



The discovery of aspirin

La découverte de l'aspirine

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Niveau : Première STL

Type d'enseignement : ETLV



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Présentation

Comment l'aspirine a elle été découverte ? À quoi sert-elle ? Comment la synthétiser ? Comment a-t-elle été utilisée à travers les siècles ? Cette séquence variée permet de répondre à ces questions de manière ludique et rythmée.

Référentiel, programme

Chimie et développement durable. Synthèses organiques : acides et dérivés (estérification, hydrolyse)

Compétences travaillées

S'approprier	■ □ □ □
Analyser	■ ■ □ □
Réaliser	■ ■ ■ □
Valider	■ ■ □ □

Niveaux de compétence en langue

Langue : Anglais

Comprendre	Écouter	<input type="checkbox"/> A2	<input checked="" type="checkbox"/> B1	<input type="checkbox"/> B2
	Lire	<input checked="" type="checkbox"/> A2	<input type="checkbox"/> B1	<input type="checkbox"/> B2
Parler	Prendre part à une conversation	<input type="checkbox"/> A2	<input checked="" type="checkbox"/> B1	<input type="checkbox"/> B2
	S'exprimer oralement en continu	<input type="checkbox"/> A2	<input checked="" type="checkbox"/> B1	<input type="checkbox"/> B2
Écrire	Écrire	<input type="checkbox"/> A2	<input checked="" type="checkbox"/> B1	<input type="checkbox"/> B2

Évaluation

Possibilité d'évaluer les présentations orales effectuées en séance 2.

Mots clés

Anglais, chimie, Chemistry, ETLV, découverte, activité documentaire, présentations, histoire des sciences, Hoffman, synthèse organique, aspirine

Niveau et type d'enseignement

Niveau : Première STL
 Type d'enseignement : ETLV

Sources

Aspirin video :
<http://www.geniusstuff.com/videos/apirin-video.htm>

Aspirin and the flu (mp3) :
www.thenakedscientists.com

The discovery of aspirin (mp3) :
www.thenakedscientists.com

Étapes de la séquence

Séance 1 : 2 heures

Activité documentaire, compréhension orale (étude d'une vidéo, d'un mp3)

Séance 2 : 1 heure

Présentation orale d'une frise temporelle

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For students

1. Medical applications

Felix Hoffman (January 21, 1868 – February 8, 1946)

In 1897, Felix Hoffman, German chemist, first synthesised a stable form of acetylsalicylic acid for medical use, better known as aspirin.

Source :

http://upload.wikimedia.org/wikipedia/commons/6/67/Felix_Hoffman.jpg

Aspirin, or acetylsalicylic acid, is a 'salicylate' drug that, as well as its best known effect as an 'analgesic' to reduce aches and pains, can also be used as an 'antipyretic' to control fever, and as an anti-inflammatory to reduce inflammation. It also has the effect of making the blood less likely to clot, known as anti-coagulation. It was the first 'non steroidal anti inflammatory drug' to be discovered (another example being ibuprofen), and it had the huge benefits of reducing pain without impairing consciousness and was not addictive unlike opiate painkillers such as laudanum.



After having read this paragraph, sum up all four medical uses of aspirin:

1. _____ 2. _____
3. _____ 4. _____

2. Chemical aspects

Aspirin or acetylsalicylic acid is an acetyl derivative of salicylic acid that is a white, crystalline, weakly acidic substance, with a melting point of 135 °C. Its pK_a equals 3.5 at 25 °C.

