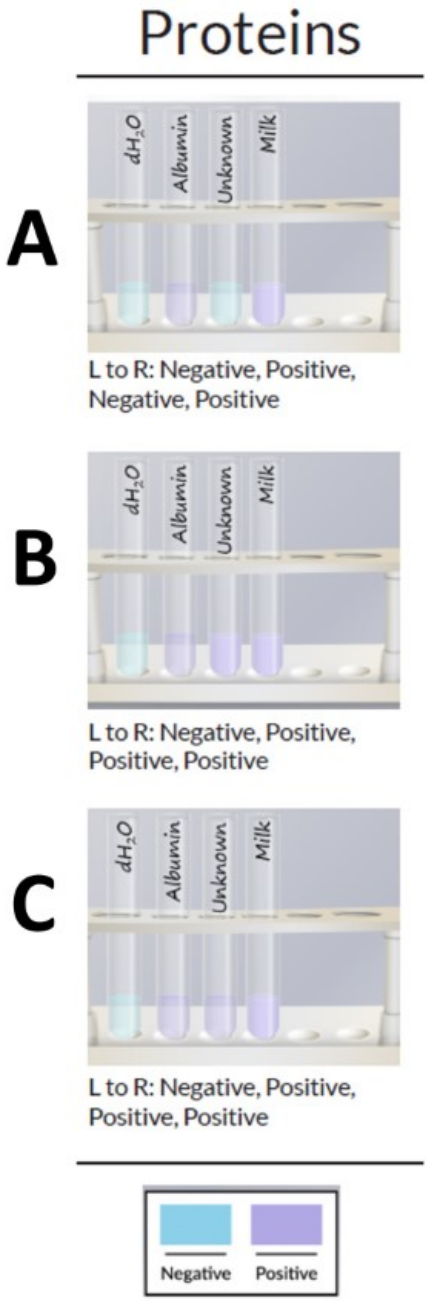
Students with unknowns B or C should answer "No". If the yolk of the egg were used in addition to the albumin, the sample would have generated positive results in the protein test, nucleic acid test, and in the lipid test. The unknown sample results would not have been consistent with any of the other samples and its identity would not have been determined. Students with unknown A should answer "Yes" as the addition of yolk would not have impacted their results, which were negative for all macromolecules.

Data Table 3: Biuret's Reagent Data
(SAMPLE ANSWER BELOW)

Sample	Initial Color	Final Color	Protein Present in Sample? Y or N

dH_2O	Clear	Clear Blue	N
Albumin	Clear with white bits	Purple with white bits	Y
Unknown	A, B, C all Clear	A = Clear Blue, B = Purple, C = Purple	A = N, B = Y, C = Y
Milk	White/cloudy	Purple/cloudy	Y

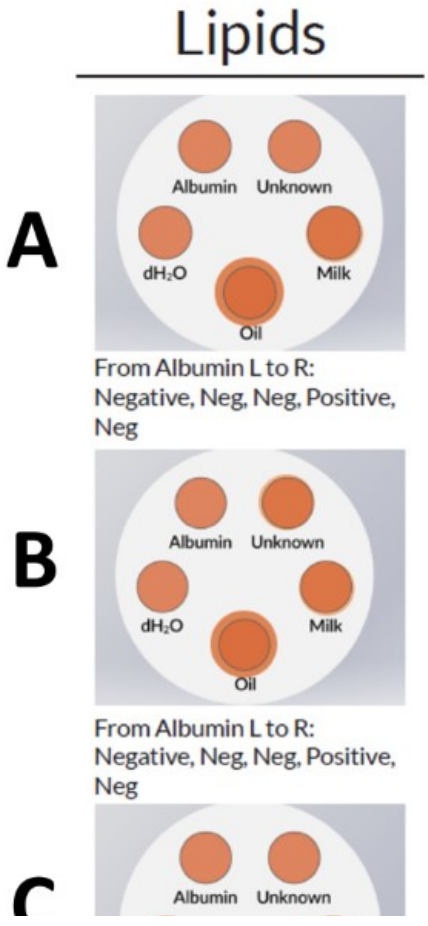
Photo 3: Biuret's Reagent Results
(SAMPLE ANSWER BELOW)



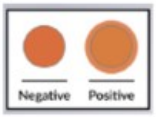
Data Table 4: Sudan III Data
(SAMPLE ANSWER BELOW)

Sample	Sample Observations	Lipid Present in Sample? Y or N
Distilled Water	The Sudan III did not extend over the pencil line	N
Albumin	The Sudan III did not extend over the pencil line, yet there was a small gray colored ring that formed just outside of the pencil line.	N
Unknown	A, B, C all = The Sudan III did not extend over the pencil line, yet there was a small gray colored ring that formed just outside of the pencil line.	A, B, C = N
Milk	The Sudan III slightly migrated outside the pencil line as a pale orange color.	N
Vegetable Oil	The Sudan III extended over the pencil line, approximately 0.5 inches around the line.	Y

Photo 4: Sudan III Results
(SAMPLE ANSWER BELOW)



