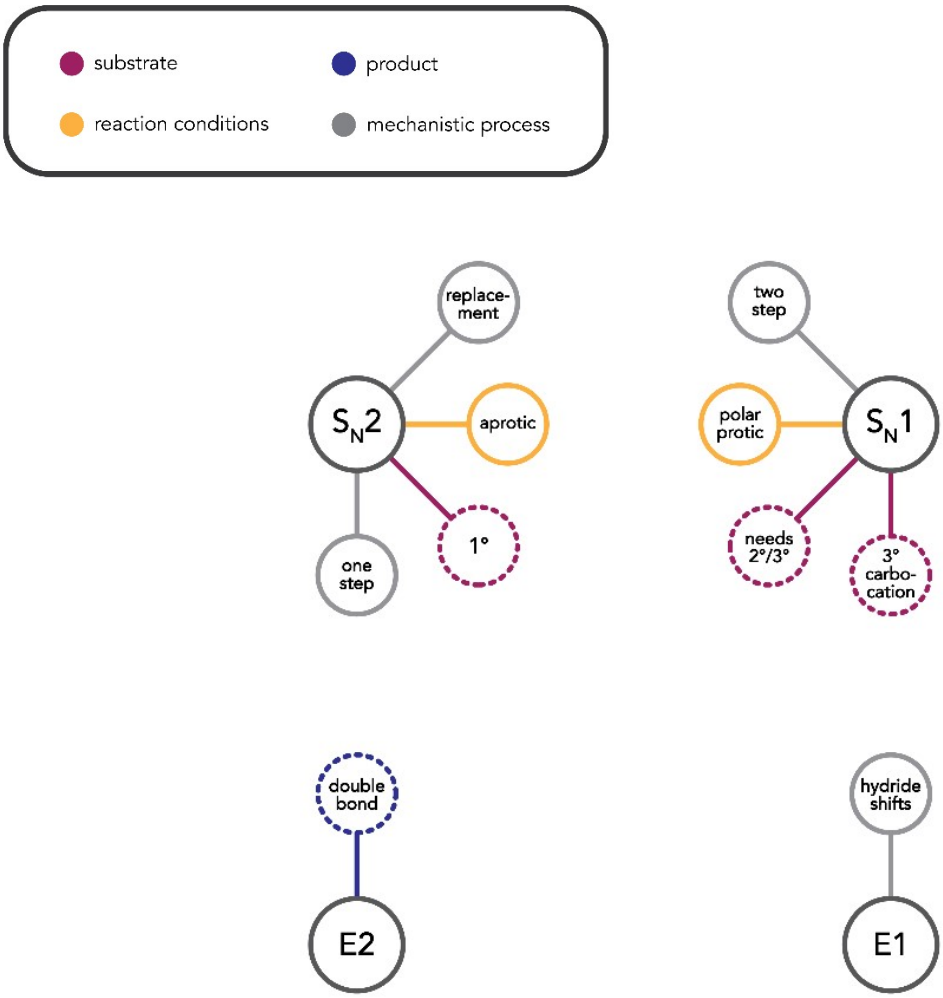
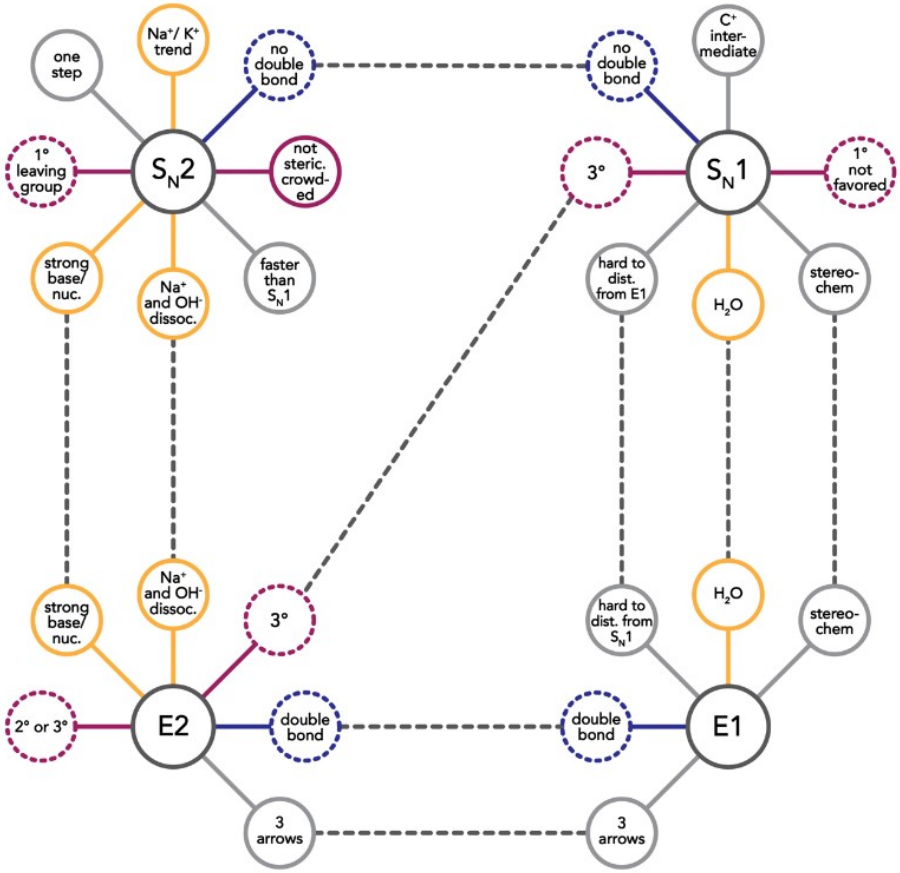
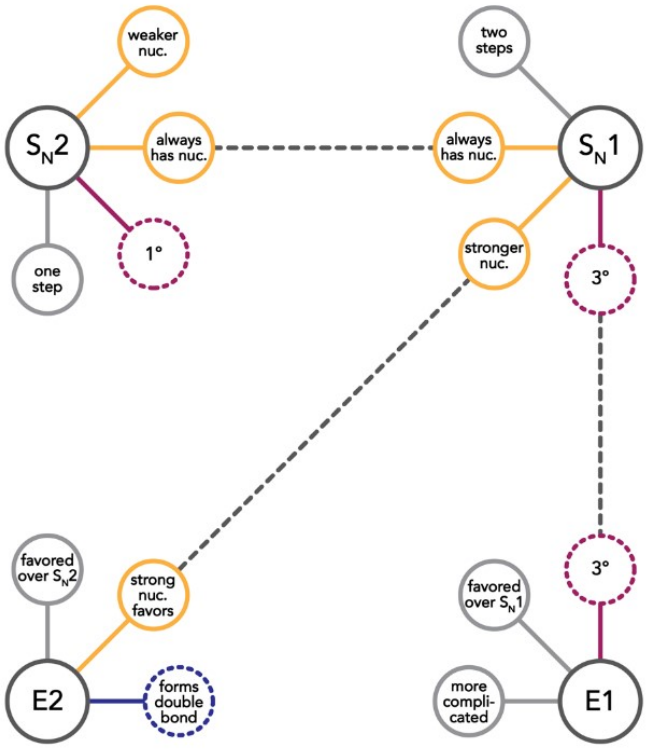
Appendix 3: Resource graphs for all nine students. First are the individual resource graphs based on case comparison tasks. Following that are the resource graphs for students solving the exam-type questions. All elements of the resource graphs follow the same color scheme indicated below which depict to which aspect of the reaction each knowledge element/ extraction refers.



