Chemistry in biology: Practice on the fundamentals of bonding:

These are some 'drills' on the basics – practice questions to make sure you get the fundamentals. Work with these questions first to build up your skills with covalent and non-covalent bonds. We'll apply these skills when talking about macromolecular assemblies and structures in the cell.

We encourage you to come to the biology learning centre (**Wesbrook room 200**) to work on these problems on your own or in groups, and with the peer tutors. Also, your instructor is happy to help at office hours.

1. A noncovalent bond is a type of _____, typically between macromolecules, that does not involve the sharing of pairs of electrons, but rather involves more dispersed variations of electromagnetic interactions between or within a molecule(s).
   A) Hydrogen bond
   B) Chemical bond
   C) Covalent bond
   D) Chemical polarity

2. Two large proteins are interacting and held together by non-covalent bonds on their surfaces. Why can these non-covalent bonds hold the proteins together?
   A) They are strong bonds.
   B) There are many bonds.

3. In macromolecular synthesis/polymerization, what type of bond would join two amino acid subunits?
   A) glycosidic bond
   B) phosphodiester bond
   C) hydrogen bond
   D) peptide bond
   E) ester bond

4. In macromolecular synthesis/polymerization, what type of bond would join two monosaccharide subunits?
   A) glycosidic bond
   B) phosphodiester bond
   C) hydrogen bond
   D) peptide bond
   E) ester bond

5. In macromolecular synthesis/polymerization, what type of bond would join two nucleotide subunits?
   A) glycosidic bond
   B) phosphodiester bond
   C) hydrogen bond
   D) peptide bond
   E) ester bond

6. In lipid synthesis/polymerization, what type of bond would join two monomers?
   A) glycosidic bond
   B) phosphodiester bond
   C) hydrogen bond
   D) peptide bond
   E) ester bond

7. Of the atoms shown below what are the most common atoms with high electronegativity? (choose all that apply)
    A) C
    B) H
    C) O
    D) N
    E) P
    F) S

8. Which of these bonds are polar covalent? (choose all that apply)
    A) O-H
    B) N-H
    C) C-H
    D) S-H
    E) C-C
    F) O-C
    G) N-C

9. A hydrogen bond is a special case of which non-covalent interaction?
    A) Ionic
    B) Ion – permanent dipole
    C) Permanent dipole – permanent dipole
    D) Permanent dipole – induced dipole
    E) Induced dipole – induced dipole

10. When two atoms are involved in a polar covalent bond, what is the charge on each atom?
    A) One is a +1 charge and the other is a -1 charge
    B) One has a permanent partial positive (delta+) and the other has a permanent partial negative (delta-).
    C) Both atoms fluctuate between partial positive and partial negative charges.

11. When two atoms are involved in a nonpolar covalent bond, what is the charge on each atom?
    A) One is a +1 charge and the other is a -1 charge
    B) One has a permanent partial positive (delta+) and the other has a permanent partial negative (delta-).
    C) Both atoms fluctuate between partial positive and partial negative charges.

12. When an atom is part of a polar covalent bond, what **types** of noncovalent interactions are possible for this atom to be part of, with another atom? (Choose all that apply)
    A) Ionic
    B) Ion – permanent dipole
    C) Permanent dipole – permanent dipole
    D) Permanent dipole – induced dipole
    E) Induced dipole – induced dipole

13. When an atom is part of a polar covalent bond, what **is the strongest** noncovalent interaction that it is possible for this atom to be part of, with another atom?
    A) Ionic
    B) Ion – permanent dipole
    C) Permanent dipole – permanent dipole
    D) Permanent dipole – induced dipole
    E) Induced dipole – induced dipole

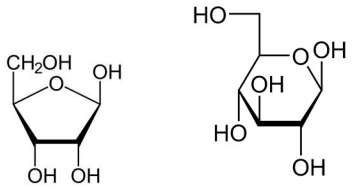
14. When an atom is part of a non-polar covalent bond, what **types** of noncovalent interactions are possible for this atom to be part of, with another atom? (Choose all that apply)
    - A) Ionic
    - B) Ion – permanent dipole
    - C) Permanent dipole – permanent dipole
    - **D) Permanent dipole – induced dipole**
    - **E) Induced dipole – induced dipole**

