ABE 580

Chapter 7

Enzymes

Enzyme Commission (Code)

Code Defined by

Nomenclature Committee of the International Union of Biochemistry and Molecular Biology (NC-IUBMB)

http://www.sbcs.qmul.ac.uk/iubmb/enzyme/

Nomenclature Committee of the International Union of Biochemistry and Molecular Biology (NC-IUBMB)

In consultation with the IUPAC-IUBMB Joint Commission on Biochemical Nomenclature (JCBN)

Enzyme Nomenclature

Recommendations of the Nomenclature Committee of the International Union of Biochemistry and Molecular Biology on the Nomenclature and Classification of Enzymes by the Reactions they Catalyse

http://www.sbcs.qmul.ac.uk/iubmb/enzyme/

World Wide Web version prepared by G.P. Moss
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To SEARCH for Information on Enzymes on the Database CLICK HERE.

This page contains general information on enzyme nomenclature. It includes links to individual documents, and the number of these will increase as more sections of the enzyme list are revised. Links to other relevant databases are provided. It also provides advice on how to suggest new enzymes for listing, or correction of existing entries. There is a list of abbreviations used in the database.

Historical Introduction

In *Enzyme Nomenclature* 1992 there was an historical introduction. This web version is slightly edited from that in the book.

Printed Version

Published in *Enzyme Nomenclature 1992* [Academic Press, San Diego, California, ISBN 0-12-227164-5 (hardback), 0-12-227165-3 (paperback)] with Supplement 1 (1993), Supplement 2 (1994), Supplement 3 (1995), Supplement 4 (1997) and Supplement 5 (in *Eur. J. Biochem.* 1994, **223**, 1-5; *Eur. J. Biochem.* 1995, **232**, 1-6; *Eur. J. Biochem.* 1996, **237**, 1-5; *Eur. J. Biochem.* 1997, **250**; 1-6, and *Eur. J. Biochem.* 1999, **264**, 610-650; respectively) [Copyright IUBMB].

Each enzyme has recorded at the end details of when first published in Enzyme Nomenclature or when added to the database and its subsequent history.

Web Version of Enzyme Nomenclature

The complete contents of *Enzyme Nomenclature,* 1992 (plus subsequent supplements and other changes) are listed below in enzyme number order giving just the recommended name. Each entry provides a link to details of that enzyme. Alternatively if looking for a specific reaction used in the classification of enzymes the broad outline defined by the first two numbers are given below. Each of these subclass entries is linked to a location where the category is subdivided to sub-subclasses. These in turn are linked to a list of recommended names for each enzyme in the sub-subclass.

List of Recommended Names for Enzymes

The common names of all listed enzymes are listed below, along with their EC numbers. Where an enzyme has been deleted or transferred to another EC number, this information is also indicated. Each list is linked to either **separate** entries for each entry or to files with **up to 50** enzymes in each file.

Common Names for:	List linked to:	
EC 1.1 to EC 1.3	separate	up to 50
EC 1.4 to EC 1.97	separate	up to 50
EC 2.1 to EC 2.4.1	separate	up to 50
EC 2.4.2 to EC 2.9	separate	up to 50

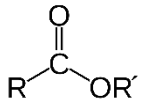
How EC Works and How to Use It

- Hierarch of classification (similar to Linnaeus taxonomy – Kingdom -> Phylum -> Class etc.)

- Class -> Sub-Class -> Sub-Sub-Class -> Serial Identifier

EC 3.1.21.4

3 = hydrolase (inserts water into bond)

1 = acts on ester bonds 

21 = endodeoxyriboneclease producing 5’-phosphomonoesters

4 = Type II sit-specific deoxyribonuclease

Classes

1. Oxidoreductases: Redox reactions
2. Transferases: Transfers chemical group from one molecule to another
3. Hydrolases: Cleaves bond by addition of water
4. Lyases: Removes a group from a molecule leaving a double bond or adds a group to an existing double bond
5. Isomerases: Isomerizes molecule
6. Ligases: Joins two molecules together

Example of Using EC to Find Enzymes

- Semi-synthetic derivatives of penicillin can increase antimicrobial activity, lower harmful side-effects, and overcome antibiotic resistance.

- You've been charged with searching for potential enzymes that could catalyze reactions with penicillin that would enable large-scale manufacture of antibiotics that affect resistant bacteria.