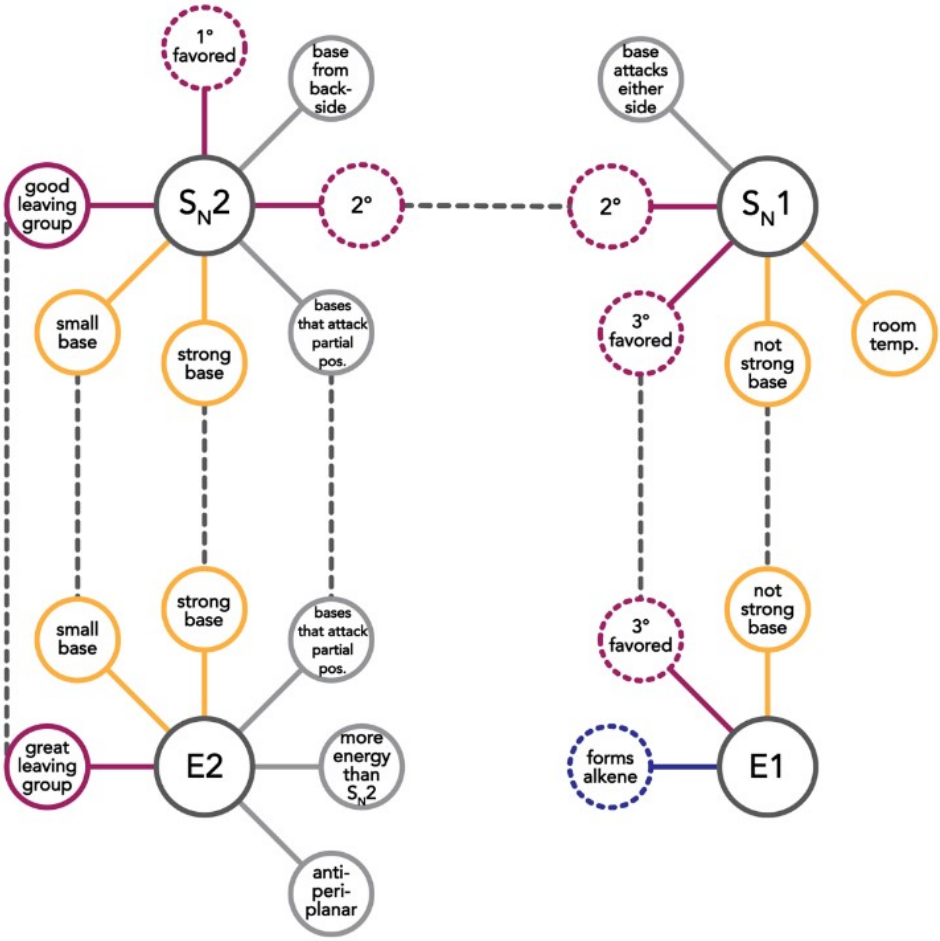
Resource graph for Phyllis which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



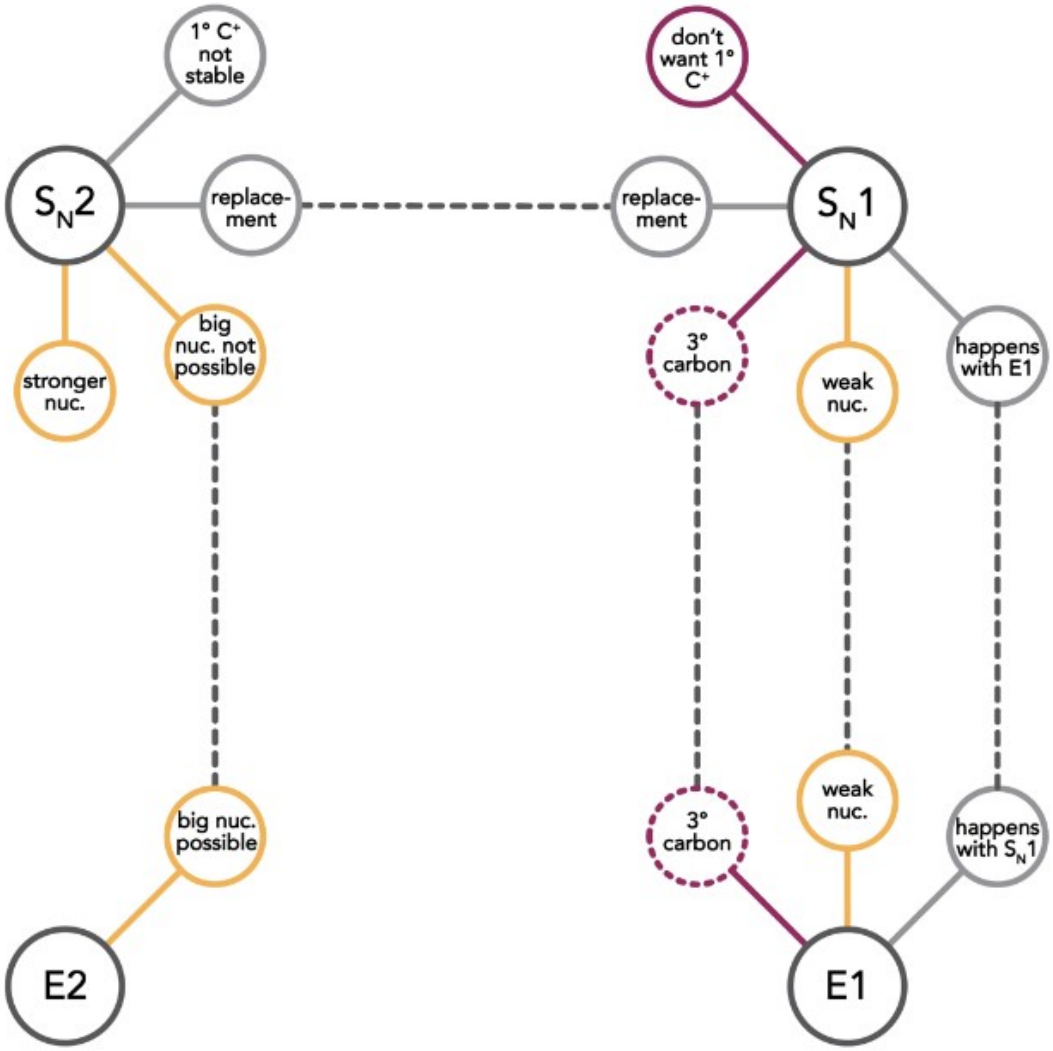