■ Synthesis

The synthesis of aspirin is classified as an **esterification** reaction. Salicylic acid is treated with acetic anhydride, an acid derivative, causing a chemical reaction that turns salicylic acid's phenol group into an acetyl group, (R-OH gives R-OCOCH₃). This process yields aspirin and

Write the balanced equation :

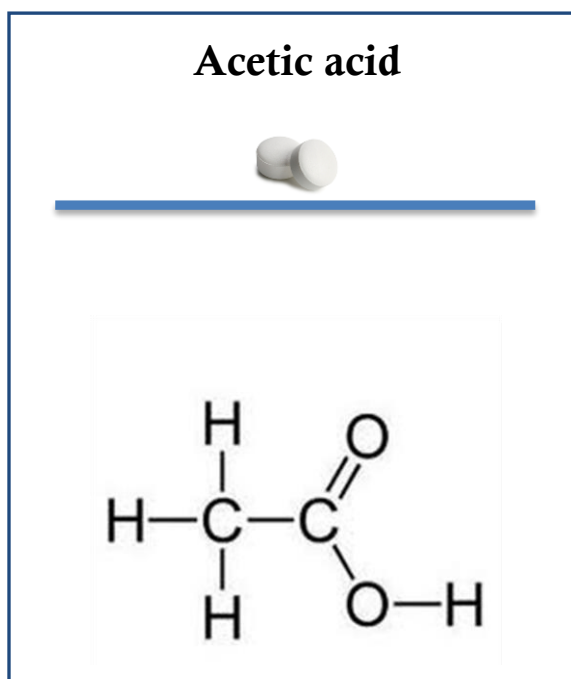
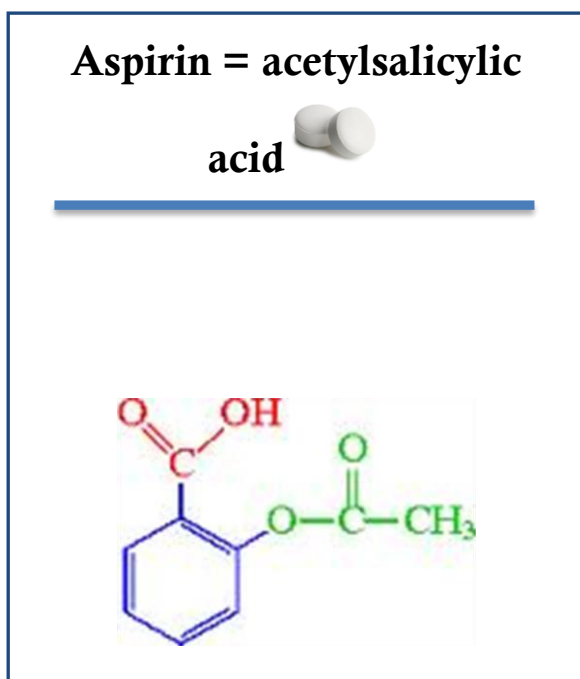
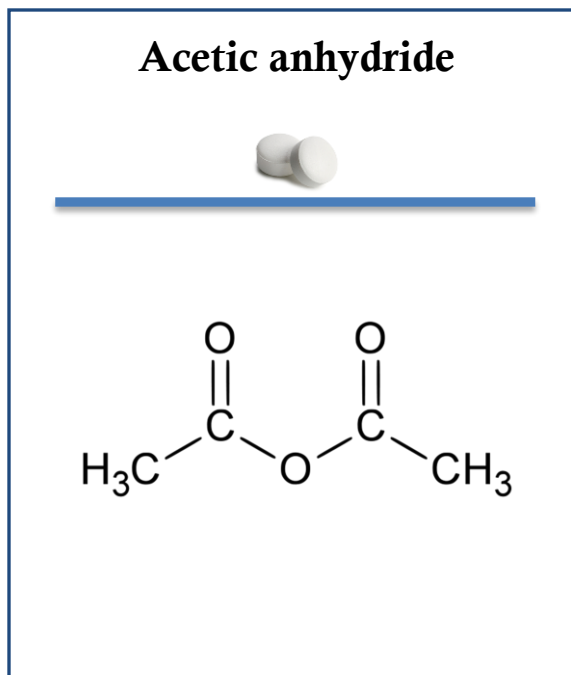
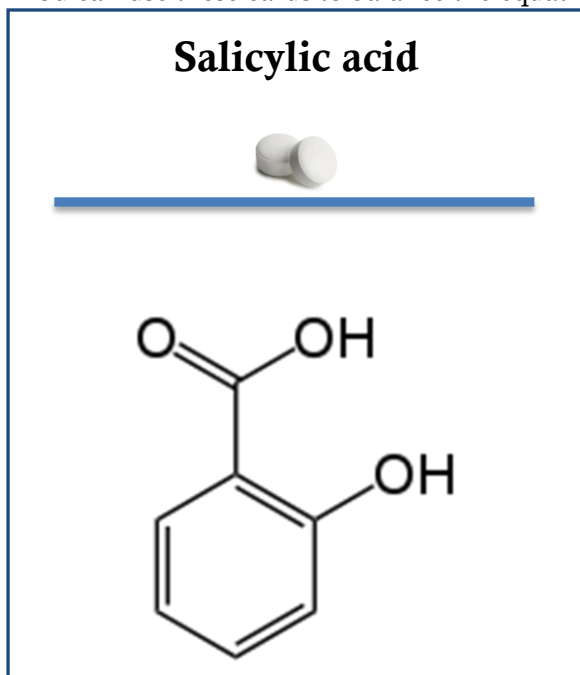


