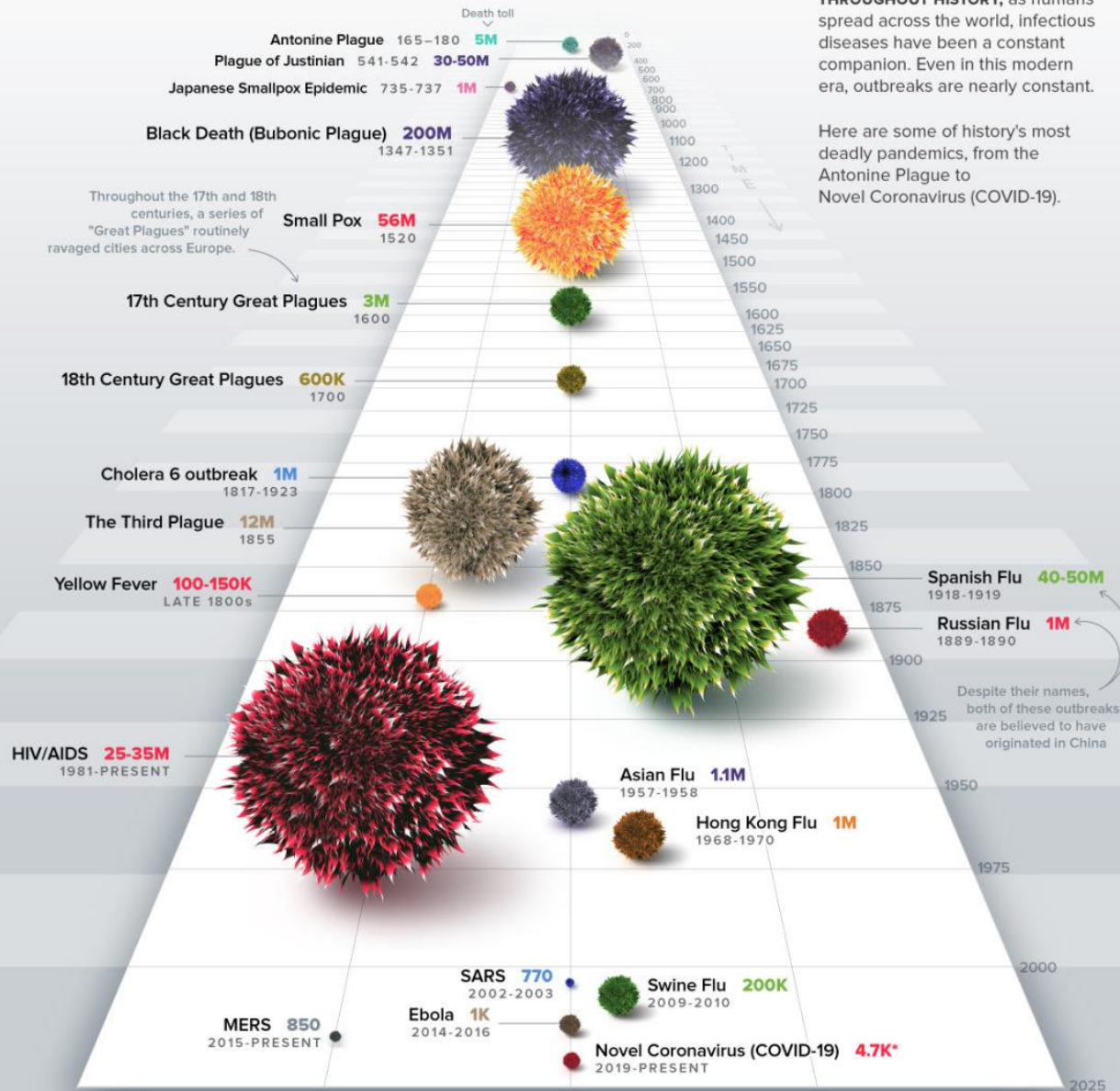


# HISTORY OF PANDEMICS

**PAN-DEM-IC** (of a disease) prevalent over a whole country or the world.

**THROUGHOUT HISTORY**, as humans spread across the world, infectious diseases have been a constant companion. Even in this modern era, outbreaks are nearly constant.

Here are some of history's most deadly pandemics, from the Antonine Plague to Novel Coronavirus (COVID-19).



