Today's Info

- Updated with Quiz 12-please check
- Final is 6/8 at 5:30pm
- Reminder-last HW is due next Monday
- All challenges to HW and quiz scores must be made by 12noon, June 9
- The page for practicing standard cell notation is available
- A copy of last year's final is posted on the class web site (pdf file)
- A compilation of all the exams and quizzes is posted (pdf file)

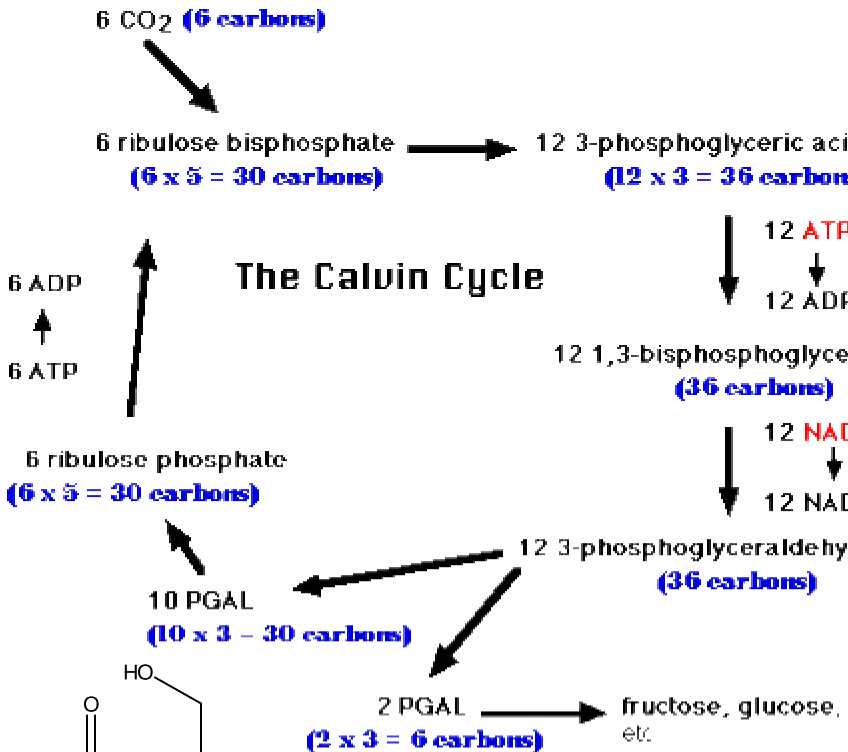
Coordination Complex Summary

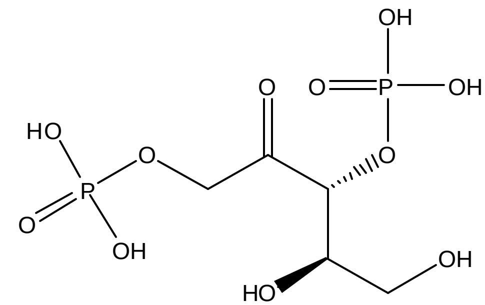
- M^{c+} + nL: => ML_n (Lewis acid/base adduct)
- Compounds exhibit usual properties with regards to:
  - color
  - variation in magnetic properties
    - diamagnetic-no unpaired eletrons
    - paramagnetic-one or more unpaired electrons
  - structure
- VBT-
  - get e- count correct or abandon all hope
  - octahedral,tetrahedral and square planar
  - know orbital ordering
  - inner and outer sphere, high and low spin
- CFT
  - get d e- config for metal correct or punt
  - octahedral only
  - strong and weak field, high and low spin

Photosynthesis

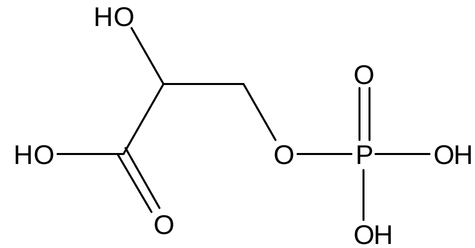
- The site below is a nice intro to the process with sufficient detail to give a fairly good sense of what's involved. Includes links to show how the Calvin cycle was identified
- http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/C/CalvinCycle.html
- The reaction:
  - $6CO_2 + 6H_2O \Rightarrow C_6H_{12}O_2 + 6\ O_2$
- Give me a break!
- In how many ways is this reaction a loser?
- What's the simple description of what is going on?