acetic acid, which is considered a by-product of this reaction. Small amounts of sulfuric acid (and occasionally phosphoric acid) are almost always used as a catalyst.

Using the previous synthesis, find an English equivalent for (connect with arrows):

French	English
<i>Ce procédé donne (comme produits)</i>	catalyst
<i>Catalyseur</i>	To turn into
<i>Transformer en</i>	This process yields

You can use these cards to balance the equation:



■ Procedure

Synthesis of Aspirin

1. Place approximately 4 g salicylic acid (known to 0.01g) into a 25 or 50 mL beaker.
2. Add 8 mL of acetic anhydride to the beaker.
3. Gently swirl the beaker then add three drops of sulfuric acid (H_2SO_4) as the catalyst.
4. Heat this mixture in a water bath on a hot plate for 20 minutes, occasionally stirring with a glass rod.
5. Remove the beaker from the water bath and cool for five minutes. SLOWLY add 15mL of chilled water. Swirl the beaker to insure mixing and place into an ice bath. Crystals of acetylsalicylic acid should begin to form.
6. When crystal formation is complete (about 15 - 20 minutes), vacuum filter your product (using a Buchner funnel). Rinse out the beaker with a small amount of chilled water and then wash your crystals in the funnel with 15mL of chilled water.

Purification and Recrystallization

1. Transfer your crystals to a 150 - 250 mL beaker. While warming on a hot plate, add warm ethanol, 5 mL at a time, to your crystals until they are completely dissolved (use no more than 20 mL).
2. Add about twice as much ice water as you added ethanol and cool the mixture in an ice bath (about 20 minutes). Large quantities of crystals should form if you stir the solution vigorously with a stirring rod.
3. Vacuum filter the products, again rinsing with **chilled** water. Allow to dry while aspirating for 5 minutes. You may want to weigh the filter paper first.
4. Weigh a small beaker (known to 0.01g). Transfer the crystals to the beaker, weigh the beaker and crystals (known to 0.01g) to determine the amount of product. Use this value to calculate the percent yield for your reaction.

Using the previous procedure, find an English equivalent for:

French	English
<i>Un mode opératoire, procédé</i>	
<i>Introduire environ 4g</i>	
<i>Un bain marie</i>	
<i>Un filtre büchner</i>	
<i>Agiter vigoureusement</i>	
<i>Filtrer sous vide</i>	
<i>Peser ... (avec une précision de 0,01g)</i>	
<i>Le rendement</i>	

3. A bit of history : Felix Hoffmann

When chemist Felix Hoffman attempted to lessen his father's chronic stomach pain, he discovered aspirin. Learn more about Hoffman's astonishing career in this video.