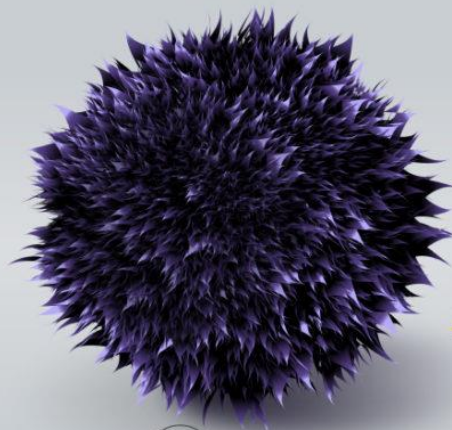
\*As of Mar 11, officially a

## DEATH TOLL [HIGHEST TO LOWEST]

\*As of Mar 11, officially a pandemic according to WHO

It is hard to calculate and forecast the impact of COVID-19 because the disease is new to medicine, and data is still coming in.

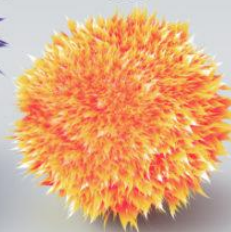
**200M**  
**Black Death (Bubonic Plague)**  
1347-1351



The plague originated in rats and spread to humans via infected fleas.

↑ The outbreak wiped out 30-50% of Europe's population. It took more than 200 years for the continent's population to recover.

**56M**  
**Small Pox**  
1520



↑ **Smallpox** killed an estimated 90% of Native Americans. In Europe during the 1800s, an estimated 400,000 people were being killed by smallpox annually. The first ever vaccine was created to ward off smallpox.

**40-50M**  
**Spanish Flu**  
1918-1919



**30-50M**  
**Plague of Justinian**  
541-542



↑ The death toll of this plague is still under debate as new evidence is uncovered, but many think it may have helped hasten the fall of the Roman Empire.



**25-35M**  
**HIV/AIDS**  
1981-PRESENT



**12M**  
**The Third Plague**  
1855



**5M**  
**Antonine Plague**  
165-180



**3M**  
**17th Century Great Plagues**  
1665



**1.1M**  
**Asian Flu**  
1957-1958



**1M**  
**Russian Flu**  
1889-1890



**1M**  
**Hong Kong Flu**  
1968-1970



**1M**  
**Cholera 6 outbreak**  
1817-1923

A series of **Cholera** outbreaks spread around the world in the 1800s killing millions of people. There is no solid consensus on death tolls.



**1M**  
**Japanese Smallpox Epidemic**  
735-737



**600K**  
**18th Century Great Plagues**  
1817-1923



**200K**  
**Swine Flu**  
2009-2010



**100-150K**  
**Yellow Fever**  
LATE 1800s



**11K**  
**Ebola**  
2014-2016



**850**  
**MERS**  
2015-PRESENT



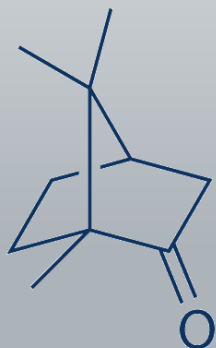
**770**  
**SARS**  
2002-2003

**4.7K\***  
**Novel Coronavirus (COVID-19)**  
2019-PRESENT

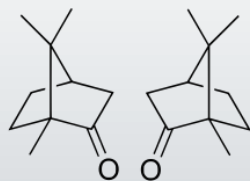
## Lab 1

# Reduction of Camphor

## Importance of Stereoselectivity



## Outline:



1. Camphor applications
2. Importance of stereochemistry
3. Reduction of camphor - overview
4. Reduction of camphor - video
5. Characterizations:  $^1\text{H}$ -NMR & GC-MS





# Applications

## Drug Facts

### Active ingredients

### Purpose

Camphor (synthetic) 4.8% ....	Cough suppressant & topical analgesic
Eucalyptus oil 1.2% .....	Cough suppressant
Menthol 2.6% .....	Cough suppressant & topical analgesic

### Uses

- when applied to chest and throat, temporarily relieves cough due to minor throat and bronchial irritation associated with the common cold
- when applied to muscles and joints, temporarily relieves minor aches and pains of muscles and joints

### Warnings

For external use only; avoid contact with eyes.