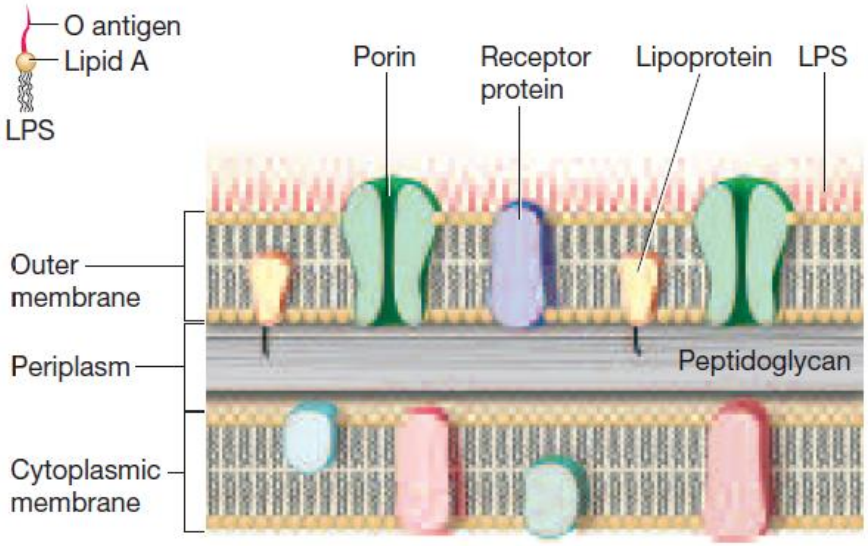
Antibiotics

- Specific chemical substances derived from or produced by living organisms that are capable of inhibiting the life processes of other organisms

- Various mechanisms are known
  - Interfere with protein synthesis
  - Interfere with key enzymes needed for synthesizing cell wall

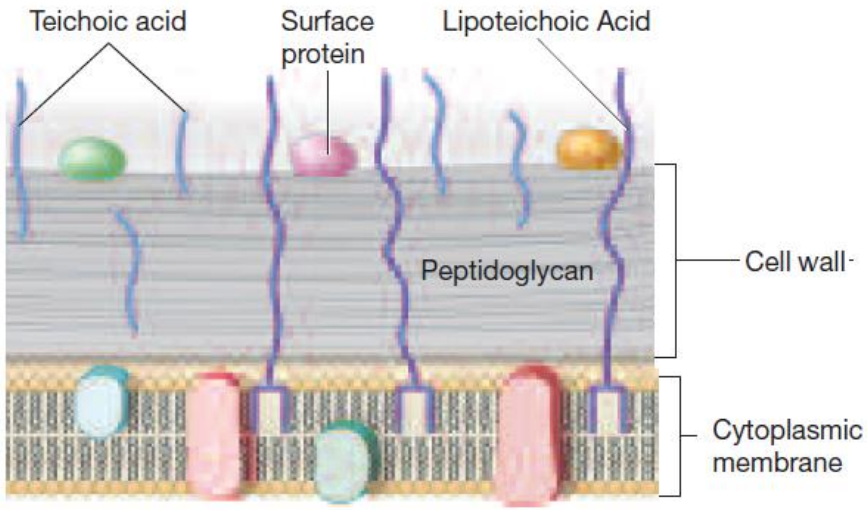
Gram (+) vs Gram (-) Bacteria

- Gram (+) Bacteria: Thick cell walls of amino acid cross-linked polysaccharides
- Gram (-) Bacteria: Thin polysaccharide cell wall coated with a lipid layer (lipopolysaccharides, LPS)
- Pathogenic forms of both are known