<http://www.geniusstuff.com/videos/apirin-video.htm>

Answer the following questions:

What was Felix Hoffman's job and for which company did he work?

Where in nature can you find a pain relief agent?

Which molecule did scientists first synthesise to mimic this natural compound?

What was the problem?

Did Hoffman manage to patent his invention?

4. Further research

4.1. Can aspirin relieve symptoms of the flu?

Listen to the MP3 regarding the 1918 flu pandemic * (start at 0'15) and answer the following questions:

<http://www.thenakedscientists.com/HTML/content/news/news/1819/>

What is today's production of aspirin around the world?

Which doses of aspirin were given to flu patients?

What was the effect?

Flu pandemic * : pandémie de grippe

4.2. The controversial discovery of aspirin

STEP 1: Discover the recording

Mp3 source:

<http://www.thenakedscientists.com/HTML/content/interviews/interview/1168/>

Start at 13'15

Stop at “It was not available over the counter until after the turn of the century. “

Listen to the MP3 for further knowledge on aspirin discovery and its true inventor.

Write down the keywords that you hear:

STEP 2: Assisted listening

*After a couple of listenings without the text, you may listen to the MP3 again but this time, read the text at the same time. Note that the main keywords appear in **bold lettering**.*

Sarah Castor-Perry

“This week in science history saw, in 1897, Felix Hoffman first synthesised a stable form of **acetylsalicylic acid** for medical use, better known as aspirin.

Aspirin, or acetylsalicylic acid, is a ‘salicylate’ **drug** that as well as its best-known effect as an ‘**analgesic**’ to reduce **aches** and **pains** can also be used as an ‘**antipyretic**’ to control fever, and as an **anti-inflammatory** to **reduce** inflammation. It also has the effect of making the blood less likely to **clot**, known as anti-coagulation. It was the first ‘**non steroidal** anti inflammatory drug’ to be discovered (another example being ibuprofen), and it had the huge benefits of reducing pain without **impairing consciousness** and was not **addictive** unlike opiate **painkillers** such as laudanum.

Salicylate based medicines derived from **plants** like meadowsweet and willow trees had already been in use for over 3 and a half thousand years by the 19th century, to reduce aches and pains and fever. In fact the name ‘salicylic acid’ comes from the Latin name for the **willow tree**, *Salix*. In the 1820s and 30s, chemists in Italy and Germany managed to purify the active chemical found in these plants – salicylic acid. The medicinal use of this grew in the mid 1800s, but it did have several drawbacks, including the fact that it caused **stomach pain**, **ulcers** and even **stomach bleeding**.

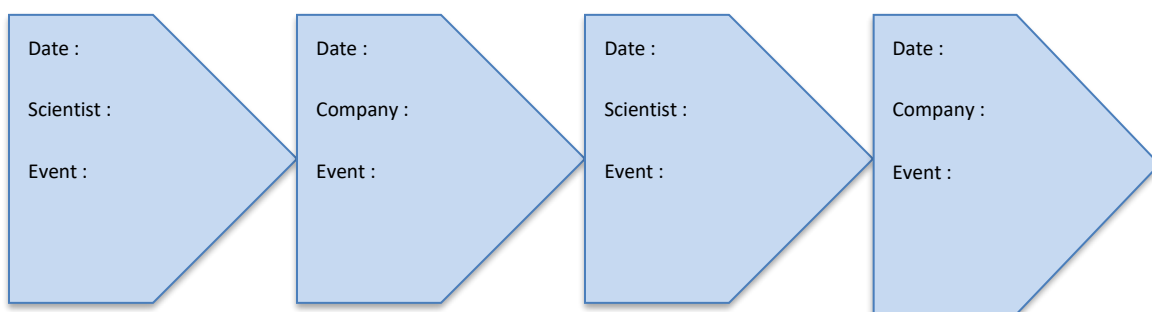
Around this time, an industry began to grow in Germany to investigate medicines that could be derived from **cloth dyes** made from coal tar. Surprising as it might sound given the starting point of coal tar, a lot of compounds were found that could be used to reduce fever and pain. A German dye firm called Friedrich **Bayer** and Company began

to expand to investigate medicines further, seeing that there was money to be made. It was this company that Hoffman joined as a young man in 1894, to work with two chemists called **Eichengrün** and **Dreser**.

