

## Catalysts and Inhibitors in Real Life

1. How do **catalysts** lower the activation energy? Isn't the  $\Delta H_{bb}$  set? No that approximation won't apply to the catalyzed pathway because the catalyst creates a whole different reaction pathway, even though it leads to the same product.

Read the following and find an example of the above concept.

*To limit environmental problems further down the road, we could translate stoichiometric titanium reactions into catalytic ones, much like earlier efforts for its transition metal cousins iron and copper. One 'green' approach to water purification uses photocatalysis: on ultraviolet light irradiation, doped  $TiO_2$  catalysts form reactive oxygen species, which tear apart bacteria and biotoxins present in drinking water. Variants that utilize visible light . are just starting to emerge. Several groups have also recently tackled multicomponent reactions in which titanium catalysts quickly stitch together drug-like molecules.*

2. a) How does aspirin act as an inhibitor? Give a brief explanation and the NSFW-version (NSFW<sup>1</sup> = not safe for weak wills)
- b) How can aspirin help a patient?
- c) How can aspirin harm a patient (what is a side-effect)?

**ANSWERS are in the following text:**

### COX and Inflammation

*When the body is injured, inflammation occurs as part of the natural healing process. Inflammation is facilitated by a number of enzymes, mediators and different cells, such as white blood cells. One enzyme involved in inflammation is cyclo-oxygenase (COX). COX is responsible for the formation of a group of inflammatory mediators known as prostaglandins.*

*\* Aspirin inhibits COX, in turn stopping the formation of prostaglandins; hence aspirin acts as*

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### <sup>1</sup> **More details on how aspirin acts as an inhibitor**

Aspirin blocks an enzyme called cyclooxygenase, COX-1 and COX-2, which is involved with the ring closure and addition of oxygen to arachidonic acid converting to prostaglandins.(compounds involved in swelling) The acetyl group on aspirin is broken off by a reaction with water and then bonded to the alcohol group of serine, an amino acid in the COX enzyme. This has the effect of blocking the channel in the enzyme, arachidonic can not enter the active site of the enzyme, and the anti –swelling compounds are never made.

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*an anti-inflammatory agent in this process.*

### COX and 'blood thinning'

*COX also plays a role in cessation of bleeding. Blood clotting is the result of a complex mechanism which involves many different cells, including a type known as platelets. When blood vessels are damaged or are diseased, platelets clump together over the hole or vessel tear to facilitate repair. COX activates a chemical known as thromboxane A2 that causes platelets to stick together to form a 'plug' over the damaged area. The aggregation of platelets (plug), in concert with the clotting process, results in a fibrin clot which stops bleeding and aids repair of the blood vessel.*

*Aspirin inhibits COX, thereby reducing the ability of platelets to aggregate. This is why aspirin is known as a 'blood thinner' or anti-platelet agent. It is also why increased bleeding is a side effect of aspirin. Although major bleeding is rare, aspirin can cause this. 'Blood thinning' however, is useful to prevent heart attacks and strokes. It is important to talk to your doctor before starting aspirin even though you can buy it without a prescription.*

### Side effects of aspirin

*Prostaglandins are also produced by cells in the lining of the stomach and form a protective barrier against the harsh stomach acid.")*

*\* Since aspirin inhibits the formation of prostaglandins, in turn depleting the protective barrier in the stomach, leading to stomach (or peptic) ulcers.*

3. See page 263 in your textbook to explain how zidovudine(AZT) helps AIDS patients.
4. See p 266 in your textbook to help you answer some of the following:
  - a) What's a heterogeneous catalyst?
  - b) From what you know about the nature of bonds, why is this reaction slow in the absence of a catalyst?  
$$\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$$
  - c) How does iron catalyze the above reaction?