**Do not use**

- by mouth
- in nostrils
- on wounds or damaged skin
- with tight bandages

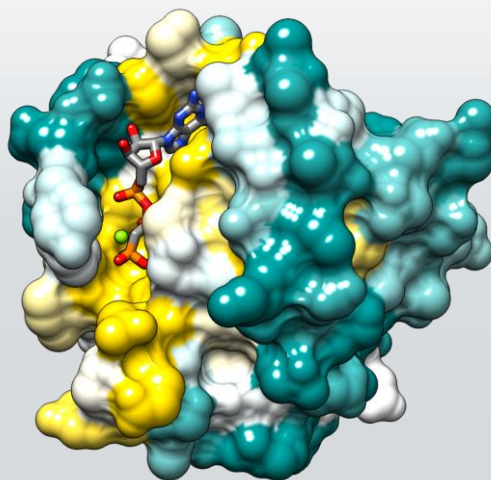
### Ask a doctor before use if you have

- cough that occurs with too much phlegm (mucus)
- persistent or chronic cough such as occurs with smoking, asthma or emphysema

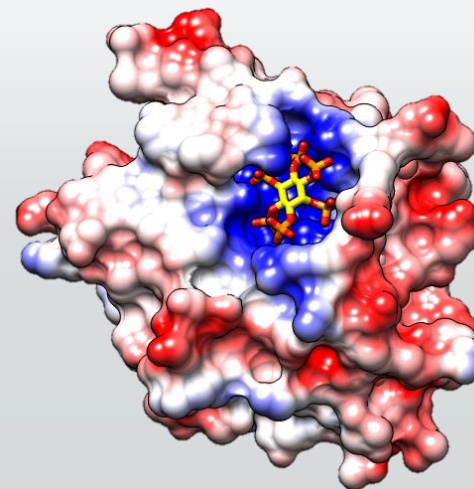


# Importance of Stereochemistry in biology

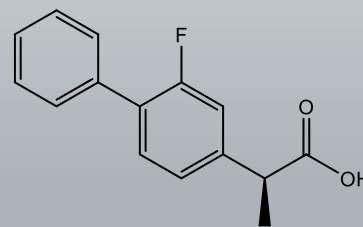
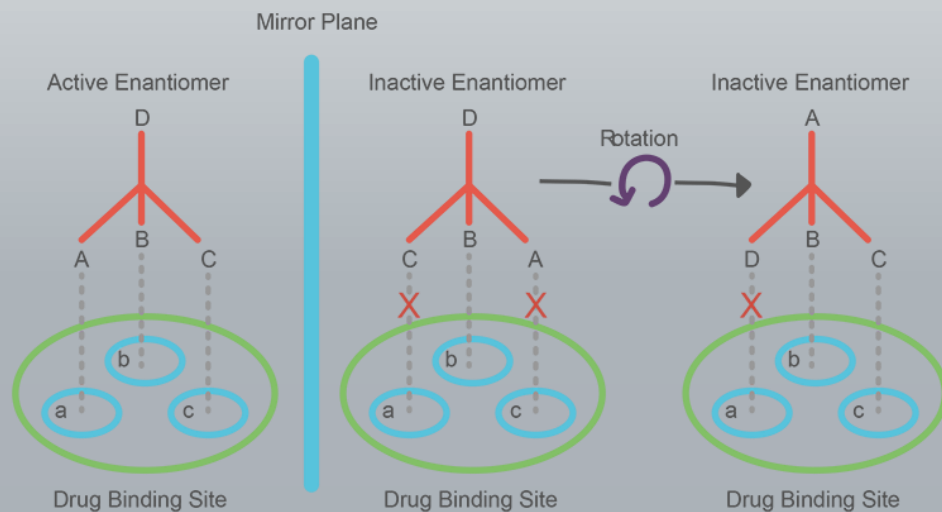
Nature is very *specific*



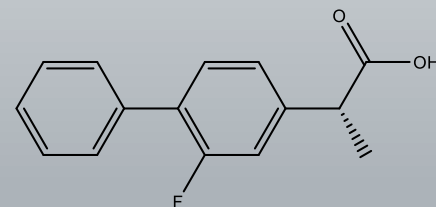
Ras GTPase



Cysteine protease



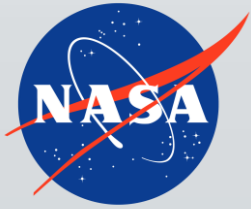
(*S*)-flurbiprofen



(*R*)-flurbiprofen

# Importance of Stereochemistry in biology

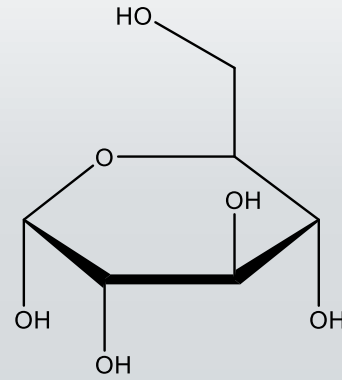
“A Natural Way to Stay Sweet”



