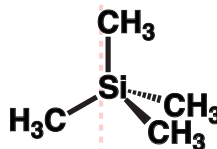


# **<sup>1</sup>H NMR SPECTRUM**



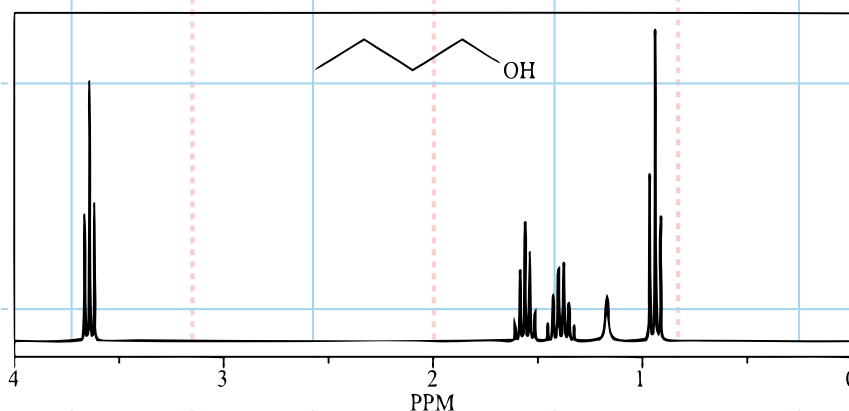
**Team-Based Mode**

## **Rulebook**

**By.  
Zachary  
Thammavongsy**

# BACKGROUND

$^1\text{H}$  NMR (Nuclear Magnetic Resonance) spectroscopy is an advanced chemistry technique used by scientists to identify complex molecules. Students are first introduced to  $^1\text{H}$  NMR spectroscopy in sophomore organic chemistry.  $^1\text{H}$  NMR Spectrum is a board game aimed to help students practice and develop their own method towards solving the identity of molecular structures via  $^1\text{H}$  NMR spectroscopy. Students will be able to collaborate with others to interpret  $^1\text{H}$  NMR spectra of organic molecules. In addition, the goal of this board game is to build student's confidence, enjoyment, and teamwork on the topic of  $^1\text{H}$  NMR.

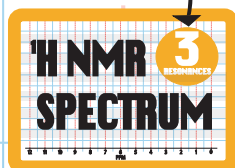


# OBJECTIVE

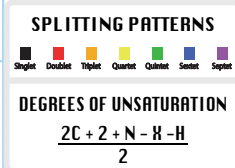
Objective of the game is for students to build their skills solving molecular structures via  $^1\text{H}$  NMR spectroscopy. Students collaborate in teams to gain as many structure points as possible in 4-6 rounds of play.

# CONTENTS

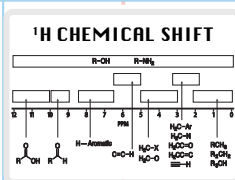
Resonance  
Point Value



(back of card)  
100 Structure Cards



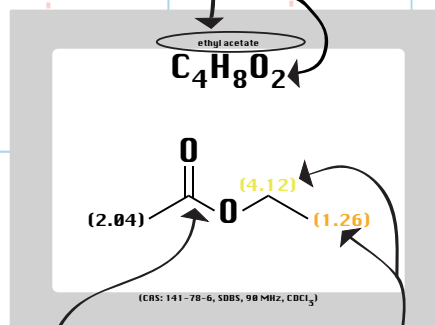
(back of card)  
6 Information Cards



(front of card)  
6 Information Cards

Name of  
Molecule

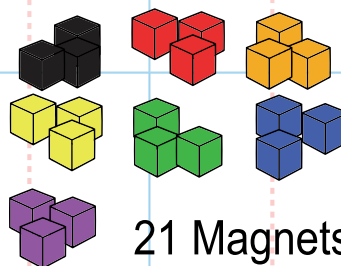
Molecular  
Formula



(front of card)  
Structure Card

Structure of  
Molecule

Shift (ppm)  
Color = Splitting



21 Magnets

(3 of each color)

A template for a sketchboard with the following sections: **DEGREE OF UNSATURATION**, **DRAW STRUCTURE BELOW**, and **MOLECULAR FORMULA**.

