LEGO 'Lunatics', Model 'Maniacs' and Puzzle 'Problem Solvers'

Hands-on activity geared to 9th and 10th grade biology and chemistry courses. Latter part of activity geared to A/P biology classes

1. Teacher using the 8-pegged Duplo blocks, while students use 8-pegged standard LEGO blocks:
    a. Depiction: the carbon atom and its 4 bonds
    b. Carbon to carbon single bonds would cover half a block
    c. The four bonds would have two on the bottom and two on the top of each C atom (8-pegged block)
    d. Four carbon atoms could attach to each block; one would not present this in one dimension as the four carbon atoms would be set at 90° angles
2. Teacher using six 8-pegged Duplos as molecules, while students use six 8-pegged LEGOs
    a. A molecule might bind to another molecule in a similar fashion
    b. Join them such that one molecule is bound to another in a linear fashion (again the binding would be ½ block)
    c. Is there a second manner to do single bonds such that a stronger product would result?
    d. Try binding one block to the top of a block, then the third block to the bottom of block 2.
    e. This results in a "wall". Note the length of the six blocks is the same if binding in this manner and the former manner. This format is structurally stronger, more difficult to break apart
3. Can one make an even stronger macromolecule?
    a. A ring structure: Start the first two carbon atoms in the linear manner. The third and fourth carbon atoms are rotated 90° with the third carbon bound under the second carbon, and the fourth carbon bound over the third carbon. The 5th carbon atom is linear to the fourth and bound under it, and the sixth carbon atom is rotated 90° and attached to the first and fifth carbon atom
    b. A ring structure is even harder to break; the bonds are structurally stronger. This the most stable molecular form of the three models.
4. Photosynthesis (Ps)
    a. What is it? Process whereby light energy is transformed into chemical energy
    b. Equation: carbon dioxide plus water equals glucose plus oxygen
    c. Math; balanced equations: C, O and H molecules must balance on both sides of equation
    d. How do plants produce glucose? Need enzymes Not simple, if it was sugar might rain from clouds, no food shortage
    e. What are enzymes? Active proteins that can either build or break apart molecules.
    f. How is the principle product of Ps used in plants? – Bio facts comes in here
        i. Energy storage macro-molecule (starch)
        ii. Structural macro-molecule (cellulose)
5. Making Macro-molecules

a. Bags of 6-pegged LEGOs made into glucose molecules
b. Note carbon atoms are numbered, oxygen atom in the carbon ring is delineated by a different color.
c. Students take bags of glucose molecules and 'act as enzymes' to build a new molecule by attaching the first carbon to the fourth carbon (producing C1/C4 bonds).
d. Any 'mutations' seen? What type of molecule resulted? In what manner might C1/C4 bonds be created?

6. Enzyme Specificity
    a. In each cell of plants, animals and microorganisms enzymes work to produce and break apart (digest) complex molecules such as carbohydrates, proteins and lipids.
    b. Each enzyme has a specific job.
    c. In the cell DNA is translated and RNA forms. The RNA is transcribed to form both structural and active proteins (enzymes). Enzymes, or groups of enzymes work to build the various organelles and macromolecules located in each cell in each organism.
    d. There are many places along this chain of metabolic events where errors (mutations) can occur.
7. Schmuzzle Puzzles
    a. Each person gets a little bag of lizard-shaped puzzle pieces.
    b. Note one may put the lizards together in many ways (one length, a ring, a solid shape).
    c. Put your pieces together. Turn your product over.
    d. Did a picture form? No. You had placed your pieces together in a random manner. You were not working as an enzyme in this case.
    e. Now 'act as an enzyme' and create a picture using your specific Schmuzzle pieces.
8. Back to DNA to RNA to enzymes to products
    a. Final product a complete picture no mutations
    b. Maybe a small mutation whereby the picture is not perfect, one can see it
    c. Major mutation no good product (no corn picture); cell/organism might not survive
9. English and the enzyme analogy
    a. Letters of the alphabet create words
    b. Words are put into sentences (with correct punctuation)
    c. Sentences make paragraphs or answer questions
    d. An introduction, body paragraphs and a conclusion will make an essay or a story