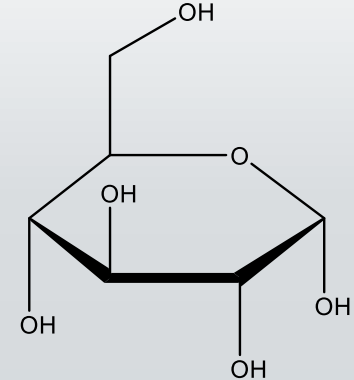
[https://spinoff.nasa.gov/Spinoff2004/ch\\_4.html](https://spinoff.nasa.gov/Spinoff2004/ch_4.html)



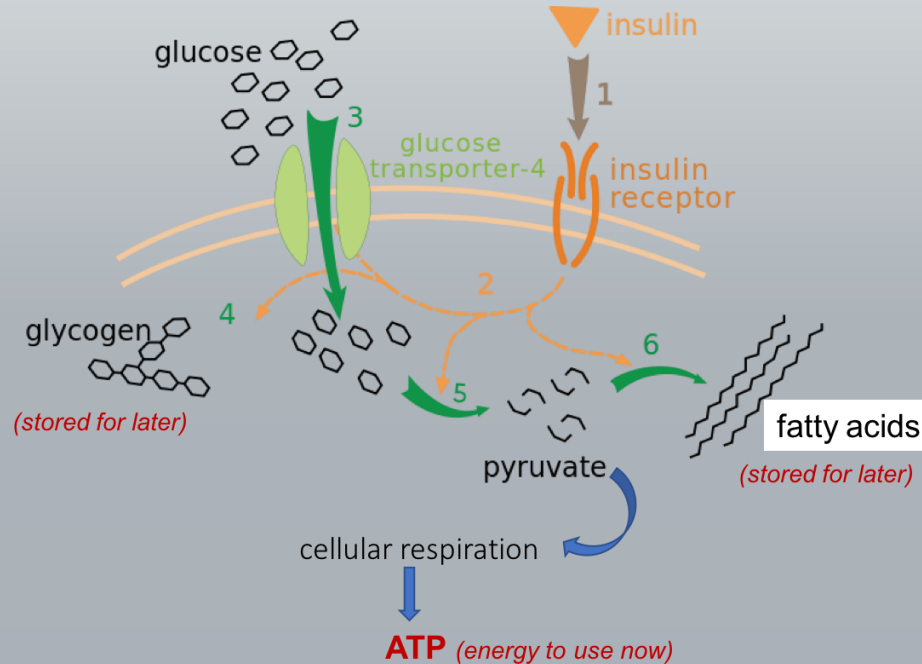
*Dr. Gilbert Levin*



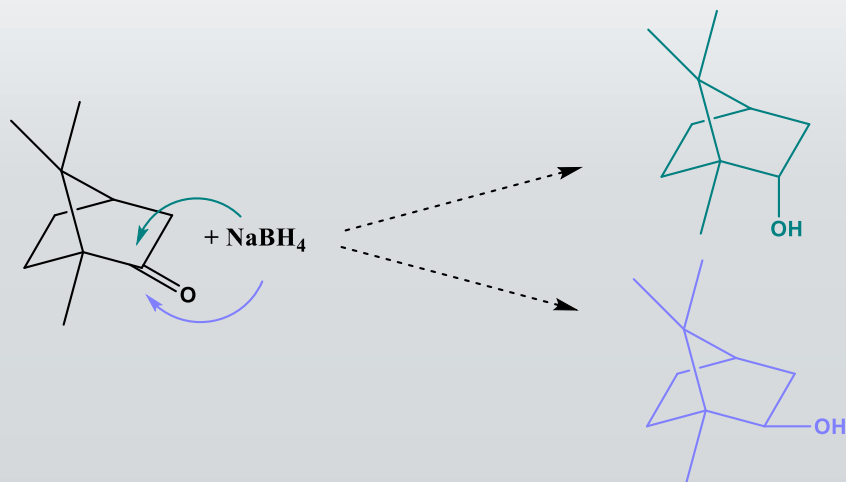
L-Glucose



D-Glucose



# Reduction of camphor - overview



## Characterizations?

$^1\text{H}$ -NMR

Number of H

IR

Functional groups

Melting point

Structure

GC-MS

Separation, molecular weight

## Chemicals

Camphor (200mg, 1.3 mmol)