In 1897, Eichengrün instructed Hoffman to find an **alternative form** of salicylic acid that would be less irritating to the stomach, but would still produce anti fever and pain effects. In his lab book entry for the 10th of October 1897, Hoffman declared that he had synthesised a pure form of acetylsalicylic acid by **refluxing salicylic acid** with **acetyl anhydride**. This ended up producing a much **purier** and more stable form of acetylsalicylic acid than had been produced before using other techniques. Clinical trials suggested that it was just as effective as salicylic acid **without** many of the **unpleasant side effects**. However, it was not until 1899 that the name **Aspirin** was decided on and the **Bayer** began producing it for use as a **prescription drug**. It was not available over the counter until after the turn of the century. “

STOP!

***STEP 3:** Build a time frame. Summarise in a time frame the different steps and actors in aspirin discovery*



***STEP 4:** Present the time frame. A couple of volunteer students should present the time frame to the rest of the class. In order to structure your presentation, you should use the expressions listed in **APPENDIX 1**. Take some time to write down your presentation, test it with a classmate, then give it in front of the class.*

Appendices

APPENDIX 1: Useful expressions for presentations

This is called signposting: you need to let your audience know where you are in the presentation

Signposting													
<u>Function</u>	<u>Language</u>												
Introducing yourself	<p>Good morning,/afternoon/evening</p> <p>I'm _____,</p> <p>My name is _____ and I come from _____ school in Paris.</p> <p>Let me take a minute to introduce myself.</p>												
Introducing the subject	<p>I'd like to start by...</p> <p>Let's begin by...</p> <p>First of all, I'll...</p> <p>I'll begin by...</p> <p>I'm here to talk about . . .</p> <p>Today, I'd like to say a few words about . . .</p> <p>I'm going to give you an overview of . . .</p> <p>The main reason I'm here today is . . .</p> <p>The focus of my remarks is . . .</p> <p>I'd like to share some thoughts on (+topic)</p>												
Showing organization	<p>I've divided my topic into three sections/parts. They are . . .</p> <p>This presentation can be divided into the following subtopics:</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-right: 20px;">First,</td> <td style="padding-right: 20px;">First of all</td> <td>The first point is . . .</td> </tr> <tr> <td>Second</td> <td>Secondly</td> <td>The next point is . . .</td> </tr> <tr> <td>Third</td> <td>Thirdly</td> <td>Next, we come to . . .</td> </tr> <tr> <td>Finally</td> <td>Last</td> <td>The final point is . . .</td> </tr> </table>	First,	First of all	The first point is . . .	Second	Secondly	The next point is . . .	Third	Thirdly	Next, we come to . . .	Finally	Last	The final point is . . .
First,	First of all	The first point is . . .											
Second	Secondly	The next point is . . .											
Third	Thirdly	Next, we come to . . .											
Finally	Last	The final point is . . .											

<p>Finishing one subject...</p>	<p>Well, I've told you about...</p> <p>That's all I have to say about...</p> <p>We've looked at...</p> <p>So much for...</p>
<p>...and starting another</p>	<p>Now we'll move on to...</p> <p>Let me turn now to...</p> <p>Next...</p> <p>Turning to...</p> <p>I'd like now to discuss...</p> <p>Let's look now at...</p> <p>That brings us to . . .</p>
<p>Ordering</p>	<p>Firstly...secondly...thirdly...lastly...</p> <p>First of all...then...next...after that...finally...</p>
<p>Analysing a point and giving recommendations</p>	<p>Where does that lead us?</p> <p>Let's consider this in more detail...</p> <p>What does this mean for ...?</p> <p>Translated into real terms...</p>
<p>Giving an example</p>	<p>For example,...</p> <p>For instance,</p> <p>Such as</p> <p>Let me illustrate,</p> <p>To illustrate,</p> <p>A good example of this is...</p> <p>As an illustration,...</p>

