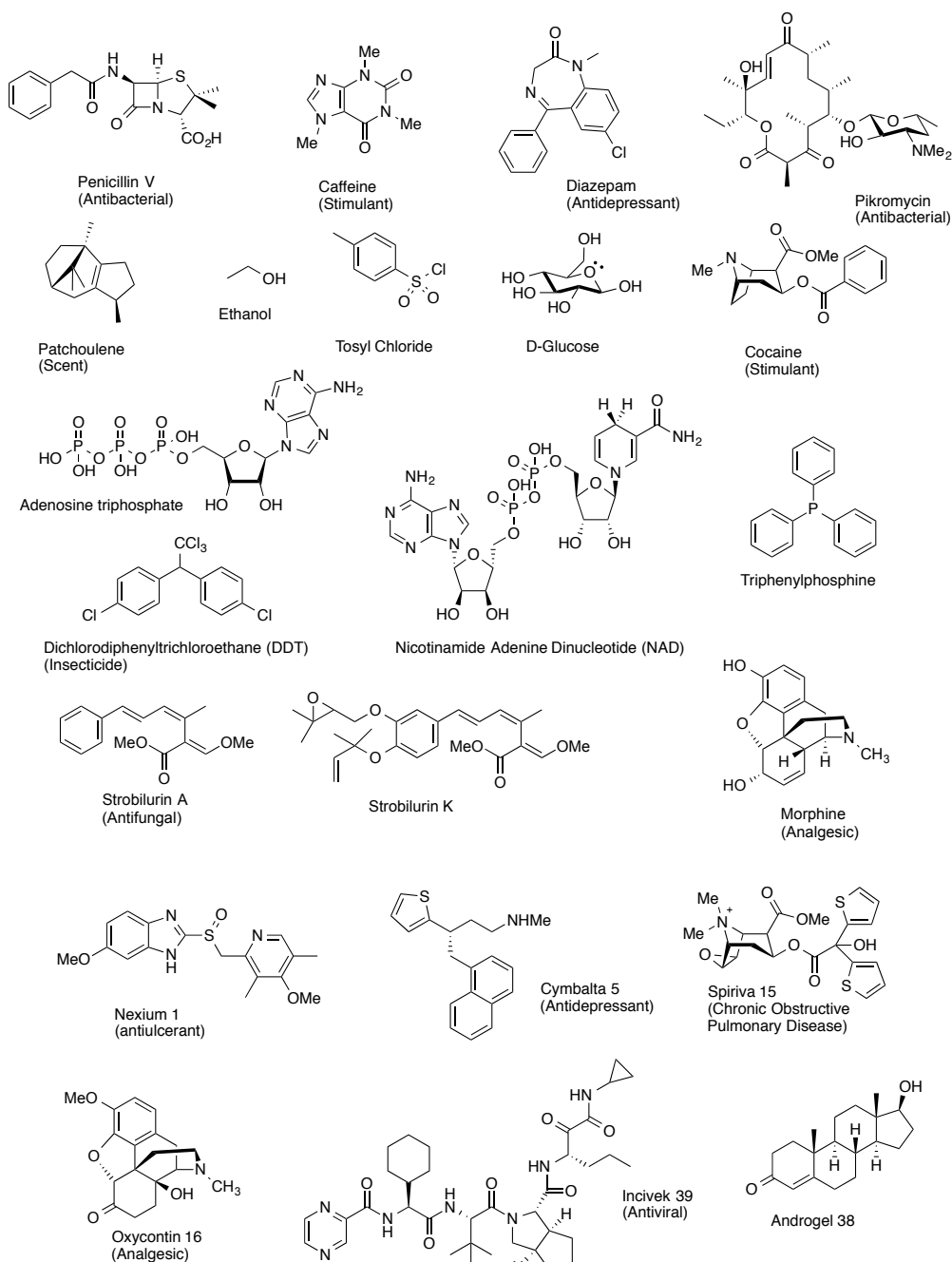


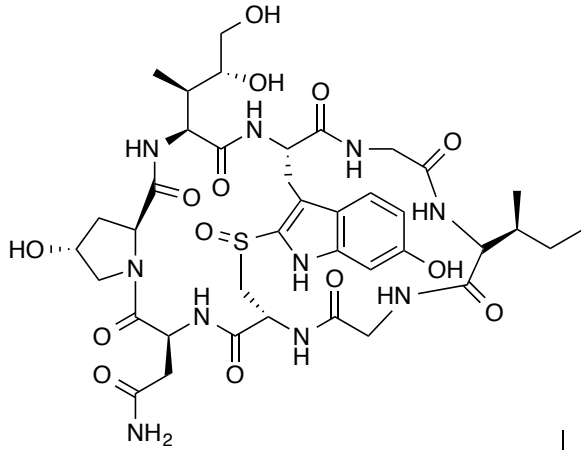
# Engineering Natural Products

## Workshop 1

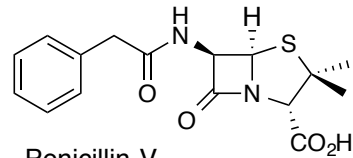
- For each of the following organic compounds:
  - State if they are *natural products* or *man-made* and explain your reasoning;
  - For the natural products state whether they are likely to be *primary* or *secondary* metabolites;
  - For the secondary metabolites state whether they are likely to be *polyketides*, *terpenes*, *peptides* or *alkaloids* and explain your reasoning.