Resource graph for Pam which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



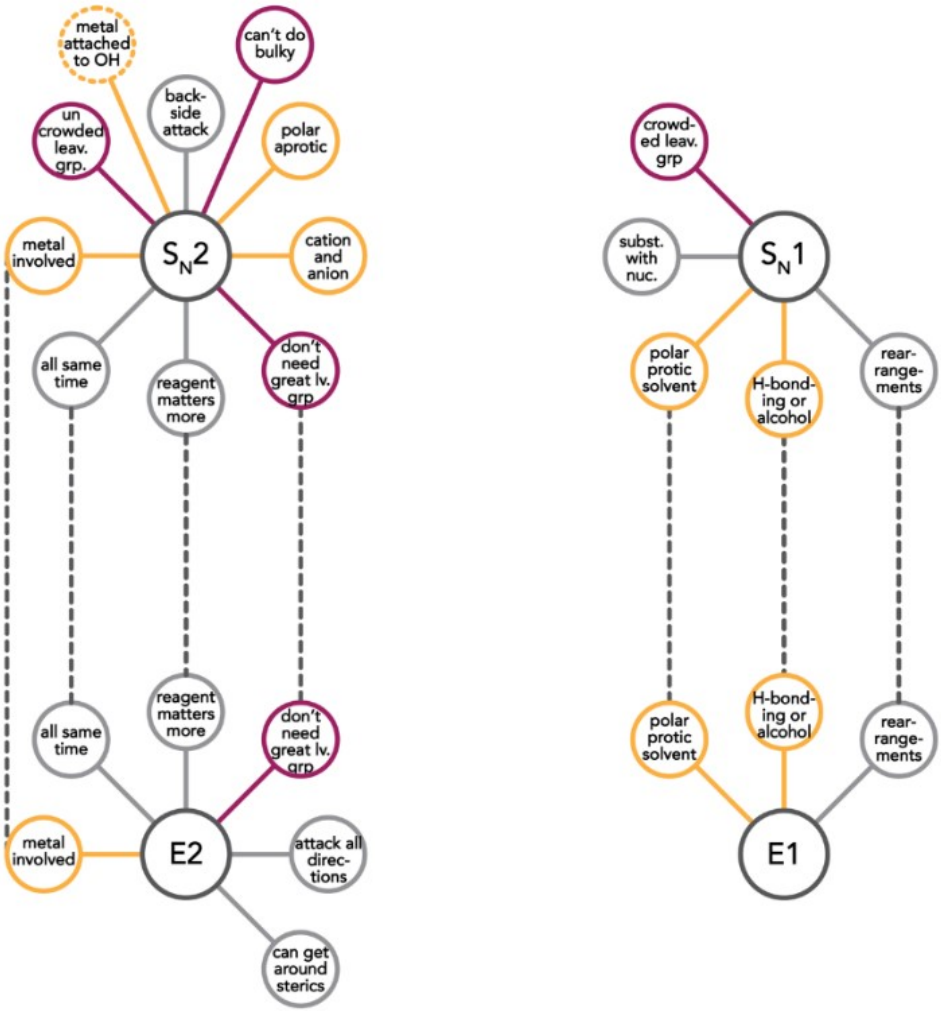
Resource graph for Holly