

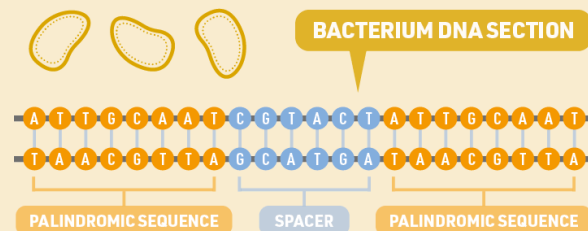


How to win a Chemistry Nobel prize?

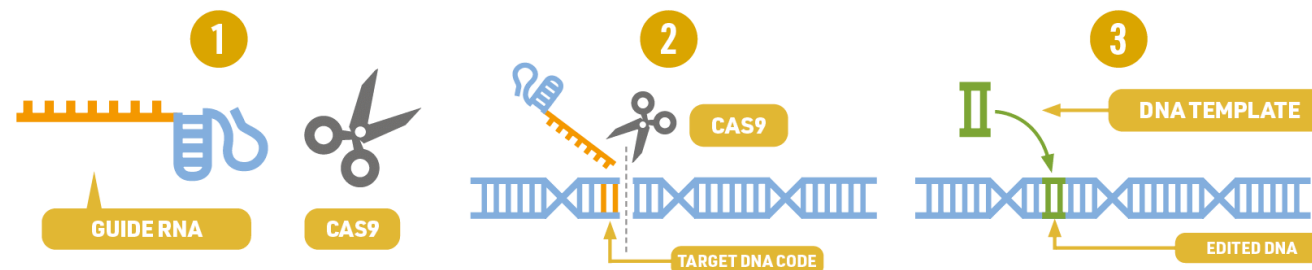
## 2020 NOBEL PRIZE IN CHEMISTRY



The Nobel Prize in Chemistry 2020 was awarded to **Emmanuelle Charpentier** and **Jennifer A. Doudna** for the development of CRISPR-Cas9 genetic scissors, a method for genome editing.



CRISPR stands for clustered regularly interspaced short palindromic repeats. It refers to repeated sequences in bacteria and archaea DNA. These sequences are part of an immune system; if a bacterium survives a viral infection, it adds a section of the virus genetic code to the CRISPR region of its own to serve as a memory in case it's infected again. **Charpentier** and **Doudna** saw that this could be used as a gene editing tool.



The first step in the CRISPR gene editing process is the creation of a strand of guide RNA. This matches the DNA sequence where we want to make a cut. A scissor protein, Cas9, binds to the guide RNA.

The guide RNA searches for the target section of DNA and transports the scissor protein to it. The scissor protein cuts the DNA at this point.

The cell will try and repair the cut DNA. This process is error-prone, disrupting the gene function. If we add a template, the cell will use this to carry out the repair, allowing us to edit the genetic code.



### WHY DOES THIS RESEARCH MATTER?

The ability to edit genomes has already found uses in plant breeding. Therapies which use it to treat some types of cancer are already in clinical trials, and it's hoped it may lead to cures for inherited diseases.

Nobel Prize in Chemistry press release: <https://www.nobelprize.org/uploads/2020/10/press-chemistryprize2020.pdf>



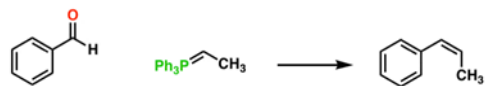
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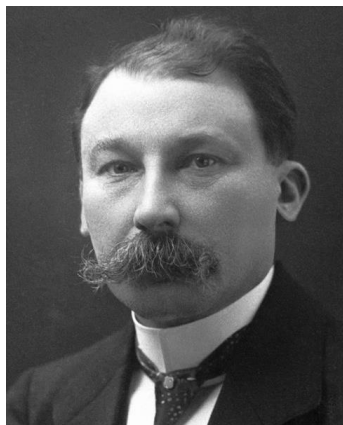
A