Methanol (5-7mL, Solvent, BP: 65°C)

$\text{NaBH}_4$  (200mg, excess)

Water (6-8mL)

$\text{CH}_2\text{Cl}_2$

$\text{Na}_2\text{SO}_4$



## Glassware/Equipment

25 mL Erlenmeyer flask

Stir bar

Stir plate

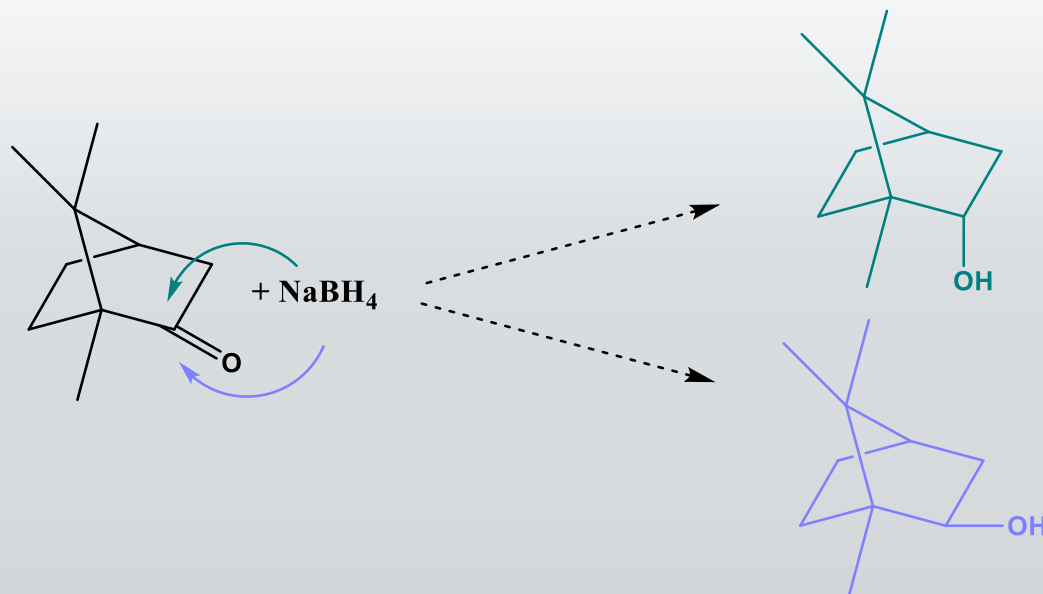
50 mL Buchner flask

Ice bath





# Reduction of camphor - overview



## Characterizations?

$^1\text{H}$ -NMR

IR

Melting point

GC-MS

Number of H

Functional groups

Structure

Separation, molecular weight

Diastereomers have different physical properties, so they show different peaks on GC

# Reduction of camphor - overview

## Chemicals

Camphor (200mg, 1.3 mmol)

Methanol (5-7mL, Solvent, BP: 65°C)

$\text{NaBH}_4$  (200mg, excess)

Water (6-8mL)