15. When an atom is part of a non-polar covalent bond, what **is the strongest** noncovalent interaction that it is possible for this atom to be part of, with another atom?
    - A) Ionic
    - B) Ion – permanent dipole
    - C) Permanent dipole – permanent dipole
    - **D) Permanent dipole – induced dipole**
    - E) Induced dipole – induced dipole

16. When an atom or functional group is ionized (e.g. an NH_3+ group or a COO- group) what **is the strongest type** of noncovalent interactions is possible for it to be part of, with another atom/group?
    - **A) Ionic**
    - B) Ion – permanent dipole
    - C) Permanent dipole – permanent dipole
    - D) Permanent dipole – induced dipole
    - E) Induced dipole – induced dipole

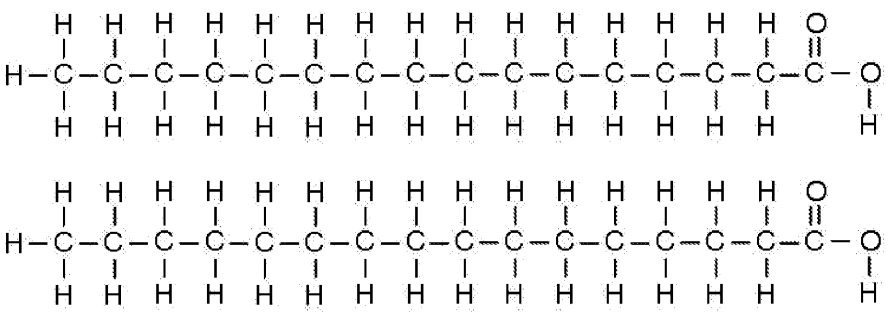
Some applications in biology…

17. What is the strongest type of non-covalent interaction that these two molecules could share?



    - A) Ionic
    - B) Ion – permanent dipole
    - **C) Permanent dipole – permanent dipole**
    - D) Permanent dipole – induced dipole
    - E) Induced dipole – induced dipole

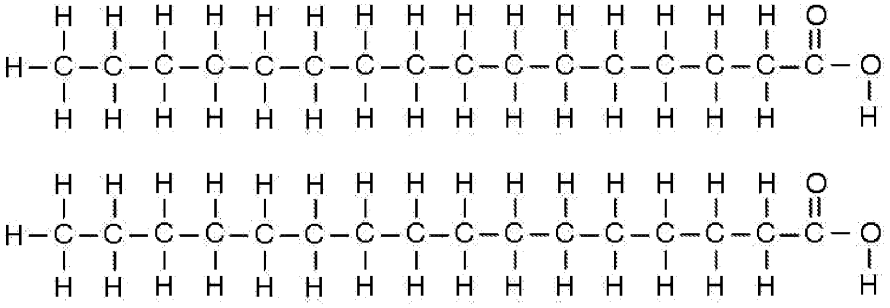
18. What is the **strongest** type of non-covalent interaction that these two molecules can share?



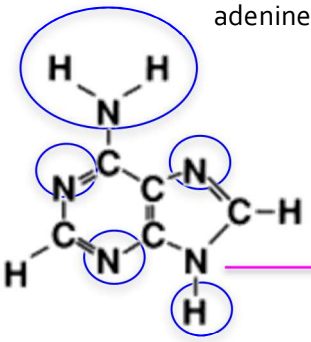
    - A) Ionic
    - B) Ion – permanent dipole
    - **C) Permanent dipole – permanent dipole**
    - D) Permanent dipole – induced dipole
    - E) Induced dipole – induced dipole

19. **Most** of (the largest number of) the non-covalent interactions that these molecules can share will be…

A) Ionic
B) Ion – permanent dipole
C) Permanent dipole – permanent dipole
D) Permanent dipole – induced dipole
E) Induced dipole – induced dipole



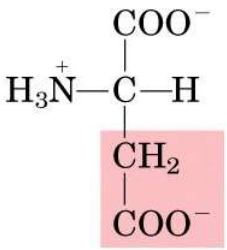
20. The molecule at the right is part of hydrogen bonds.