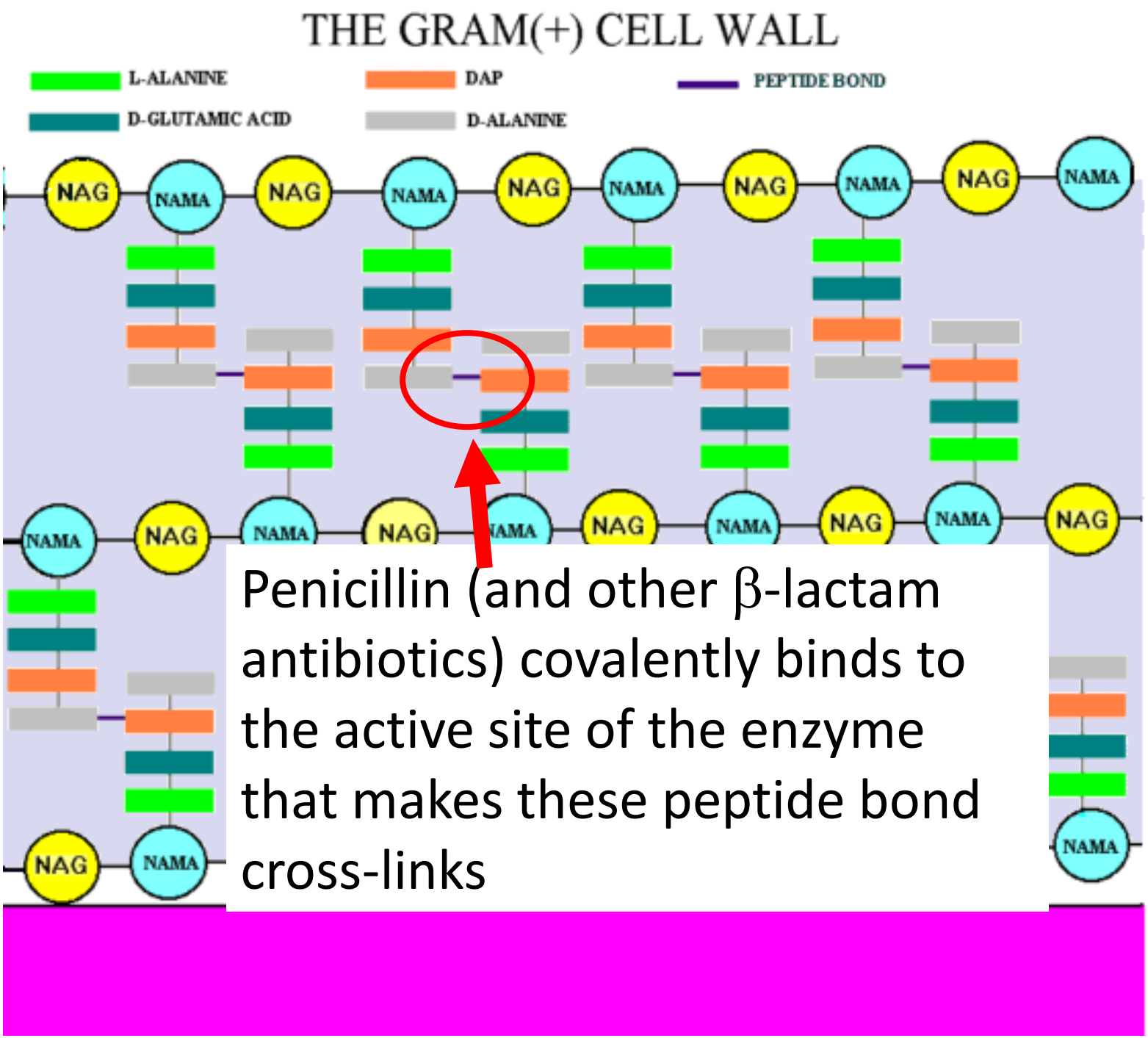
Cell Wall of Gram Negative Organism

E. coli
Klebsiella
Salmonella
Shigella
Yersinia

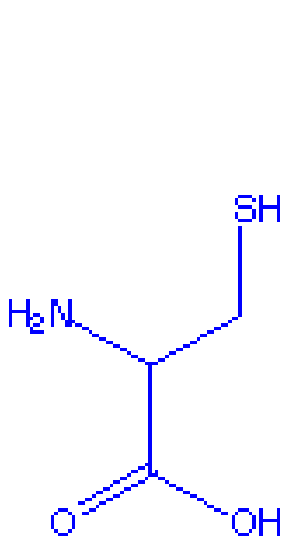


Cell Wall of Gram Positive Organism

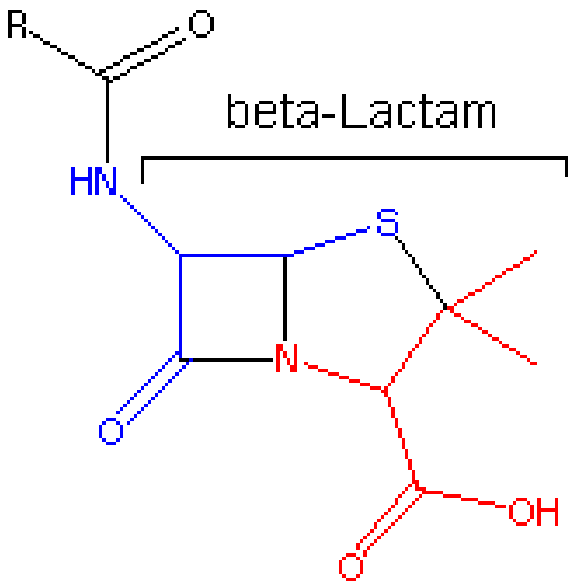
Bacillus antracis
Clostridium perfringens, defficile
C. diptheriae
Listeria monocytogenes
Staphylococcus
Streptococcus
Shigella

