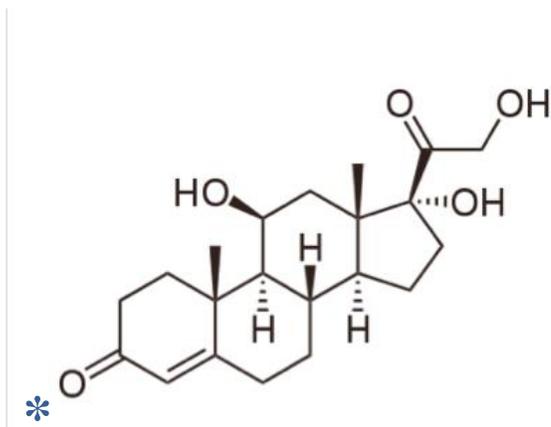


NAME: _____ ANSWERS _____**Quiz 4 November 18, 2009**

1. We have spent the last two weeks talking about cell signaling. In each type of signaling molecule, messages needed to be sent from one part of the body or cell to another. This question asks you to think about the molecules we have discussed according to the time frame in which this signal needs to act. Give as best you can an example of a precise signaling molecule (not class of molecules such as steroids) that act in each time domain and give the where what and how answers requested.

Time scale of response	Example of signaling molecule	Where is it made/stored?	What part of cell / body does it act upon?	How does it get from one place to another?
1-20sec	NO	Epithelial call walls, neurons	Close by where it is made or stored	Gas diffusion which is very rapid requiring no receptors
20 sec-1 min	IP3, Ca(II), 5HT, dopamine	IP3: cell membranes; Ca(II) sequestered inside vesicles; 5HT, dopamine in neurons	General cell functions such as cell metabolism and division; nerve synapse	IP3: diffuses through cell; Ca(II) carried by calmodulin; 5HT and dopa diffuse across synapse
1 min-1 hour	Any peptide hormone such as oxy, vaso, insulin, HCG, LH; also cortisol	Oxy, vaso: pituitary; insulin: pancreas; HCG, fetus; LH ovaries; Cortisol, adrenal	Oxy and vaso; brain as well as breast and uterine muscles (oxy) and kidneys (vaso)	Often carrier proteins, sometimes soluble in blood
1 day-1month	steroids such as estrogen, testosterone	Ovaries(est) and testes (test)	Est: breast, uterine, brain, bone, cardiovascular system ; Tes; testes /general	Usually carrier proteins through blood

2. Shown below is the hormone cortisol, which is often called the stress hormone.



This molecule is part of a class or molecules called steroid hormones. The molecule at left has 21 C atoms. This particular hormone is synthesized in the adrenal glands. Once at its target cells, it passes through the cell membrane and bind to receptors inside the cell. When bound inside the cell, the most important atom that guides the making of H-bonds in the A ring of the molecule is **labeled with a *** (do this)

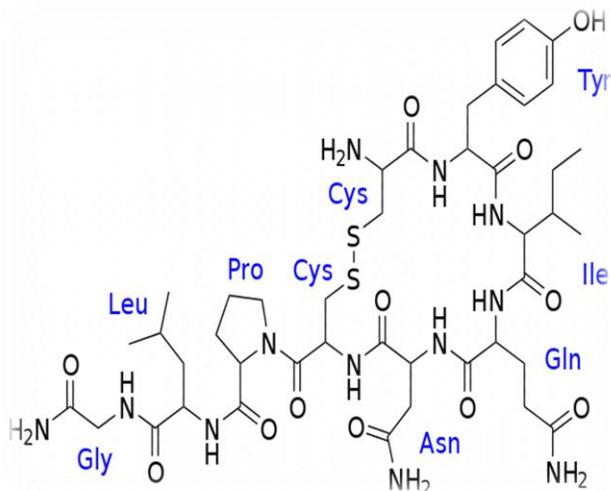
on the drawing. Once bound, they travel to the nucleus where they bind to promoter sequences in the DNA and initiate transcription. Cortisol is absent in people with Addison's disease.

3. Nitric oxide is made by the enzyme nitric oxide synthase which exists in three forms eNOS, nNOS, and iNOS. When you knock out the gene for the enzyme that makes NO in mice that is active in neurons, the consequence of this for the behavior in male mice is that they show high levels of aggression. Paradoxically, serotonin, also known as 5HT, can also be linked to this same behavior, although here knock out the gene to transport serotonin, then male mice more calm.

The Lewis Structure with formal charge for the NO is shown in the box below:

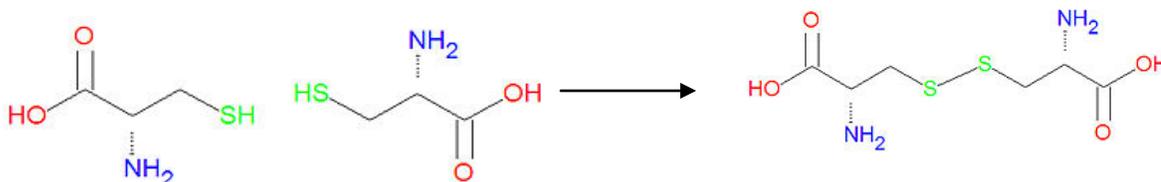
Lewis Structure NO	Total Number of Electrons	Formal Charge
$\begin{array}{c} \cdot \quad \ddot{} \\ \text{:N=O:} \end{array}$	11	$\begin{array}{l} \text{FC N} = 5 - (3 + \frac{1}{2}(2)) = 0 \\ \text{FC O} = 6 - (4 + \frac{1}{2}(4)) = 0 \end{array}$

4. _____ is a complex human disease that typically appears during the first two years of life and is the result of a neurological disorder that affects the functioning of the brain, impacting development in the areas of social interaction and communication skills.



Researchers have discovered that one group of children with this disorder fail to make oxytocin, and instead, have high levels of the prohormone, OXY-X in their blood, presumably due to a defect in the enzyme that catalyzes the transformation. The chemical structure of oxytocin is shown at left. The class of signaling molecules that this falls into is _____ hormones. This particular one has _____ amino acids. The amino terminal is circled (**do that**) and the carboxy

terminus has a square drawn around it (**do that as well**). The _____ bond that forms to convert this into a cyclic peptide occurs when the side groups of two of the amino acid _____ bind together. In making this bond, the sulfur atom goes from being bonded to one C (electronegativity=2.5) and one H (en=2.1) to being bonded to one C and one S (en=2.5) (see below). In this transformation, the oxidation state of the S changes from _____ to _____ and so therefore, it is oxidized/reduced (**cross out the wrong term**).



5. Here is the table prepared by the class for testing the sensitivity of the Pregnancy detection kit which detects the presence of the pregnancy hormone HCG.

Dilution factor	1/100	1/200	1/1000	1/10,000	1/100,000
Pregnant?	YES	YES	NO	NO	NO

1. The stock HCG solution was 1.00 microgram per ml. What is the detection limit of the kit in micrograms per ml? (1 microgram = 10^{-6} g)
2. How would you prepare a 1/200 dilution from the HCG stock if you wanted to make a total of 5.00 ml of the solution?
3. Even if we had gotten cross-reactivity of the HCG with the LH ovulation kit (we did get a very little at the highest concentration), we would not have been able to say if it was an agonist or antagonist. Why is that?