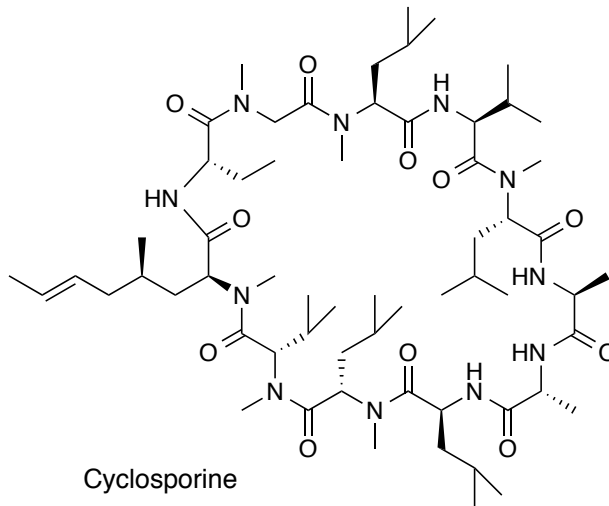
2. The following compounds are naturally occurring peptides. For each one:
- indicate the amino acid building blocks;
  - show which atoms are not derived from the common amino acids;
  - show which amino acids have been modified - show how.



$\alpha$ -amanitin  
*Amanita phalloides*

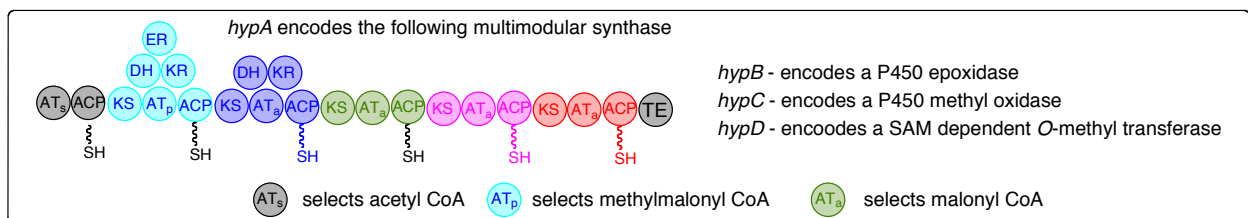
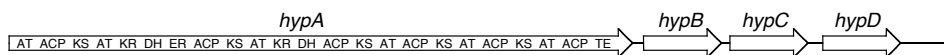


Penicillin V  
*Penicillium chrysogenum*

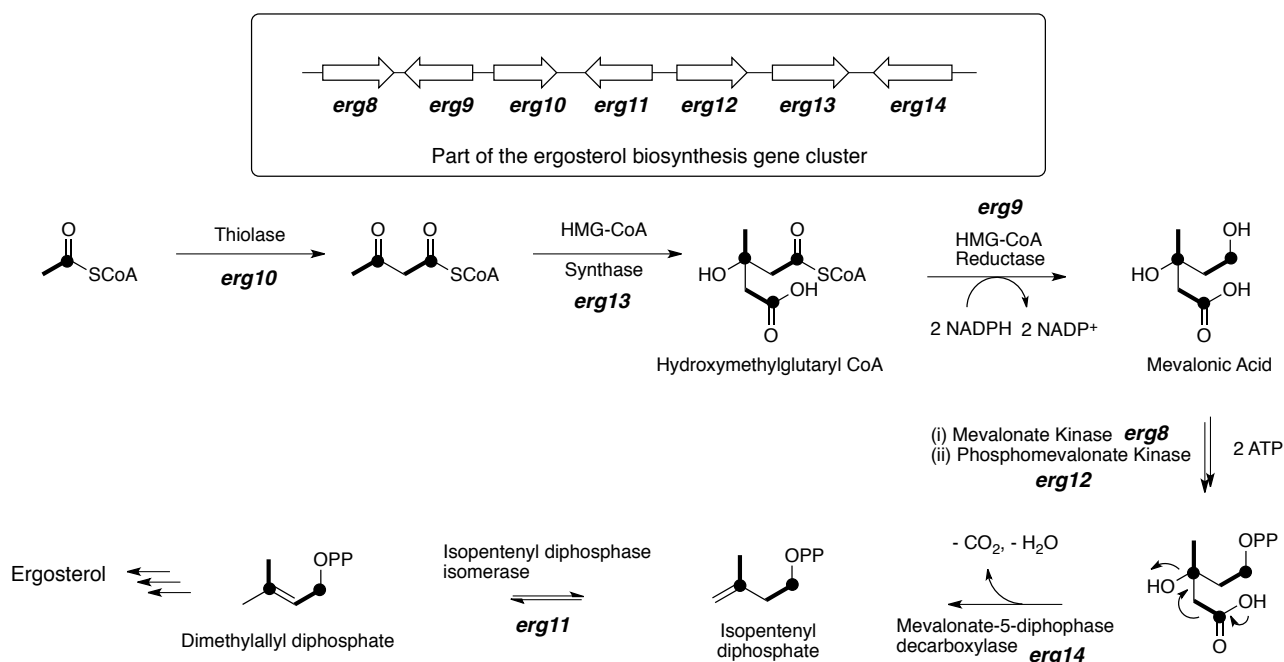


Cyclosporine  
*Beauveria nivea*

3. Speculate about what might be the product of the following (hypothetical) bacterial gene cluster.



4. Part of the gene cluster and biosynthetic pathway to ergosterol, is shown below.



- Which gene (or genes) could be knocked out to prevent ergosterol biosynthesis?
- The genes are named by the order in which they occur on the genome. Why does their order on the genome not matter for the biosynthetic pathway?
- Which compound would accumulate if the *erg8* gene were knocked out?
- How could the production of ergosterol be increased?
- Which steps require cofactors? Why are cofactors required?