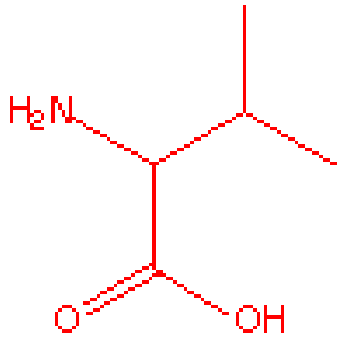

THE GRAM(+) CELL WALL
L-ALANINE
DAP
PEPTIDE BOND
D-GLUTAMIC ACID
D-ALANINE
NAG
NAMA
Penicillin (and other β-lactam antibiotics) covalently binds to the active site of the enzyme that makes these peptide bond cross-links

Penicillin - Beta Lactam Structure



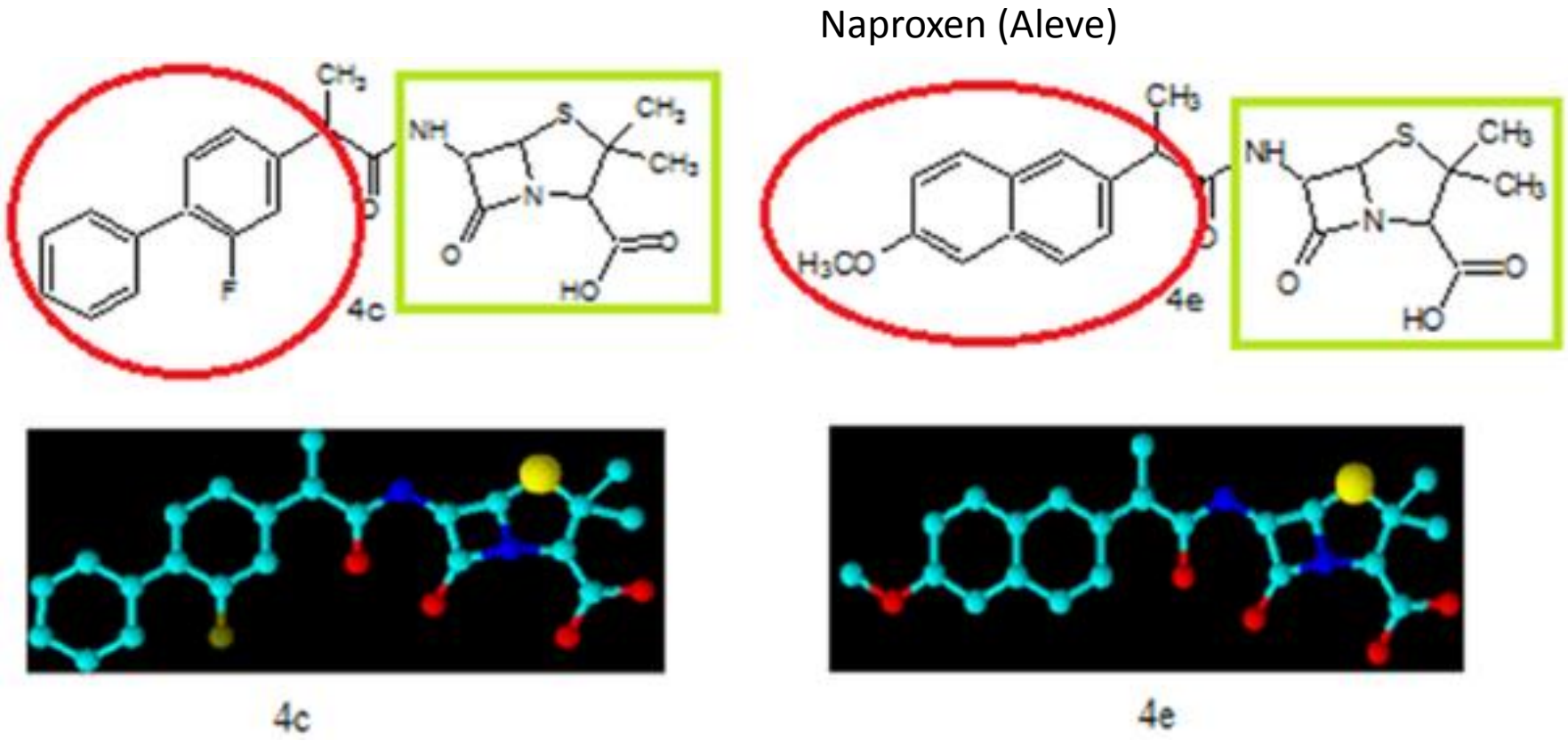
Cysteine





Valine

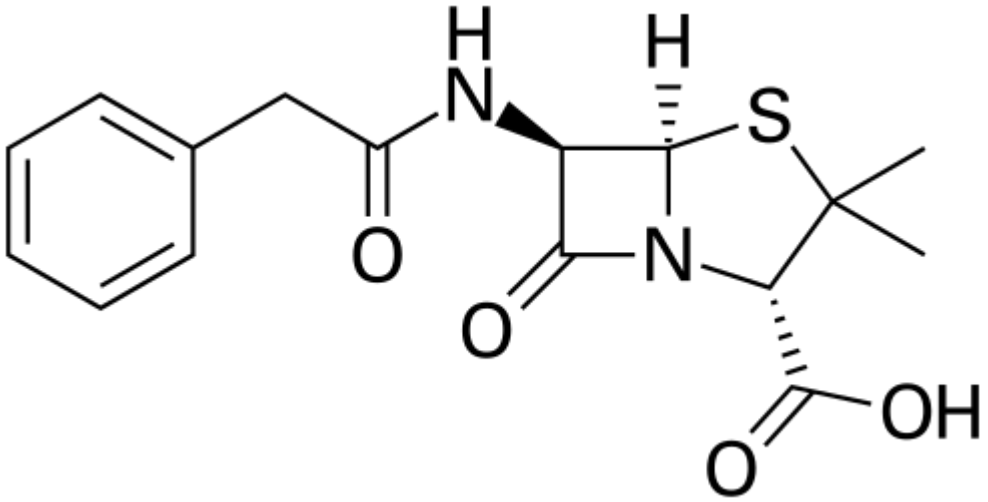
Fig 2. Chemical structure and three dimensional view of compounds 4c and 4e with highlighted green show the main penicillin nucleus and red show the designed moiety to increase the bioactivity.



Ashraf Z, Bais A, Manir MM, Niazi U (2015) Novel Penicillin Analogues as Potential Antimicrobial Agents; Design, Synthesis and Docking Studies. PLOS ONE 10(8): e0135293. https://doi.org/10.1371/journal.pone.0135293
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0135293

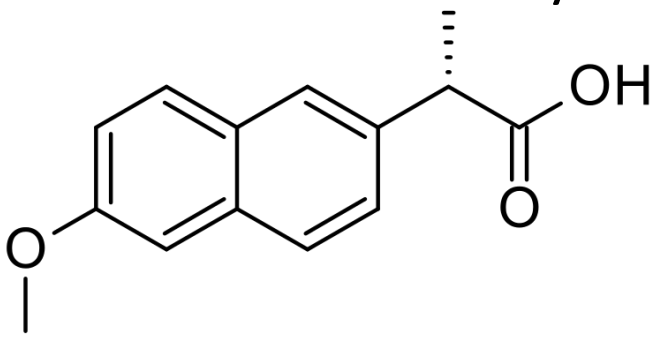
Penicillin G

(natural fermentation product)