The Calvin Cycle

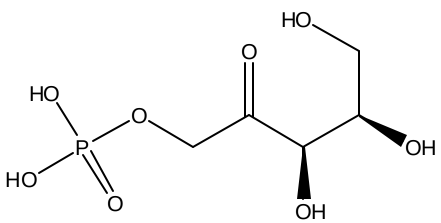




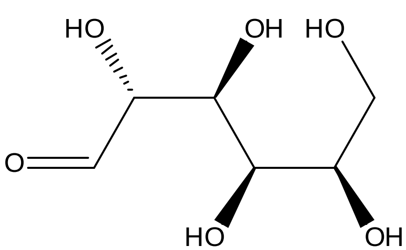
ribulose bisphosphate



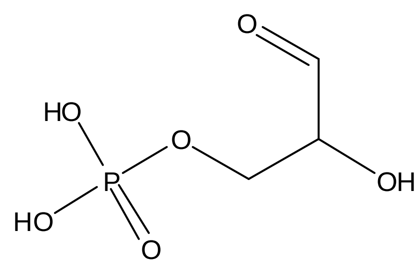
3-phosphoglyceric acid



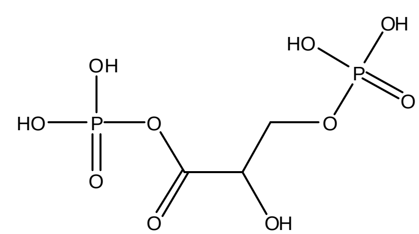
ribulose phosphate



glucose



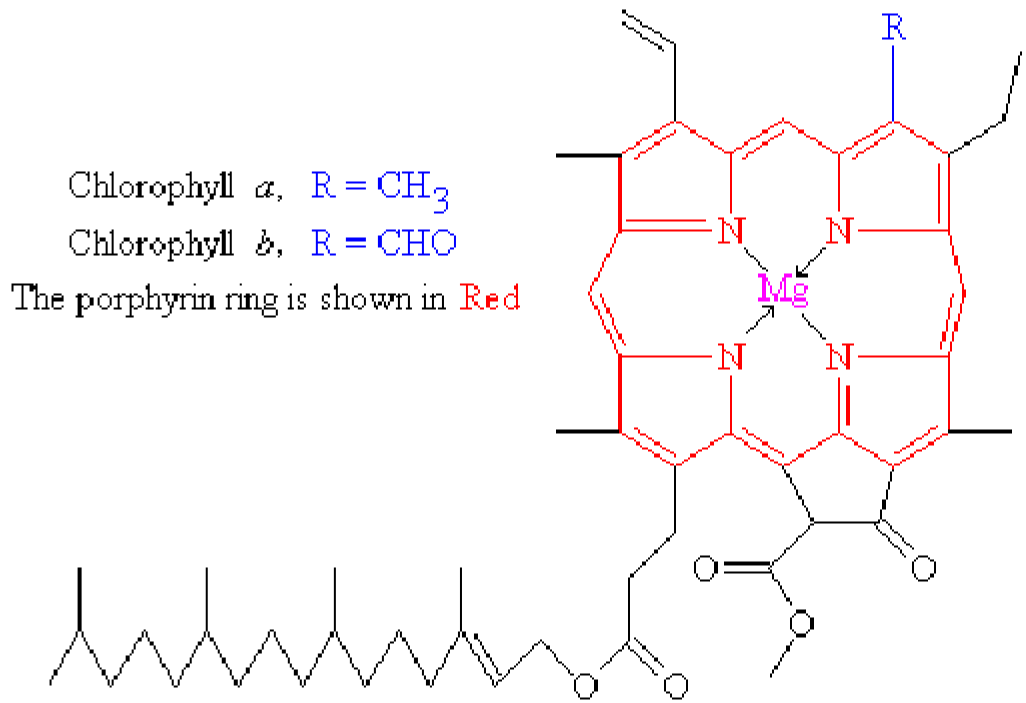
3-phosphoglyceraldehyde



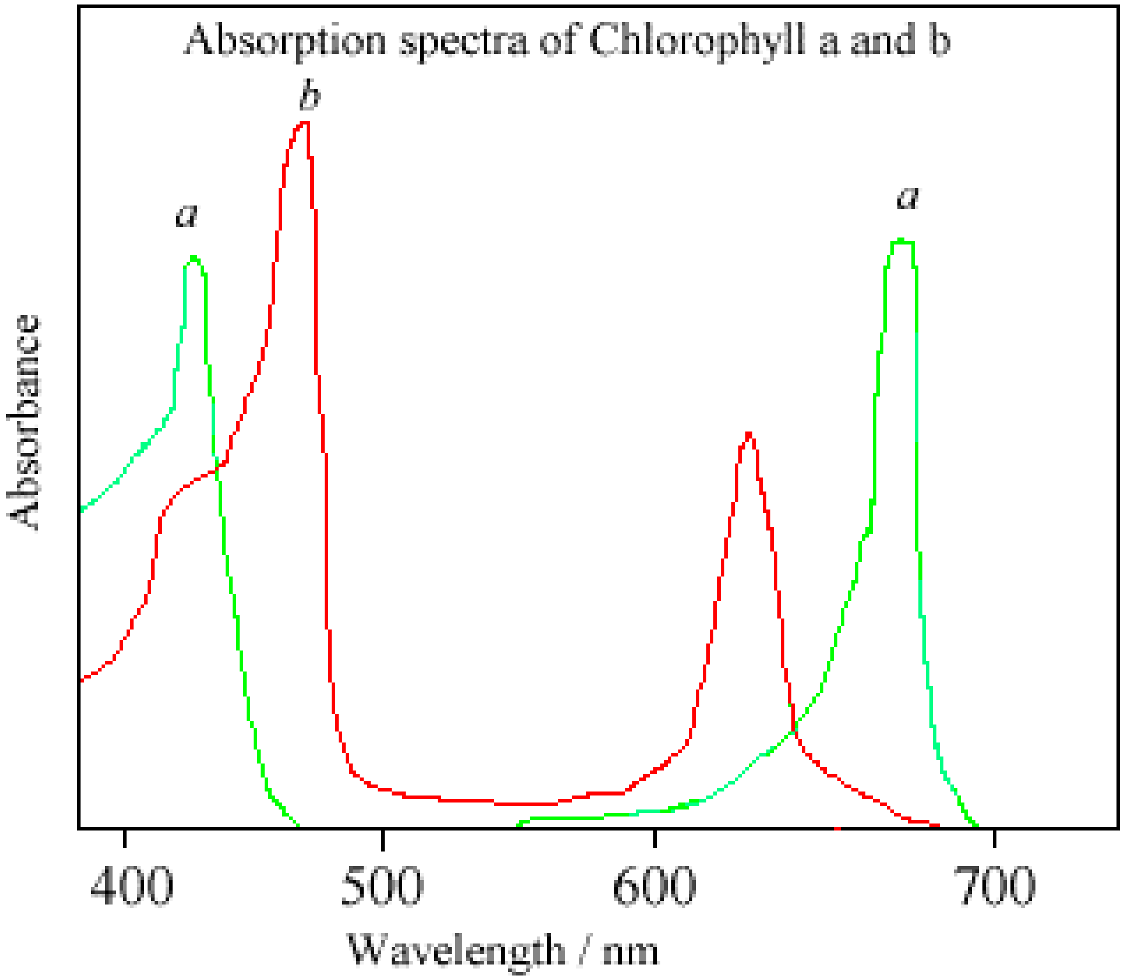
1,3-bisphosphoglyceric acid

O

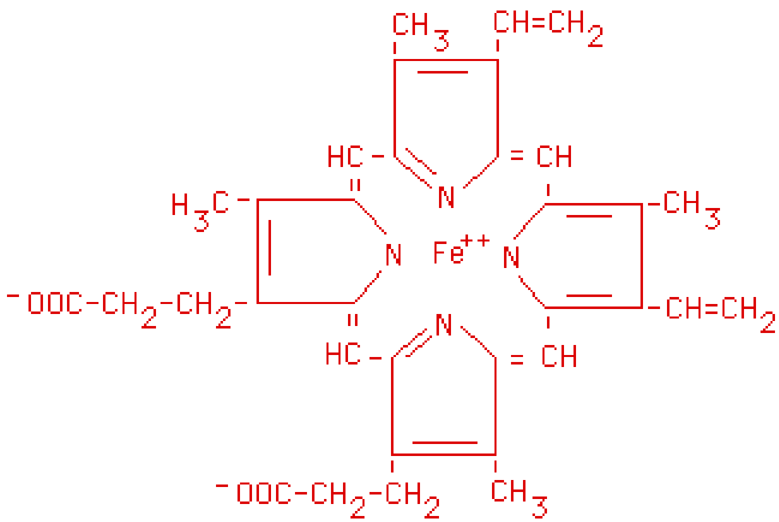
