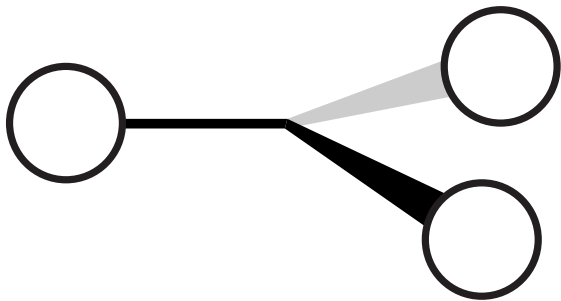


SALC

An Orbital Arrangement Game



By
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& Madalyn Radlauer, PhD

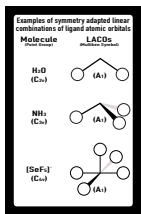
BACKGROUND

SALCs are one of those concepts in chemistry that can make students nervous just from their name: symmetry adapted linear combinations of ligand atomic orbitals. Admittedly, that's a mouthful. Yet, SALCs are an important part of molecular orbital theory, and can be incredibly powerful for visualization of electron density in both transition metal complexes and organic molecules. So we want students to learn about them. The "SALC" betting game was crafted in hopes of strengthening student's visualization of the atomic and molecular orbitals for a compound of a given symmetry. Indeed, as students connect the SALCs to the atomic orbitals on the central atom during this game, we believe they will get past any initial reticence and find SALCs to be pretty approachable.

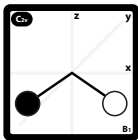
GOAL OF THE GAME

The goal of "SALC" is to be the player with the highest point total from their winning betting chips at the end of the game.

COMPONENTS



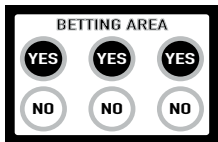
Example
Card 2x



Playing Card 65x



Center Atom's
Orbital Pieces 10x



Betting Mat 2x



Scoring Mat 2x



LO = Ligand Orbital

 = Players

OVERVIEW

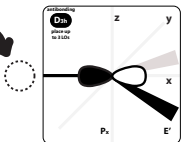
Place the 6 ligand s-orbital pieces at the top of the playing area



More information on LO placement can be found on pages 8 to 10.



Place LO here during play.

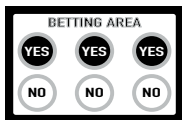


Place LO here during play..



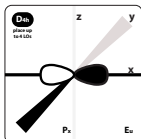
Metal Orbital Facing Up.
(Answer on backside of Playing Card.)

Place LO here during play.



Discard pile.

Playing Card stack.
64x

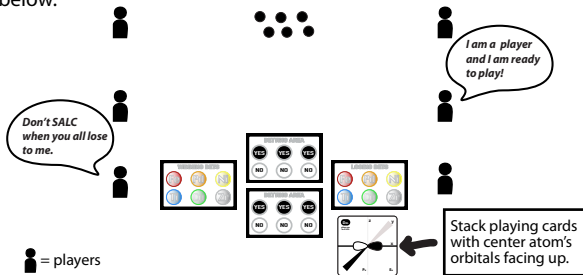


GAME PLAY

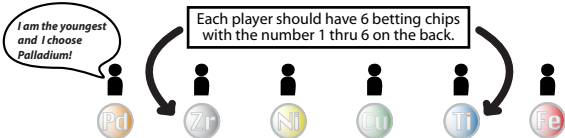
SET UP ROUND

Step 1: Assemble all 65 "Playing Cards" with the center atom's orbital side facing up. Shuffle the "Playing Cards" and position them (along with all other playing components) as shown below.

Step 2: Gather all players around the playing components as shown below.



Step 3: Players select their betting chip group (based on transition metals). Select betting chips based on whatever house rule you like (e.g. based on age, youngest goes first).



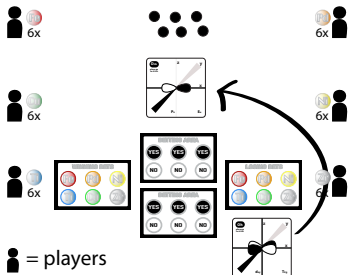
Step 4: The player who chooses their betting chips last gets to play first. Then take turns clockwise.



GAME PLAY

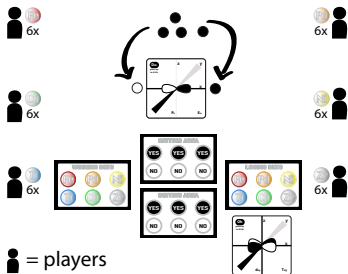
PLAYING ROUND

Step 5: Have the player take a "Playing Card" from the "Playing Card" stack and place it in the middle of the playing area. Make sure the backside of the card (answer) doesn't get revealed.