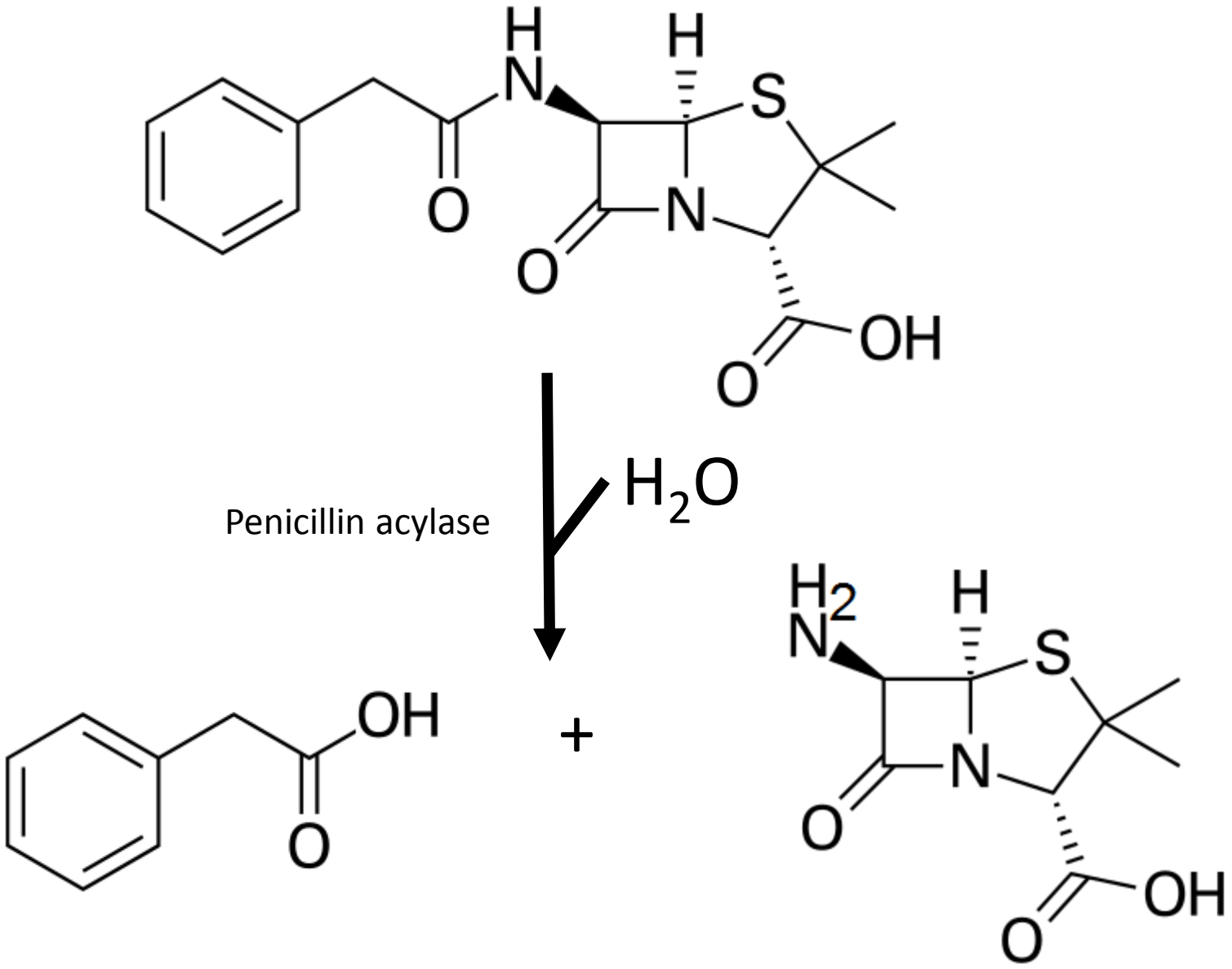


Naproxen

(Nonsteroidal anti-inflammatory drug: NSAID)



Step 1: Prepare Penicillin G (existing technology)



What is EC for Penicillin Acylase?

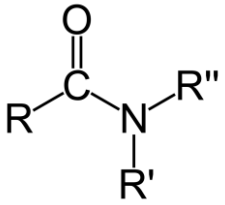
What is EC for Penicillin Acylase?