Chlorophyll



Spectra of Chlorophyll

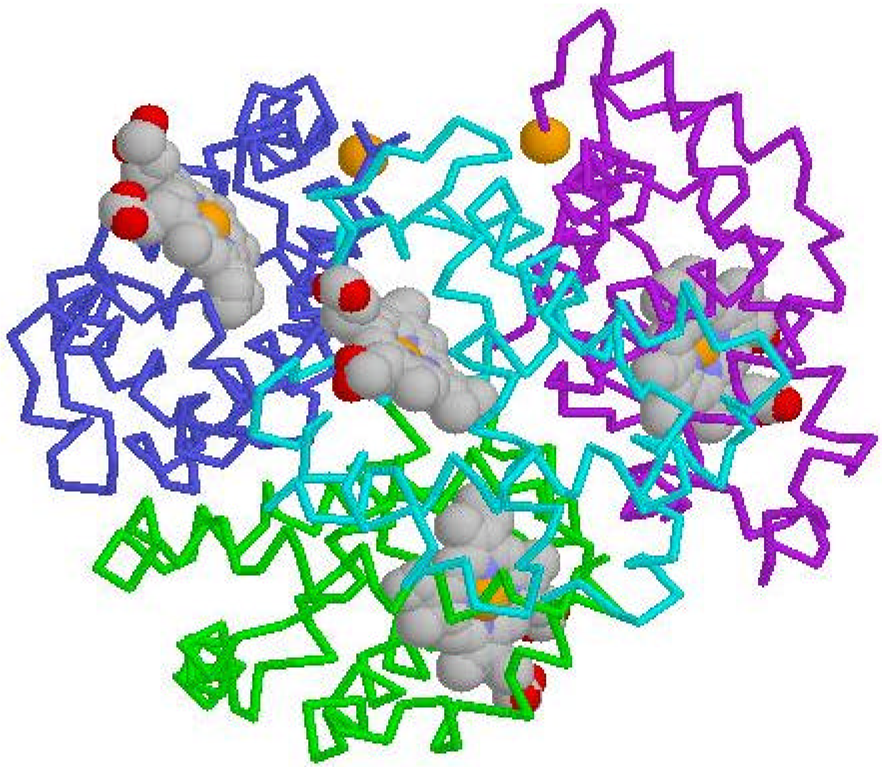


Heme-Iron Porphyrins

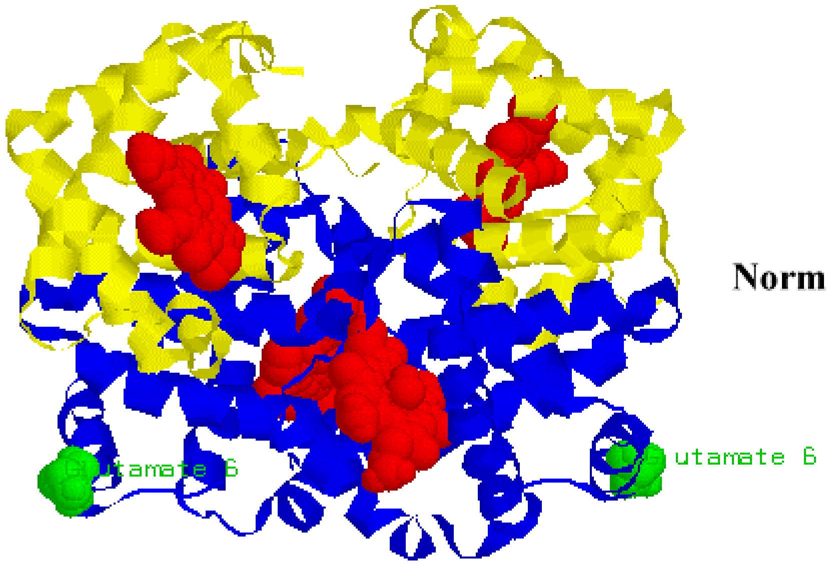


Heme

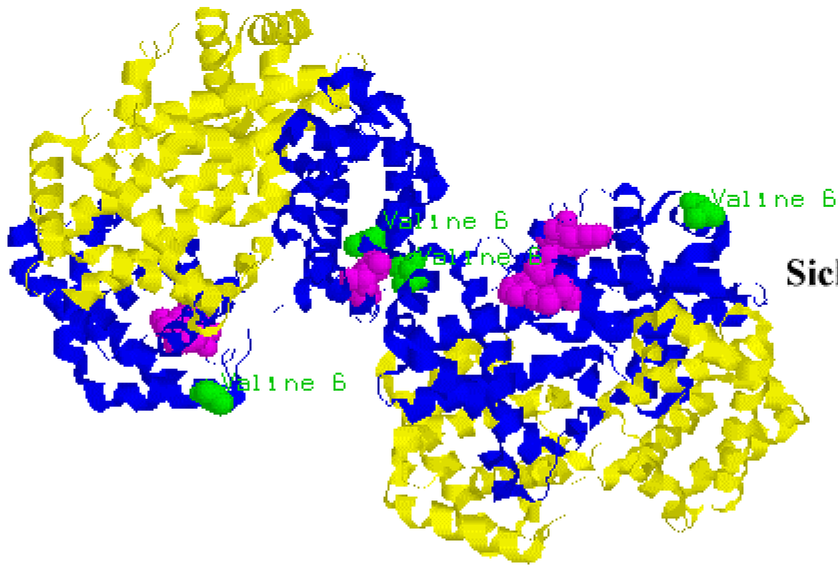
Hemoglobin



A Small Change



Normal Hemoglobin



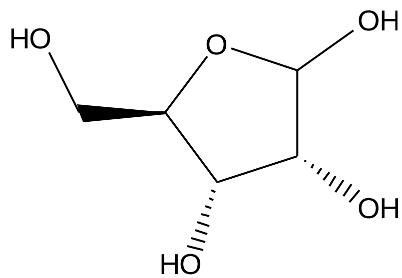
Sickle Hemoglobin

Note: The Sickle hemoglobin image is drawn at 50% of the size of the Normal hemoglobin

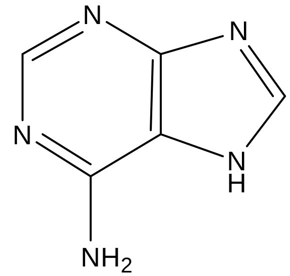
Where from come these porphyrins?

- OK-here's what happens.
- glycine($NH_2CH_2CO_2H$) reacts with succinyl CoA in a reaction catalyzed by δ-aminolevulinic acid synthetase and requiring pyroxidal phosphate. This produces δ-aminolevulinic acid ($NH_2CH_2COCH_2CH_2CO_2H$)
- 2 δ-aminolevulinic acid molecules combine to create porphobilinogen which has the five member pyrrole ring which is the basis of porphyrin
- By magic, four of the porphobilinogen molecules combine linearly and then cyclize.
- OK, it's not magic. The enzyme for the condensation of the four monomers is called PBG deaminase. The product is hydroxymethylbilane. It is enzymatically converted to uroporphyrinogen III(a porphyrin), the next intermediate on the path to heme. This step requires the enzyme uroporphyrinogen synthase plus a protein known as uroporphyrinogen III cosynthase.
- radio tracer studies show that all of the nitrogen in the porphyrin comes from glycine.