which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



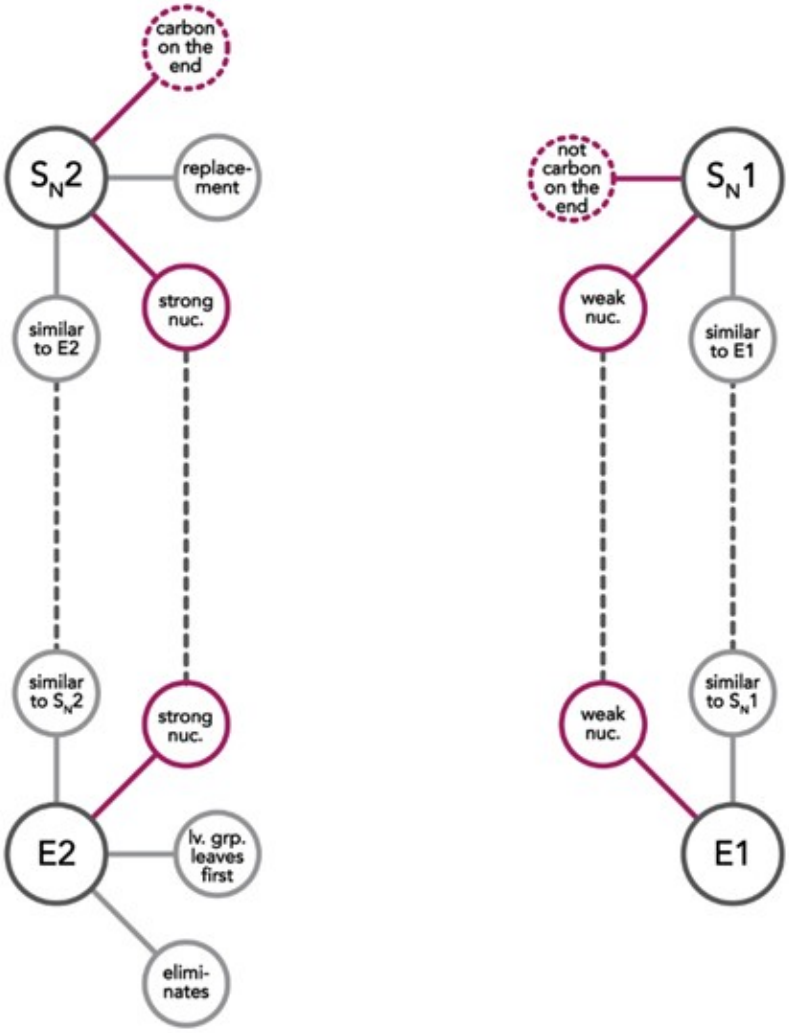
Resource graph for Ben which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