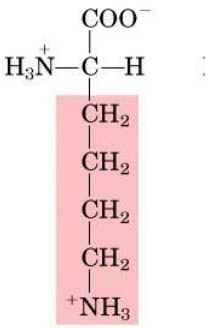
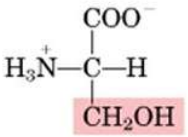
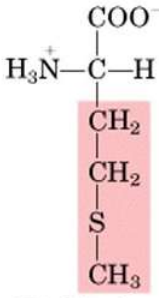
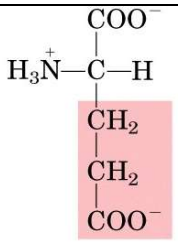
adenine. Circle all of the atoms in adenine that could be

The lone pair on this N cannot be involved in H-bond, because of its involvement in maintaining the stability of the ring.
BIOL 112 students will not be responsible for this level of details.

21. Shown below are some amino acids. For this question, consider only their side chains (in the boxes).



Which amino acid side chain below will aspartate's side chain be able to share the strongest attractive interaction with? **Lysine, ionic**

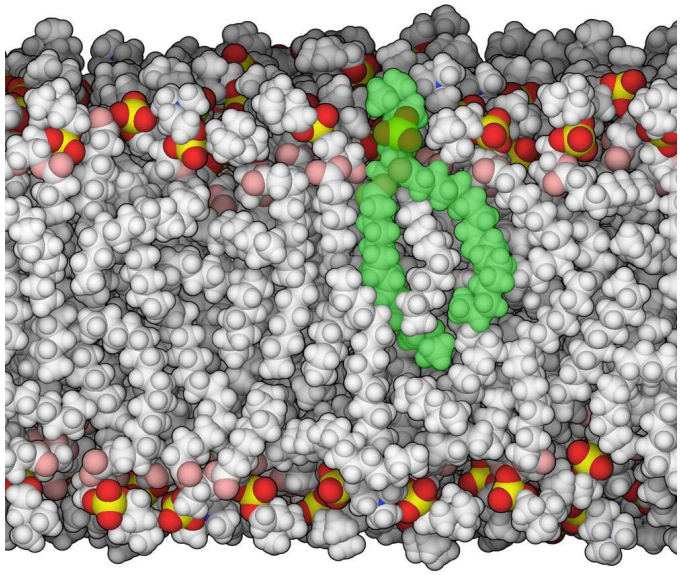
A)	B)	C)	D)
 Lysine	 Serine	 Methionine	 Glutamate

Aspartate

22. Shown below is a phospholipid bilayer. Oxygen is shown in red/pink, Carbon and Hydrogen are both white, and yellow is Phosphorus.

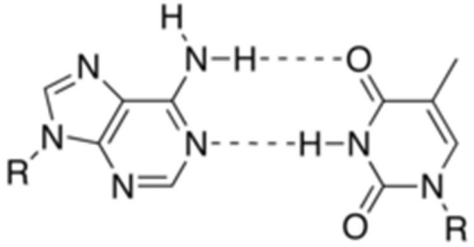
Predict what types of non-covalent interactions the non-polar region of the green phospholipid is sharing with its neighbours. (choose all that apply, and write down which atoms are involved in each.)

A) Ionic
B) Ion – permanent dipole
C) Permanent dipole – permanent dipole
D) Permanent dipole – induced dipole
E) Induced dipole – induced dipole



Which are the strongest interactions? **PD-ID**
Which are the most numerous? **ID-ID**

23. Shown below are two nucleotide bases. Their non-covalent interactions are shown with dashed lines. What types of non-covalent interactions are these molecules sharing with each other?



Adenine Thymine

A) Ionic
B) Ion – permanent dipole
C) Permanent dipole – permanent dipole
D) Permanent dipole – induced dipole
E) Induced dipole – induced dipole