$\text{CH}_2\text{Cl}_2$

$\text{Na}_2\text{SO}_4$



## Glassware/Equipment

25 mL Erlenmeyer flask

Stir bar

Stir plate

50 mL Buchner flask

Ice bath



---

## Safety and Practical

$\text{NaBH}_4$  reacts strongly with water to produce hydrogen gas

Methanol is flammable

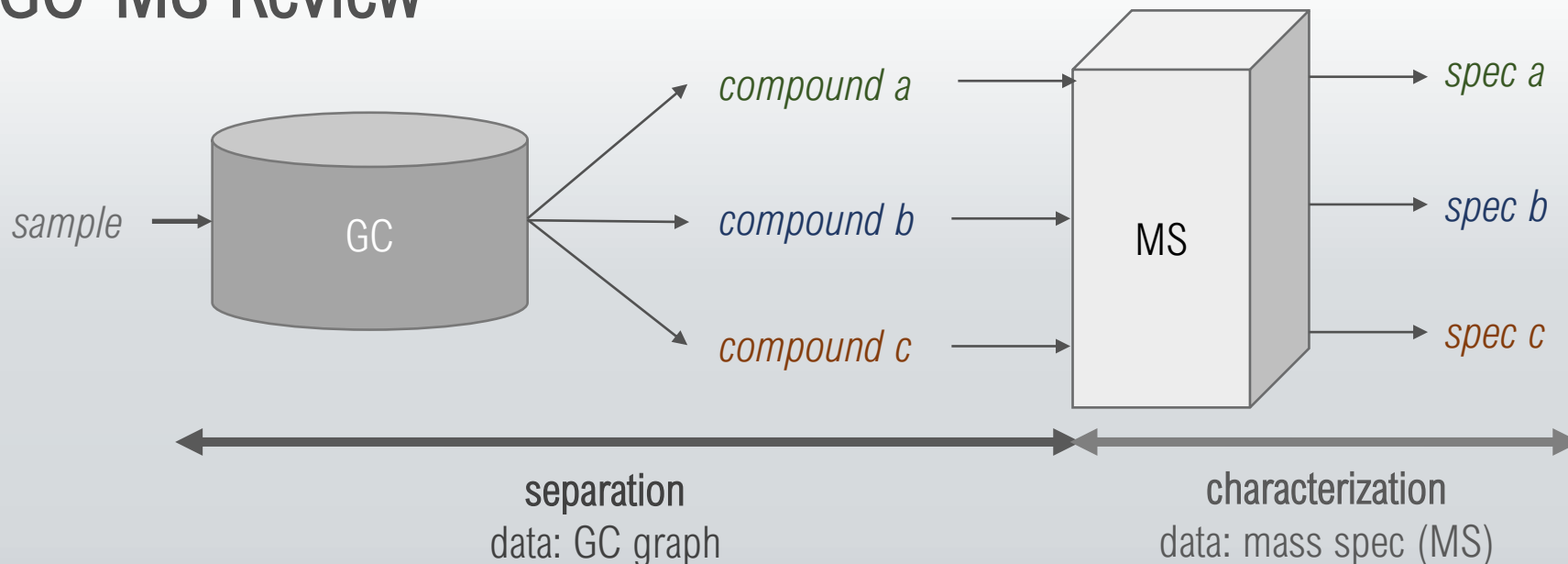
Quick reaction – don't need reflux condenser

Want to isolate any borneol/isoborneol/camphor present, don't want to remove any of these with recrystallization