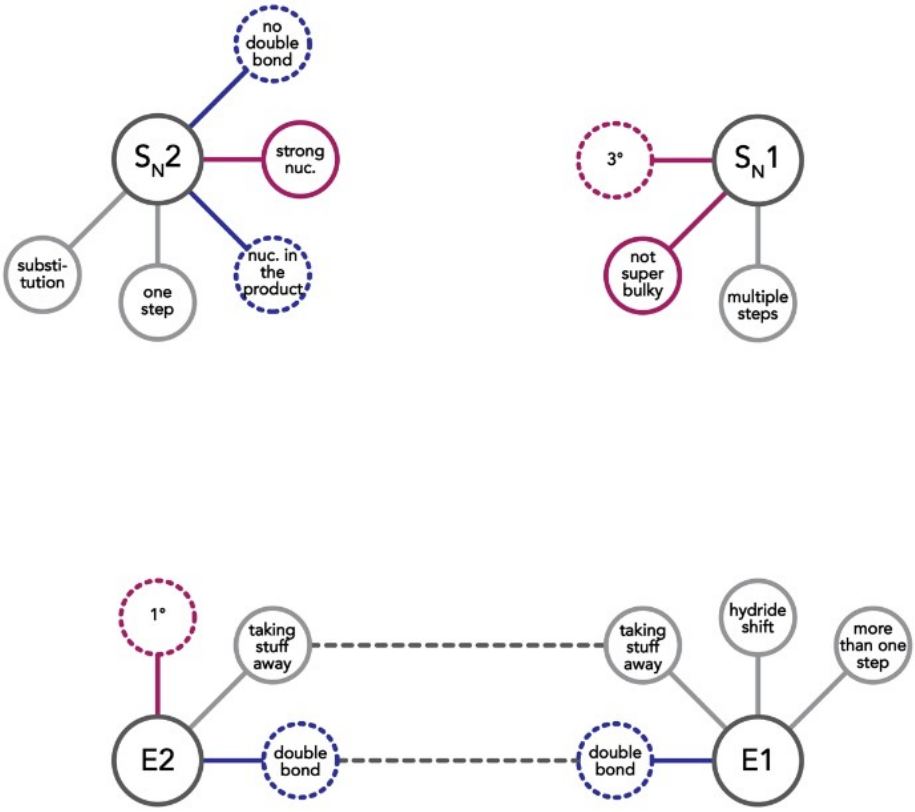
Resource graph for Jan which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



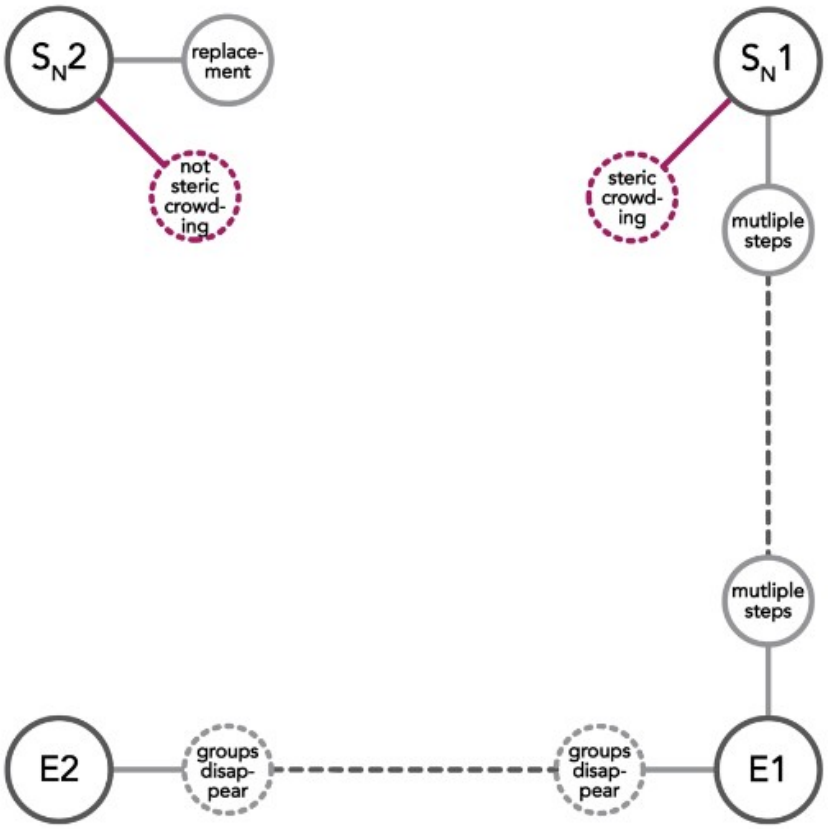