6 Sketchboard

1 Whiteboard (shown in Set Up )



# SET UP

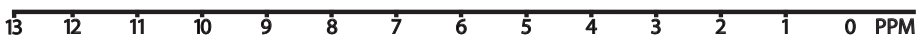
**#** = Integration


**Molecular Formula**

## WHITE BOARD

**PLACE MAGNETS ON WHITE BOARD**

**PLACE STRUCTURE CARDS NEXT TO GAME BOARD**





**1H NMR SPECTRUM 2**

**1H NMR SPECTRUM 3**

**Every team should have**

- 3 Sketchboards
- 3 Information Cards
- 3 Dry Erase Markers

**1H NMR SPECTRUM 2**

**1H NMR SPECTRUM 3**

**1H NMR SPECTRUM 2**

**1H NMR SPECTRUM 3**

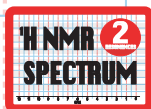
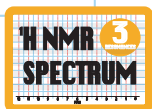
**TIMER (CELL PHONE)**

**1H NMR SPECTRUM 2**

**1H NMR SPECTRUM 3**

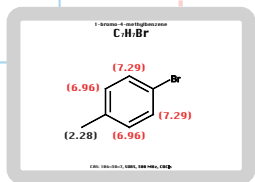
# GAME PLAY

1. Split into teams of two.
2. The team with the youngest combined age goes first.
3. For each round, team members select one of their players to be the "Structure Giver."
4. The Structure Giver chooses a Structure Card.



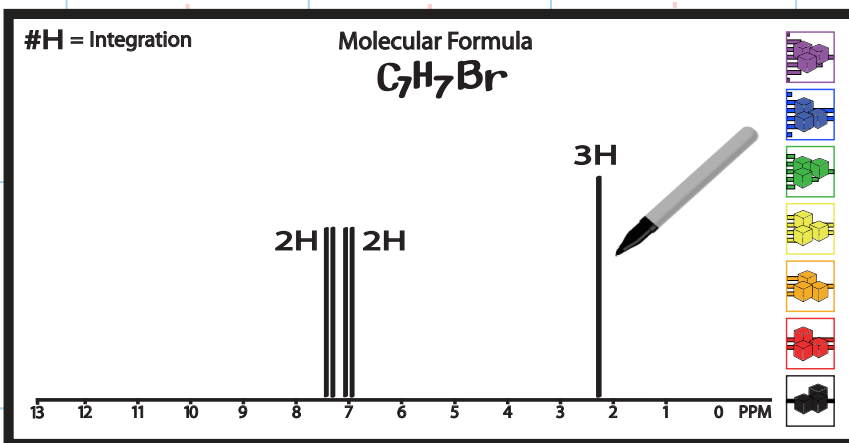
(The Structure Giver does not show anyone else the card.)

5. Once the Structure Card is selected, the Structure Giver writes out the molecular formula and draws the spectrum from the Structure Card on the whiteboard.



- **Molecular Formula** displayed on top
- **Chemical Shift** of proton displayed next to carbon
- **Chemical Splitting** represented by a color
- Structure Giver must figure out **integration**
- **Reference** for molecule displayed on bottom

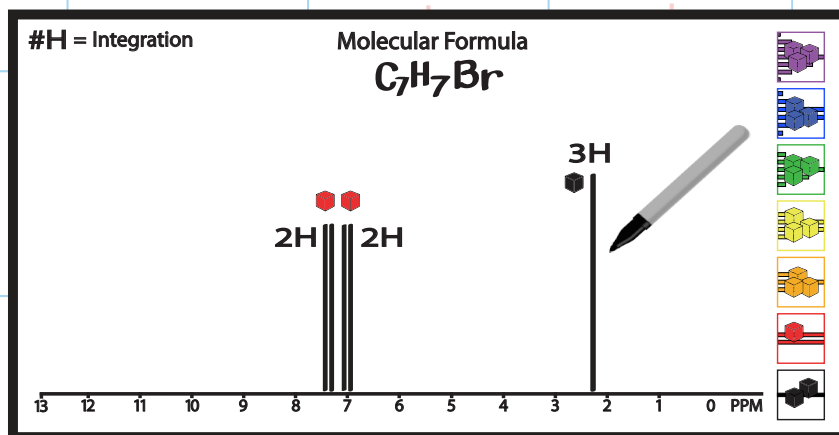
6. Timer starts when the Structure Giver starts drawing.  
Default time is 5 minutes.



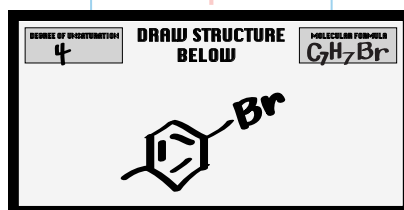
# GAME PLAY

## CONTINUED

7. Structure Giver can also place the color magnets on the drawn splitting patterns to help team members determine the splitting patterns.