	<p>To give you an example,...</p> <p>To illustrate this point...</p>
Highlighting	<p>Actually,</p> <p>In fact,</p> <p>As a matter of fact,</p> <p>In particular</p> <p>Particularly</p> <p>Especially</p>
Giving reasons	<p>This is why . . .</p> <p>The main reason is . . .</p> <p>Therefore,</p>
Generalising	<p>Generally,</p> <p>Usually,</p> <p>As a rule,</p> <p>Most of the time,</p> <p>In most cases,</p>
Dealing with questions	<p>We'll be examining this point in more detail later on...</p> <p>I'd like to deal with this question later, if I may...</p> <p>I'll come back to this question later in my talk...</p> <p>Perhaps you'd like to raise this point at the end...</p> <p>I won't comment on this now...</p>
Summarising and concluding	<p>In conclusion,...</p> <p>Right, let's sum up, shall we?</p>

	<p>I'd like now to recap...</p> <p>Let's summarise briefly what we've looked at...</p> <p>Finally, let me remind you of some of the issues we've covered...</p> <p>If I can just sum up the main points...</p> <p>Thank you for your time</p> <p>Thank you for taking the time to be here</p>
Taking questions	<p>Are/Were there any questions?</p> <p>We have just a few minutes for questions</p>

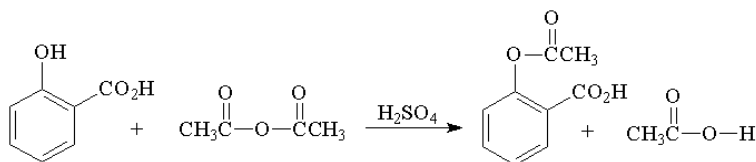
APPENDIX 2: Answers (for teachers)

1. MEDICAL APPLICATIONS

1. analgesic 2. Antipyretic 3. Anti-inflammatory 4 anti-coagulating agent

2. CHEMICAL ASPECTS

Write the balanced equation :



French	English
<i>Introduire environ 4g</i>	Place approximately 4 g
<i>Introduire environ 4g</i>	Place approximately 4 g
<i>Catalyseur</i>	catalyst
<i>Un bain marie</i>	A water bath
<i>Un filtre büchner</i>	A Buchner funnel
<i>Agiter vigoureusement</i>	To swirl vigorously
<i>Filtrer sous vide</i>	To vacuum filter
<i>Peser ... (avec une precision de 0,01g)</i>	Weigh ... (known to 0.01g).
<i>Le rendement</i>	The yield

3. A BIT OF HISTORY

What was Felix Hoffman's job and for which company did he work?

He was a chemist and worked for Bayer pharmaceuticals

Where in nature can you find a pain relief agent?

You can find a pain relief agent in willow bark (salicylic acid)

Which molecule did scientists first synthesise to mimic this natural compound?

They synthesised salicylic acid

What was the problem?

It causes stomach pain, sometimes bleeding and ulcers.

Did Hoffman manage to patent his invention?

No, Hoffman never got the financial credit for his invention: he is an infamous inventor.

4. FURTHER RESEARCH

4.1. Can aspirin relieve symptoms of the flu?

What is today's production of aspirin around the world?

Today, around 40,000 tons of the drug are sold every year around the world.

Which doses of aspirin were given to flu patients?

Very high doses of aspirin were given to patients during the flu pandemic up to 30 g/day

What was the effect?

This contributed to the deadly effects of the flu, and increased the chances of lung infections: this is called aspirin poisoning.

4.2. The controversial discovery of aspirin

STEP 3: Time frame

Summarise in a time frame the different steps and actors in aspirin discovery