Resource graph for Anne which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



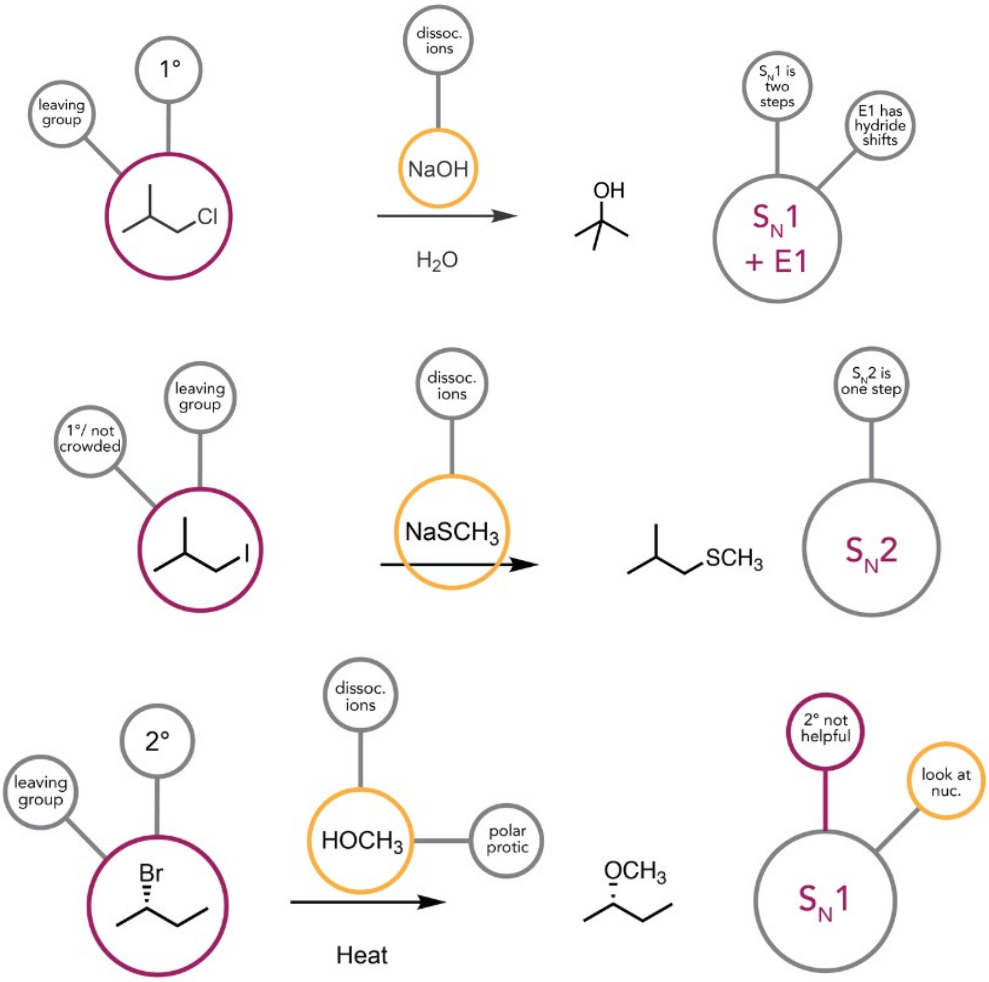
Resource graph for Lindsay