When reaction over, add water as an “anti-solvent” to precipitate all organics

# Reduction of camphor - Video

# GC-MS Review



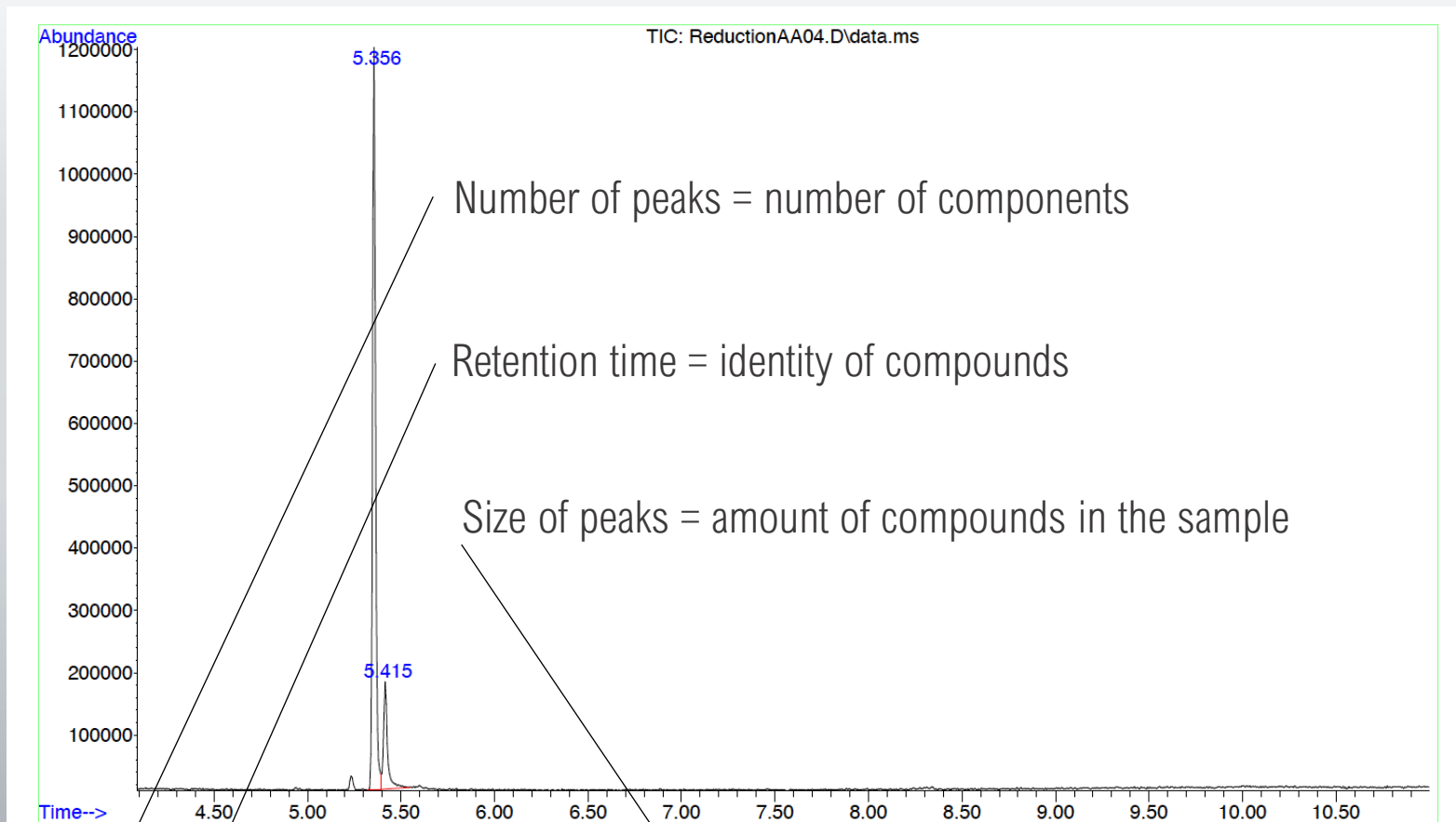
Interpretation: # of compounds retention time  
bp comparison composition of sample