Player move
"Playing Card"
to middle of
the playing
area.

Step 6: The same player then arranges the ligand s-orbitals around the "Playing Card." The player can choose to play 0 to 6 ligand s-orbital pieces around the center atomic orbital. Suggested number of s-orbital ligand pieces to play can be found on the "Playing Card."

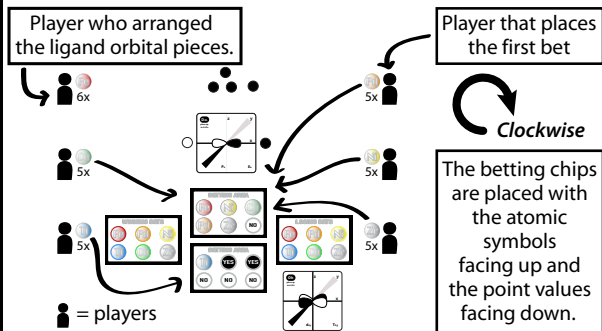


The ligand
s-orbitals
should be
placed
around the
"Playing Card."
Not on the
"Playing Card"

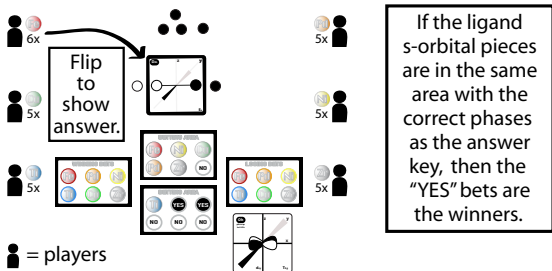
GAME PLAY

PLAYING ROUND CONTINUED

Step 7: All other players then place one of their betting chips on the "Betting Area Mat". Place bets in a clockwise manner, starting with the player to the immediate left of whom arranged the ligand s-orbitals.



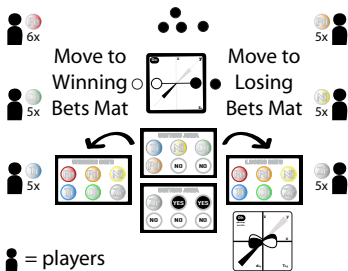
Step 8: The player who arranged the ligand s-orbitals then flips the "Playing Card" to reveal the answer on the backside of the card.



GAME PLAY

SCORING ROUND

Step 9: If the linear combination of atomic orbitals (LCAOs) is correct then the "YES" bets are the winning bets. Place the chips from the "YES" bets on the "Winning Bets Mat" and the chips from the "NO" bets on the "Losing Bets Mat".



All played betting chips must have the point values displayed facing down until the very end of the game.

Step 10: The player to the immediate left of the player who previously arranged the ligand s-orbitals goes next. Repeat steps 5-9 until all players had a chance to arrange the ligand s-orbitals around a "Playing Card." The player with the most combined point values from their betting chips on the "Winning Bets Mat" is crowned the winner!

There may be multiple winners in the event of a tie.



Winners!

Iron the best!



Example...

6 5 1 3 4

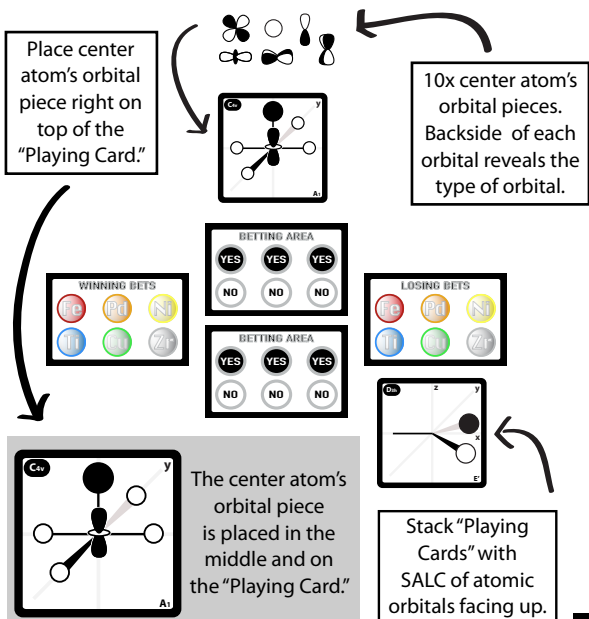
A combined total point value of 19.

There can be unused betting chips depending on the amount of players and/or the number of rounds played.