8. All team members (excluding Structure Giver) should collaborate to determine the molecular structure.



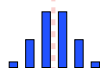
While the Structure Giver's team tries to figure out the molecular structure, the other team should also collaborate to come up with their own answer.

9. Team members have unlimited chances to show their drawn structure on the Sketchboard to the Structure Giver before time runs out.

10. The Structure Giver have the option to pass on a Structure Card if they deemed to challenging to solve.

11. Repeat steps 4 - 10 until time expires.

12. For any Structure Cards that were not solved, the other team has 30 seconds and only one chance (per structure card) to show their drawn molecular structure to the Structure Giver.



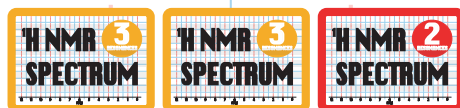
# GAME PLAY

## CONTINUED

13. If no team gets the molecular structure correct, no team receives the points associated with the Structure Card.
14. Remove the Structure Cards from the game to ensure it does not get played in the following rounds.
15. Next team repeats steps 3 - 14.
16. Play six total rounds.
17. The winning team will move on to play another winning team.

## ***Determined Winner***

Structure Points will be tallied up after six rounds.



Example:  
Team 1 won three  
Structure Cards  
 $3 + 3 + 2 =$   
8 Structure Points

The team with the most Structure Points is crowned the winner.

Instructor's Note: Although this rulebook provides key steps on how to play the game, instructors are encouraged to add/change steps as needed to suit their classroom. Certain recommended changes include the time of gameplay, allocation of structure points, and total round of play.

## CREDITS

Game Designer: Zachary Thammavongsy (Ph.D.)

[www.dorbitalgames.org](http://www.dorbitalgames.org)



### What Materials to Buy – Team-Based Mode (per one game set)

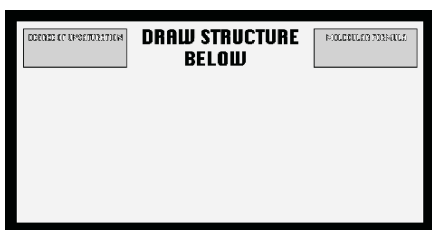
- 21 Magnets (2.1" x 1.2")



- Colored Tapes – Make sure to buy tape that have 7 different colors. Recommended colors are red, orange, yellow, green, blue, purple, and black.

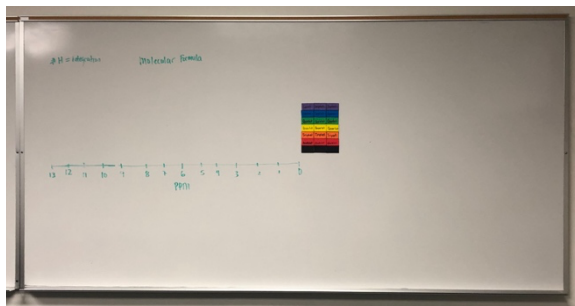


- Laminator – Laminate the Sketch Board

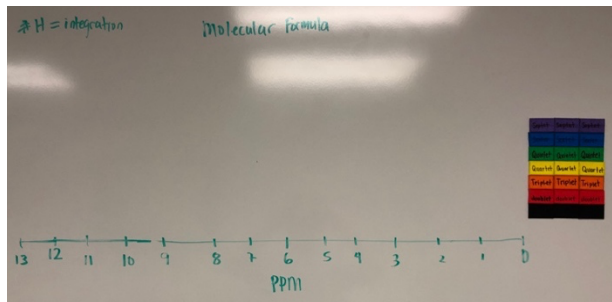


- Dry Erase Markers – 6 total
- Big Classroom White Board

### Example of what the set up should look like...



Full View of Set Up



Zoomed in View

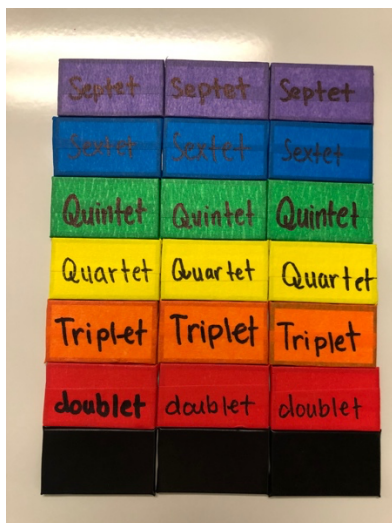


Image of magnets with colored tape covering each magnet. Write multiplicity on magnets as shown on image.