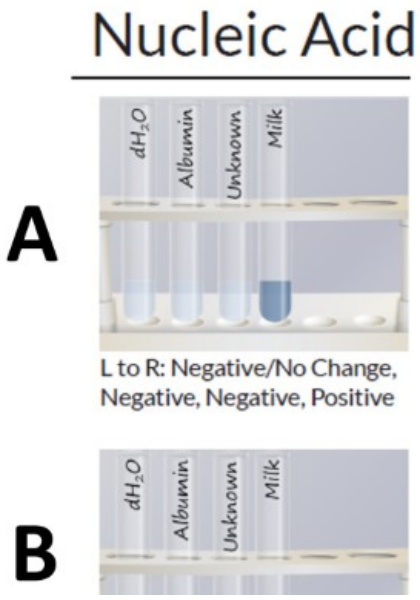
From Albumin L to R: Negative, Neg, Neg, Positive, Neg

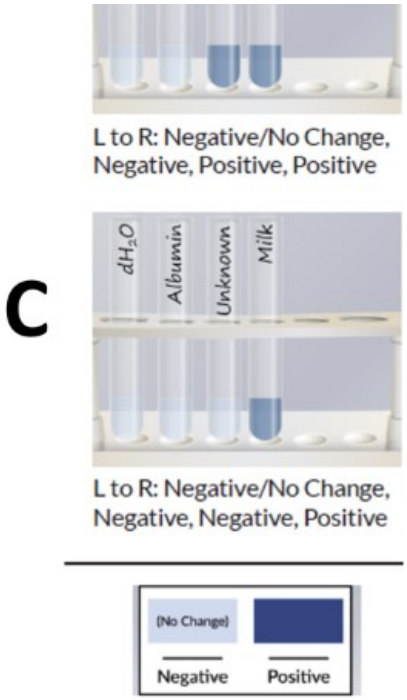


Data Table 5: Dische Diphenylamine Data
(SAMPLE ANSWER BELOW)

Sample	Sample Observations	DNA Present in Sample? Y or N
Distilled Water	No color change	N
Albumin	No color change	N
Unknown	A = No color change, B = Turned dark blue, C = No color change	A = N, B = Y. C = N
Milk	The solution turned dark blue	Y

Photo 5: Dische Diphenylamine Reagent Results
(SAMPLE ANSWER BELOW)





Data Table 6: Results Summary
(SAMPLE ANSWER BELOW)

Sample	Reducing Sugars (Y or N)	Starch (Y or N)	Protein (Y or N)	Lipids (Y or N)	DNA (Y or N)
Distilled Water	N	N	N	N	N
Albumin	N	N	Y	N	N
Unknown	A = N, B = Y, C = N	A, B, and C all = NN	A =N, B = Y, C = YY	A, B, and C = NN	A - N, B = Y, C = N
Milk	Y	N	Y	N	Y

Panel 1: Unknown Identity
(SAMPLE ANSWER BELOW)

Unknown A is distilled water as both it and the distilled water sample were negative for all biological macromolecules. Unknown B is milk. Milk was determined as the results for the unknown matched only milk: positive reducing sugars, protein, and nucleic acid, and negative for starch and lipids. Unknown C is albumin. Albumin was determined as the results for unknown testing matched only albumin: positive for protein and negative for reducing sugars, starches, lipids, and nucleic acids.

Competency Review

_____ are macromolecules formed of chains of amino acids.

- Lipids
- Carbohydrate
- Proteins ✔
- Nucleic acids

Stored polysaccharides are broken down into simple sugars when cells require energy.

- True ✔
- False

_____ reagent is used to indicate the presence of reducing sugars.

- Benedict's ✔
- Biuret's
- IKI
- Sudan III

Examples of lipids include _____ and other molecules that are not water soluble

- monosaccharides
- disaccharides
- oils ✔
- RNA

DNA occurs as a single-stranded nucleic acid composed of adenine, thymine, cytosine, and guanine.

- True
- False ✔

When using IKI indicator, an inky black colored solution is a positive test result for _____.

- proteins
- reducing sugars
- starch ✔
- DNA

The Sudan III test is performed by carefully adding one drop of reagent followed by a drop of sample to filter paper.

- True ✔
- False

Biuret's reagent turns from blue to _____ when mixed with a sample containing peptide bonds.

- purple ✔
- black
- orange
- yellow

An unknown tested negative for reducing sugars, starch, lipids, and DNA but positive for proteins. The sample could be identified as _____.

- glucose
- canola oil
- milk
- albumin ✔

Extension Questions

Sam is a biology lab instructor at a local college. One of his online students asks if they can replace the 2% fresh milk required for their macromolecule testing experiment with unsweetened almond milk, a plant-derived product. The nutrition label is pictured below.

Nutrition Facts

Serving Size 8 fl oz (237ml)
Servings Per Container 6

Amount Per Serving

Calories 35	Calories from Fat 30
	% Daily Value*
Total Fat 3g	**5%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 1g	**0%**
Dietary Fiber 1g	**4%**
Sugars 0g	
Protein 1g	
Vitamin A 0% • Vitamin C 0%	
Calcium 45% • Iron 2%	

*Percent Daily Values are based on a 2,000 calorie diet.

What should Sam recommend to the student regarding the substitution for procedures that mirror the ones used in the lab you just completed? Explain your answer by including the testing results that the almond milk will generate for proteins, lipids, reducing sugars, starch, and DNA based on your experience when completing the exercises for this laboratory.

(SAMPLE ANSWER BELOW)

Sam should not recommend the student use almond milk as the macromolecules differ from those in 2% milk. Unsweetened almond milk lacks reducing sugars and would produce negative results when performing Benedict's test. Conversely, almonds contain starch (dietary fiber) and would produce positive results when using IKI indicator, unlike 2% milk. Lastly, almond milk contains very little protein and might not produce positive results for the Biuret test.