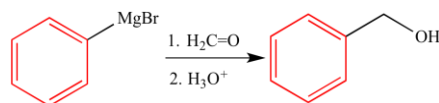
1979  
Wittig



B



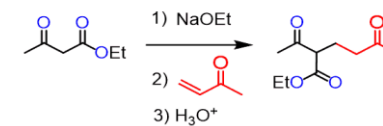
1912  
Grignard



C



Michael



D



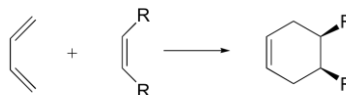
2010  
Heck



E



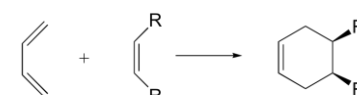
1950  
Diels



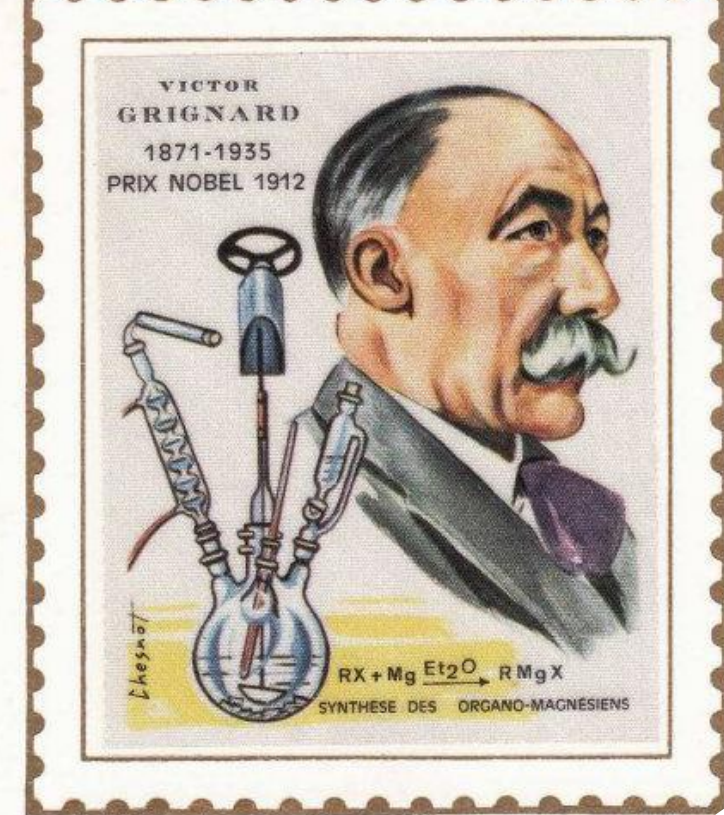
F



1950  
Alder



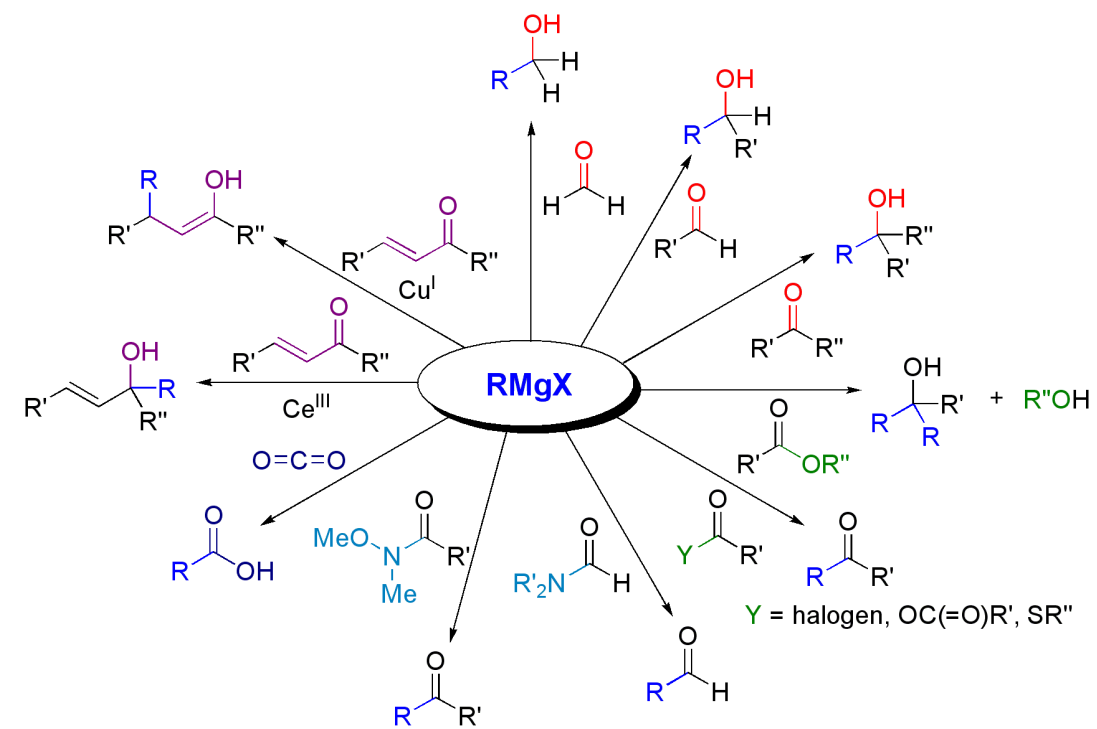
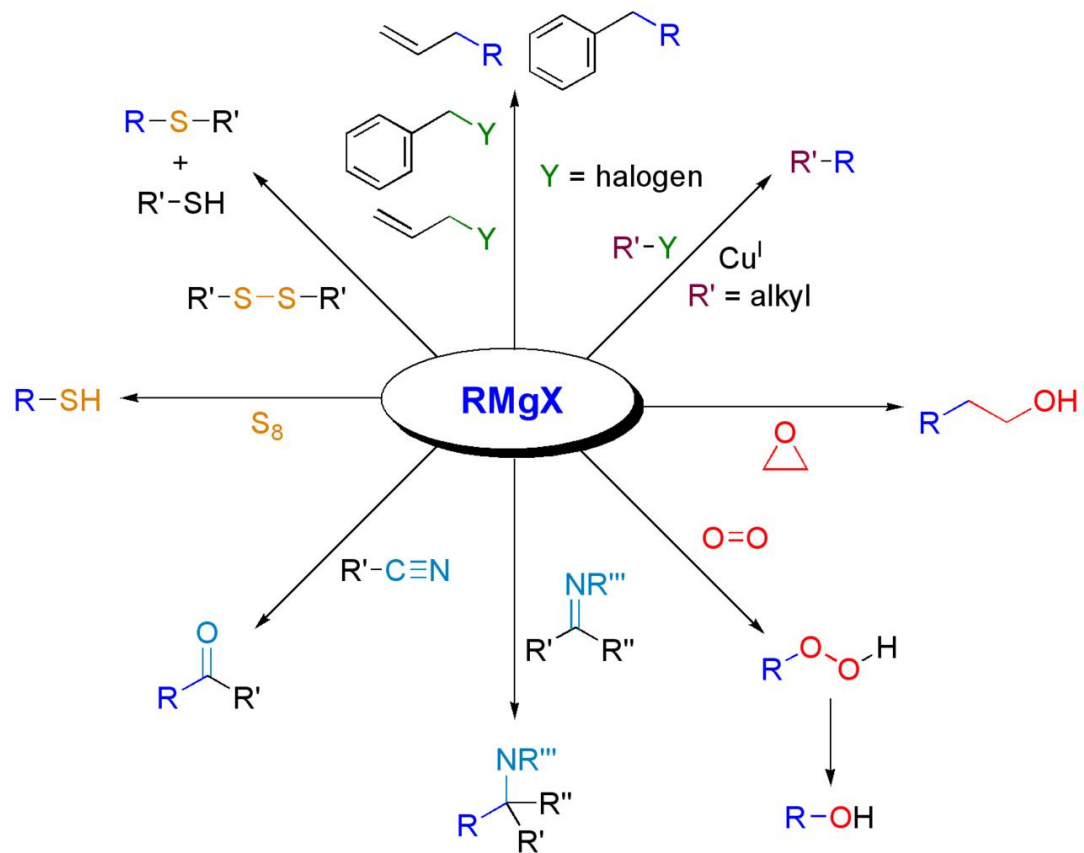