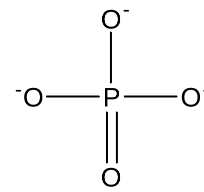
Nucleic Acids



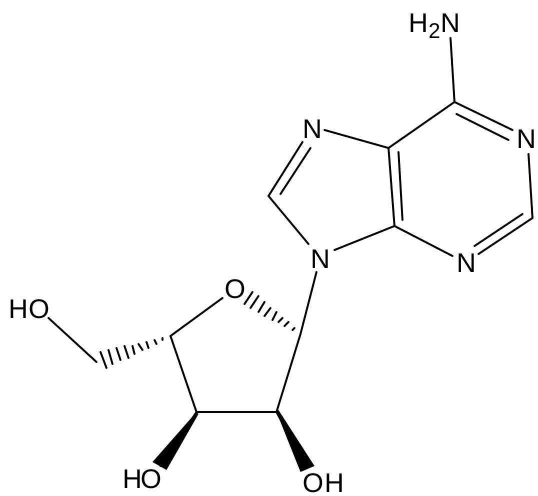
ribofuranose



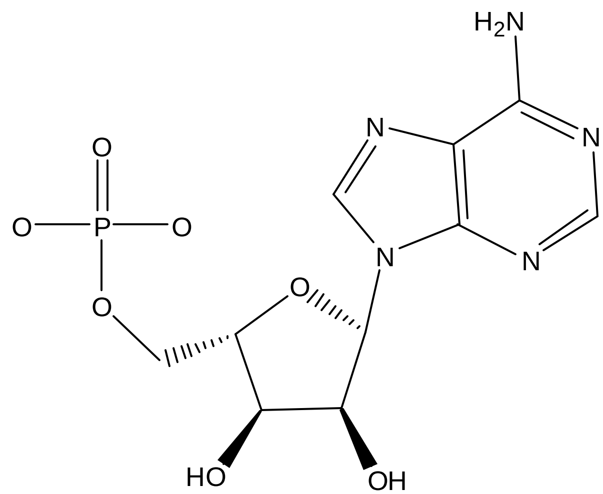
adenine



phosphate

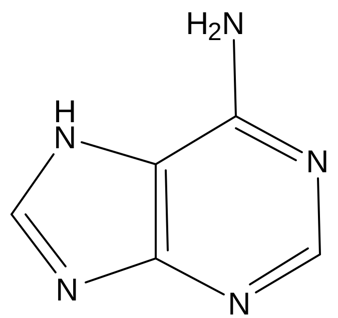


adenosine

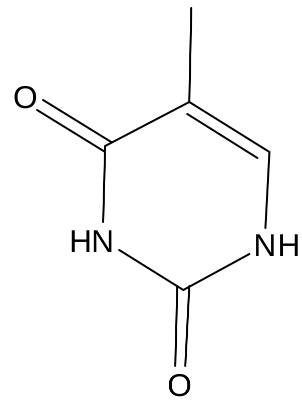


adenosine-5'-monophosphate

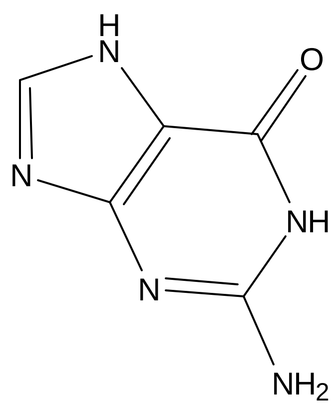
The Four Bases



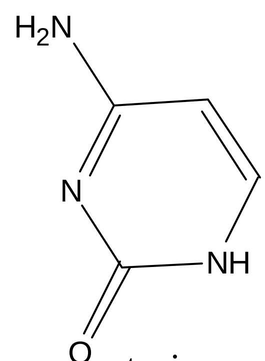
adenine



thymine

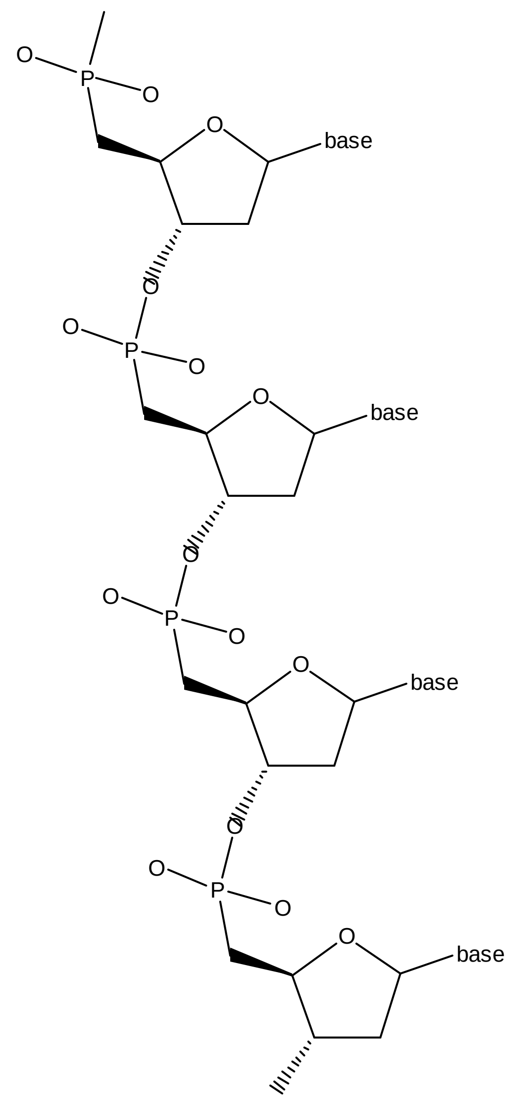


guanine



cytosine

DNA

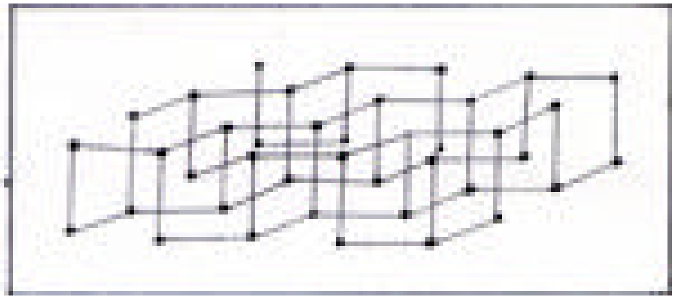


How hard can it be?

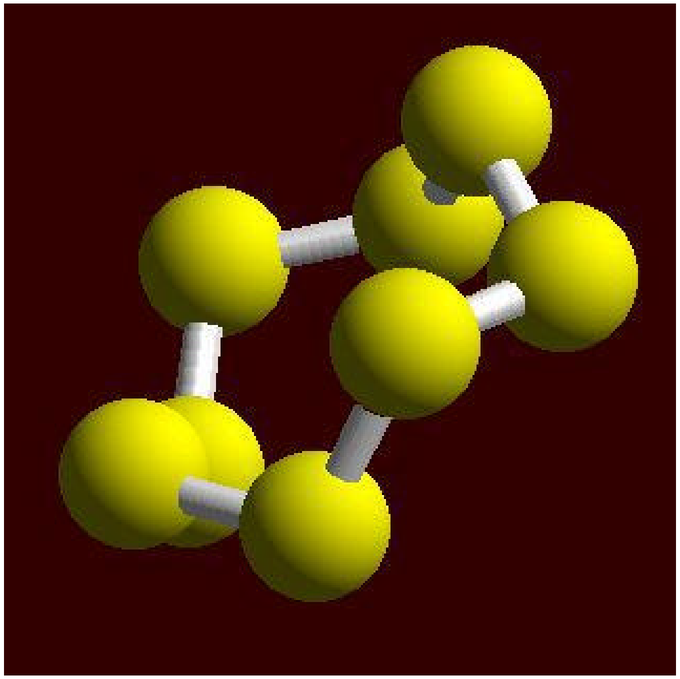
- Everyone is aware of the double helix model of DNA and the fact that the strands are complementary with each acting as a template for the production of the second. Sounds simple enough.
- However, the actual lab synthesis of nucleotide oligomers from nucleotide monomers is very challenging.
  - blocking groups need to be added and then removed
  - the growing strand needs to be purified after each base is added
  - and so on
- 25 years ago, a pace of one base per day was very good. Suppose a gene was 10,000 base pairs-do the math.
- Modern synthesizers have it down to roughly 1 base per minute. It would take roughly 7 days nonstop to synthesize a 10000 base pair sequence and you wouldn’t have very much of it
- Cells do it at roughly 19 per second
- PCR saves the day-and relies totally on natural enzymes.