ALTERNATIVE GAMEPLAY

CENTER ATOMIC ORBITAL

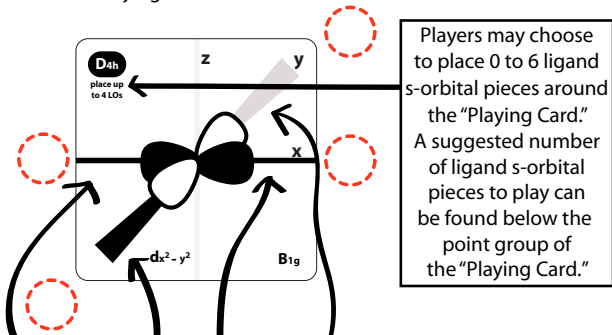
The backside of the "Playing Cards" can be played in order to use the center atom's orbital pieces. Similar set up to the original gameplay with a few exceptions. The center atom's orbital pieces will replace the ligand s-orbital pieces and the "Playing Cards" are flipped, showing the SALC of atomic orbitals rather than the center atomic orbital.



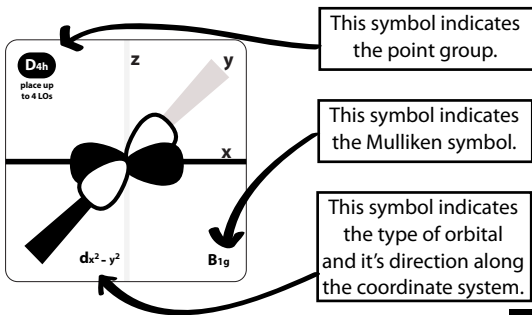
PLAYING CARDS

LIGAND ATOMIC ORBITAL

Playing Card details and additional information.



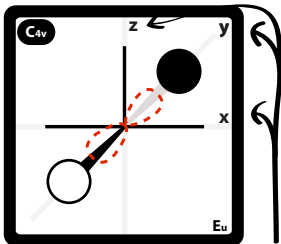
Helpful Tip: The end of the solid black and wedged lines show where players should potentially place the ligand s-orbital pieces.



PLAYING CARDS

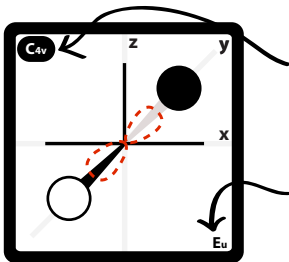
CENTER ATOM'S ORBITAL

Playing Card details and additional information.



Players choose
1 center orbital
piece to be placed
on the "Playing Card."

Helpful Tip: Play attention to the x, y, and z coordinates on the "Playing Card" and how the center atom's orbital is positioned within the coordinate system. Even though these cards are flat, they are representing molecules in 3D space.



This symbol indicates
the point group.

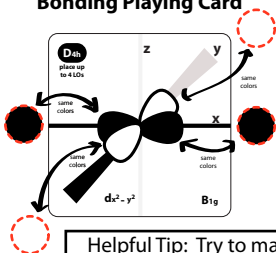
This symbol indicates
the Mulliken symbol.

For "Playing Cards" that are non-bonding events, there may be multiple answers at play. Therefore, if a player is solving for a non-bonding event, they may choose to skip and use another "Playing Card."

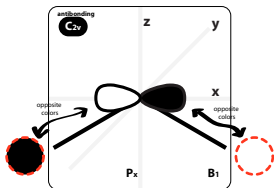
PLAYING CARDS

The three types of "Playing Cards" and additional information.

Bonding Playing Card

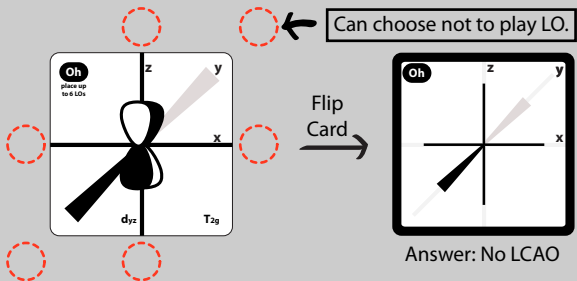


Antibonding Playing Card



Helpful Tip: Try to match the ligand orbital (LO) phase with the center atomic orbital phase in the bonding "Playing Cards" but do the exact opposite when playing with the antibonding "Playing Cards."

Non-bonding Playing Card



Answer: No LCAO

Non-bonding "Playing Cards" should have zero ligand s-orbital pieces around the "Playing Card."

CREDITS

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LEGAL

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