# Lab 6

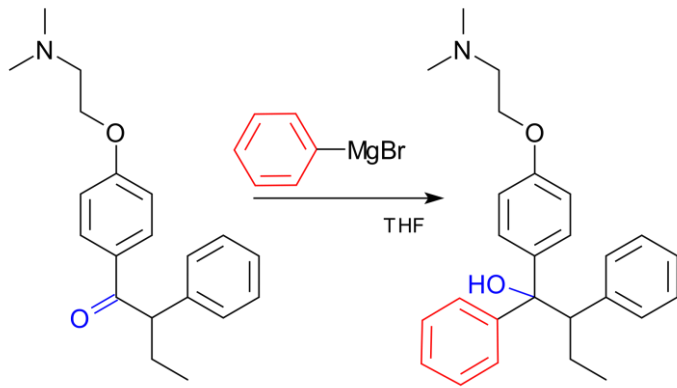
## Grignard Reaction

# Grignard reactions

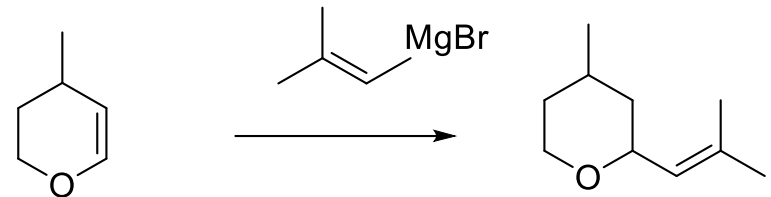


# Some applications

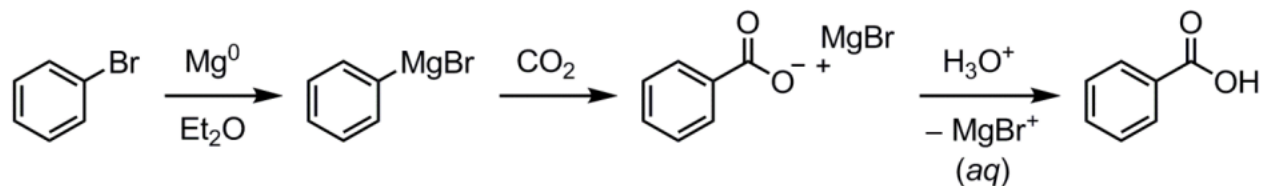
## Breast cancer treatment



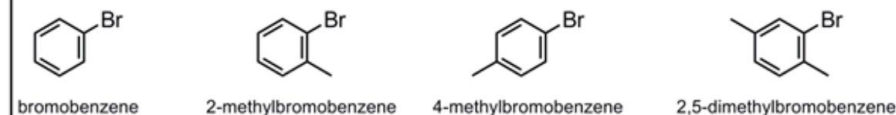
## Synthesis of rose oxide



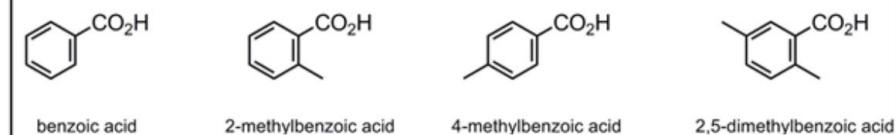




**Possible Starting Materials:**

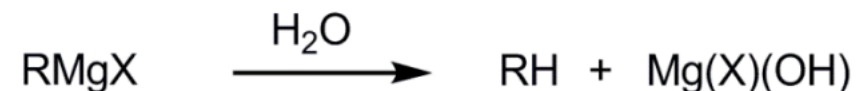
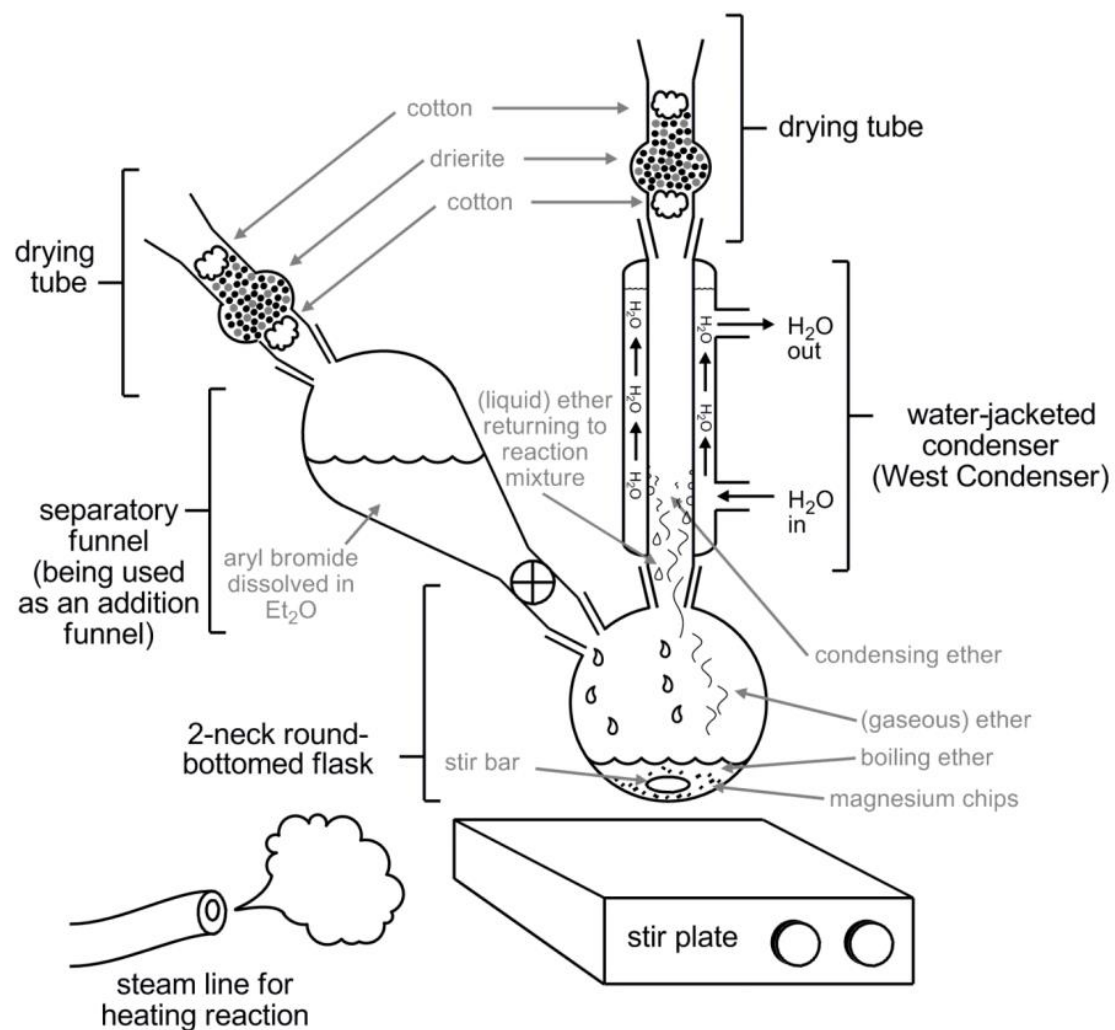


**Possible Carboxylic Acids:**



| Chemical           | Appearance   | MW | Equivalent | Amount      | Notes                                |
|--------------------|--------------|----|------------|-------------|--------------------------------------|
| Starting materials | Clear liquid |    | 1          | 0.025 moles | Flammable liquids,<br>Aquatic Hazard |
| Possible products  | ?            |    | 1          |             | Damage lung                          |
| Mg                 | Solid        |    | 1          | 0.7 g       | Flammable solid                      |
| Diethyl Ether      | Lq           |    | Solv       |             | Extremely<br>flammable               |
| dry ice            |              |    | Excess     |             | Cause frostbite                      |
| HCl                |              |    | /          |             | Corrosive                            |