First Short Period vs the rest

- Elements N_2 and O_2-both diatomic gases
- P-



- S-



- In the major hydrides H_2O and NH_3 a bond angle roughly tetrahedral is found. In H_2S and PH_3 the angle is app 90^o.

- N,S and P all form multiple oxides. The oxides will generally hydrolyze to form oxyacids
- Halides: O and N form simple “monoatomic” fluorides: OF_2 and NF_3. S and P exhibit valence expansion yielding multiple fluorides :SF_2, SF_4 and SF_6; PF_3 and PF_5.

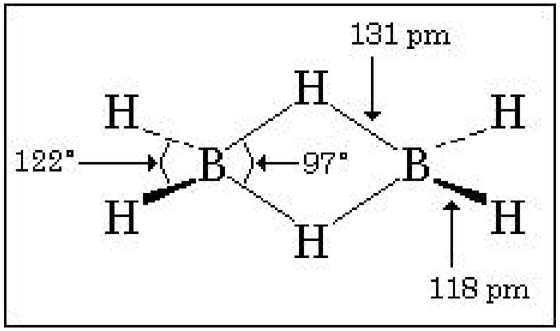
Carbon vs Silicon

- Elemental form:
  - C: graphite or diamond
  - Si: diamond form only
- Silicon lacks the ability to multiple bond or concatenate(make long chains). Thus, there are no silenes and few silanes.
- Key to the "useful" chemistry of Si are its compounds with oxygen.
  - SiO_2(quartz or cristabolite)-both involve Si bound to 4 O in a tetrahedron
  - Silicates are made by heating SiO_2 with alkali metal carbonates. CO_2 is lost. Depending on the quantity of metal present, the properties vary considerably. Basic unit is SiO_4^{4-}. These can be linked in numerous ways. If they are infinite chains, for example, these are the asbestos minerals

- Portland cement is a mixture of limestone, clay, and sand which is heated to approx 1700 deg.
- glass-white sand, crushed limestone($CaCO_3$), and sodium carbonate. It usually contains 60-75% silica, 12-18% soda, 5-12% lime.
- borosilicate glass (pyrex) is made by adding boric acid to the glass mixture-contains at least 5% boric oxide. Harder and more heat resistant than soft glass
- Silicones-covalent compounds whose basis is Si-O-Si unit-depending on the size and 3-D structures, these compounds can be liquids, rubbers or solids and are very resistant to heat, stress and chemicals. The Si-O bond is ~10% stronger than the C-O bond
- Looking for a rubber substitute a chemist combined a silicone with boric acid and got a rubbery polymer. He was so excited he threw some on the floor and it bounced. Silly putty was born. No practical application is ever found for it.

Boron

- Elemental boron occurs as B_{12} icosahedron
- BH_3 is unknown with B_2H_6 being the simplest binary hydride.



- A few other binary hydrides are known, all exhibiting complex structures characterized by three center bonding. One bonding MO, one nonbonding MO and one antibonding MO

____B_1+B_2-H antibonding

____ B_1-B_2 nonbonding

⇑⇓ B_1+B_2+H bonding

Note that there is no advantage to having more than two electrons

- BX3 are all known-why?
- What happens when you put a BX_3 in water
- What's boric acid and how is it different from other proton acids.

Interhalogens

- Compounds containing two different halogens are called interhalogens
- Generally can be made by direct combination of the elements $A_2 + B_2 \Rightarrow AB_x$
- Up to AB_5 known(A=Cl,Br,I) B=F and the extreme IF_7
- Expected cations and anions are formed, ex BrF_4^+ and BrF_4^-
- Structures follow basic VSEPR rules. When given an option, lone pairs prefer equatorial positions in trigonal bipyramidal structures