EC 3. 5. 1. 11

3 = Hydrolase

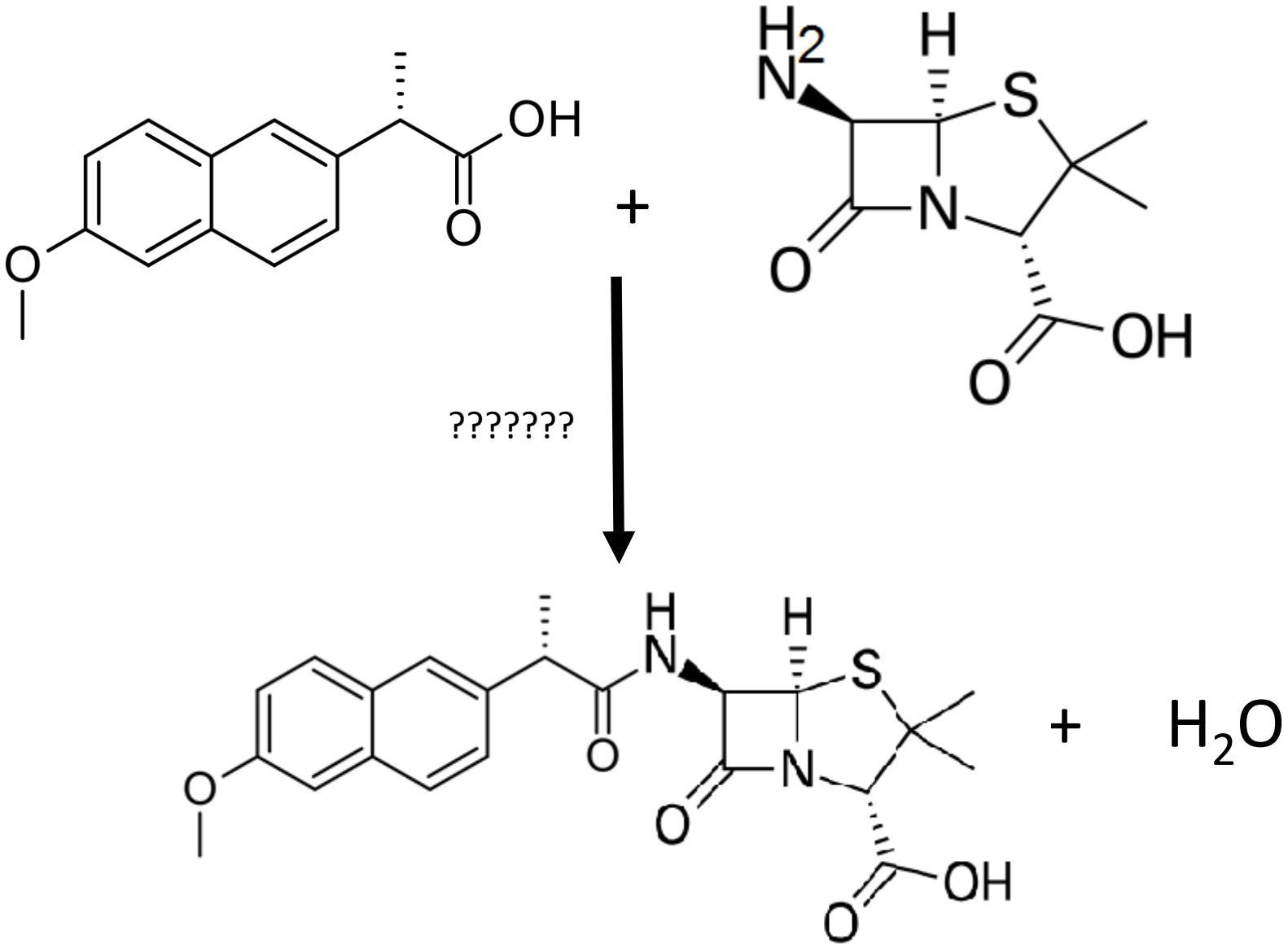
5 = Acting on C-N bond, other than peptide

1 = Acting on linear amides



11 = penicillin amidase (preferred name)

Step 2: Conjugation (new technology)



What would be the EC for this enzyme?

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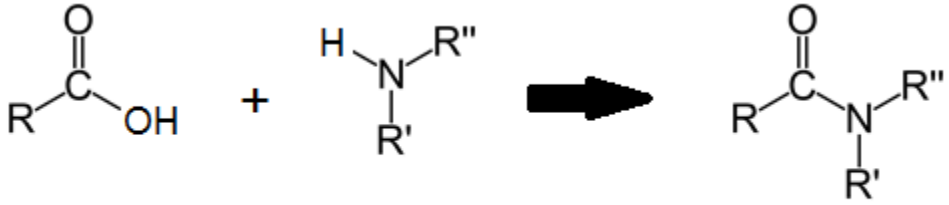
6 = Ligases: joining two molecules together

6.3 = Forming C-N bonds

6.3.1 = Acid-Amonia or Amine Ligases (Amide Synthases)



EC 6. 3. 1. ??

Based on enzymes in this category, likely requires ATP to drive Gibbs free energy!