| NaOH               |              |    | /          |             | Corrosive                            |

# Glassware Setup and Excluding Water

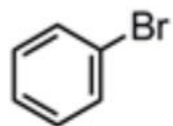


- Dry glassware before reaction – flame dry with Bunsen burner
- Keep system dry during Grignard formation – drying tubes
- System is sensitive until Grignard reagents react with  $\text{CO}_2$

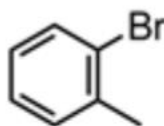
# Procedural Guidance

- Diethyl ether is extremely flammable
- Slow addition of reagent allows for a controlled reaction
  - Why might this be important? (two reasons)
- Dry ice can quickly condense water vapor onto its surface thus we must act quickly
  - What might go wrong if we take our time?

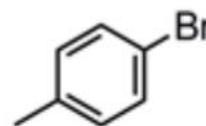
- Unknowns:



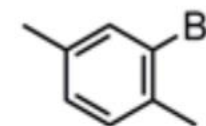
bromobenzene



2-methylbromobenzene



4-methylbromobenzene



2,5-dimethylbromobenzene



# Purification

- Purification methods we have seen include: column chromatography, recrystallization, extractions, distillations.
- What are we trying to isolate? What are we trying to remove?
- Which purification methods apply to the Grignard system?
- What are the benefits and drawbacks to those methods?

# $^1\text{H}$ -NMR and Carboxylic Acids

Why is  $H_a$  broad in the spectra on the left?

Why doesn't  $H_a$  show up in both spectra?