Interpretation: molecular weight  
fragmentation pattern





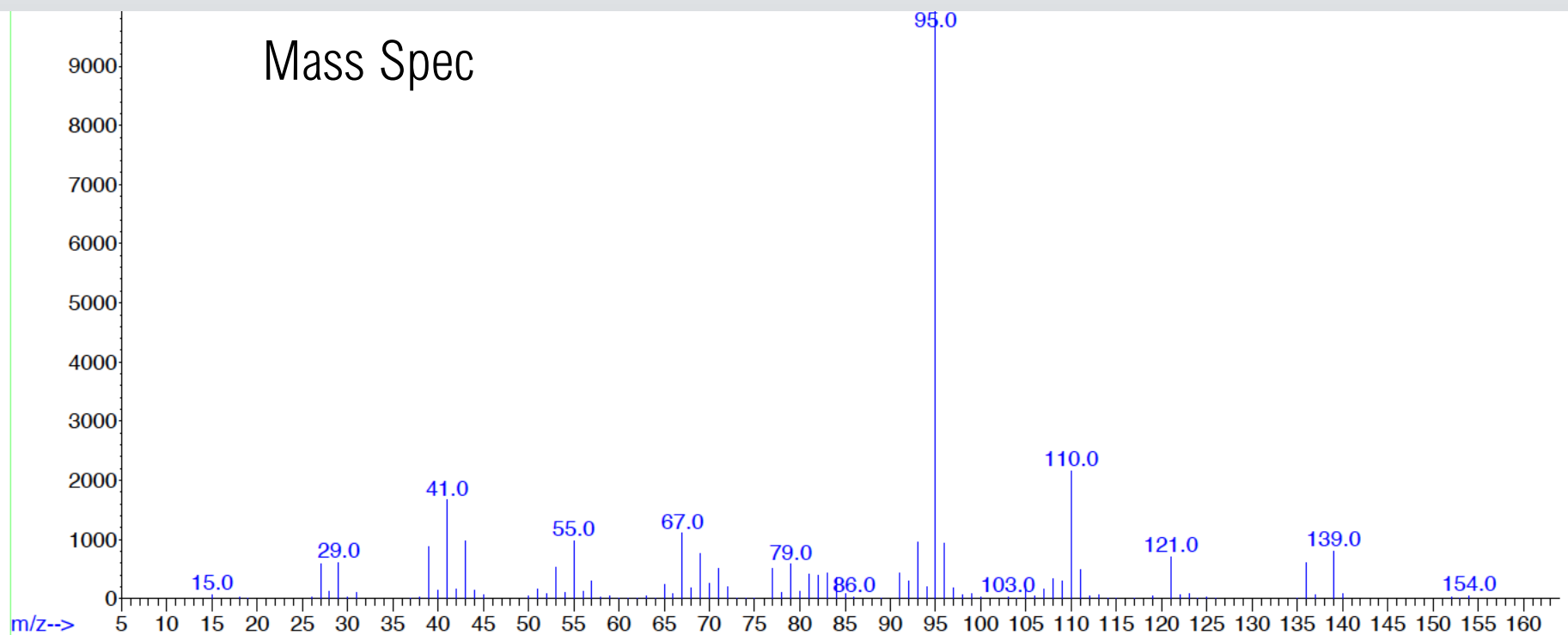
# GC-MS Review



peak #	R.T. min	first scan	max scan	last scan	PK TY	peak height	corr. area	corr. % max.	% of total
1	5.356	211	217	223	rBV	1191806	1328237	100.00%	83.866%
2	5.415	223	227	249	rVB	171070	255519	19.24%	16.134%

Sum of corrected areas: 1583756

# GC-MS Review



# NMR

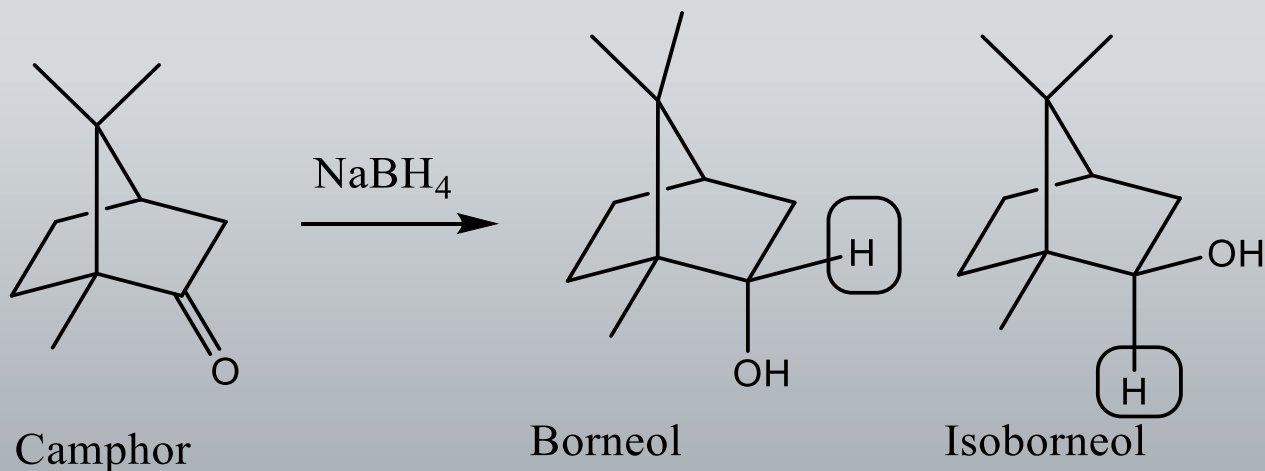
Chemical shifts of solvents:

water: singlet at 1.5

DCM: singlet at 5.3

acetone: singlet at 2.1

chloroform: singlet at 7.2



- Enantiomers have identical chemical shifts.
- Diastereomers may show different chemical shifts, likely to be similar
- Borneol vs isoborneol – look for CH peak around 3-5 ppm

# Reading list

'Fake' sugar

- [https://spinoff.nasa.gov/Spinoff2004/ch\\_4.html](https://spinoff.nasa.gov/Spinoff2004/ch_4.html)

Camphor history and uses

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6270224/#:~:text=Camphor%20was%20used%20as%20a,corpses%20before%20shrouding%20%5B6%5D>.

History of pandemic

- <https://www.weforum.org/agenda/2020/03/a-visual-history-of-pandemics>