which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



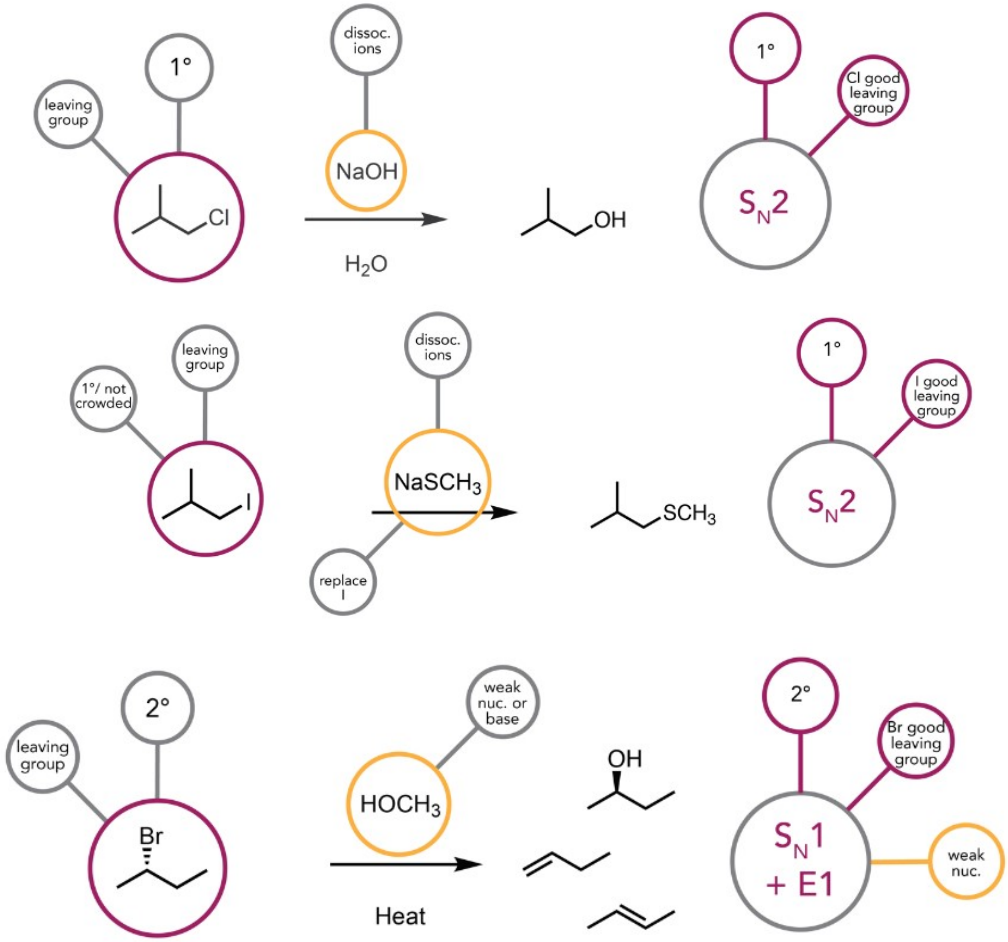
Resource graph for Leslie which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



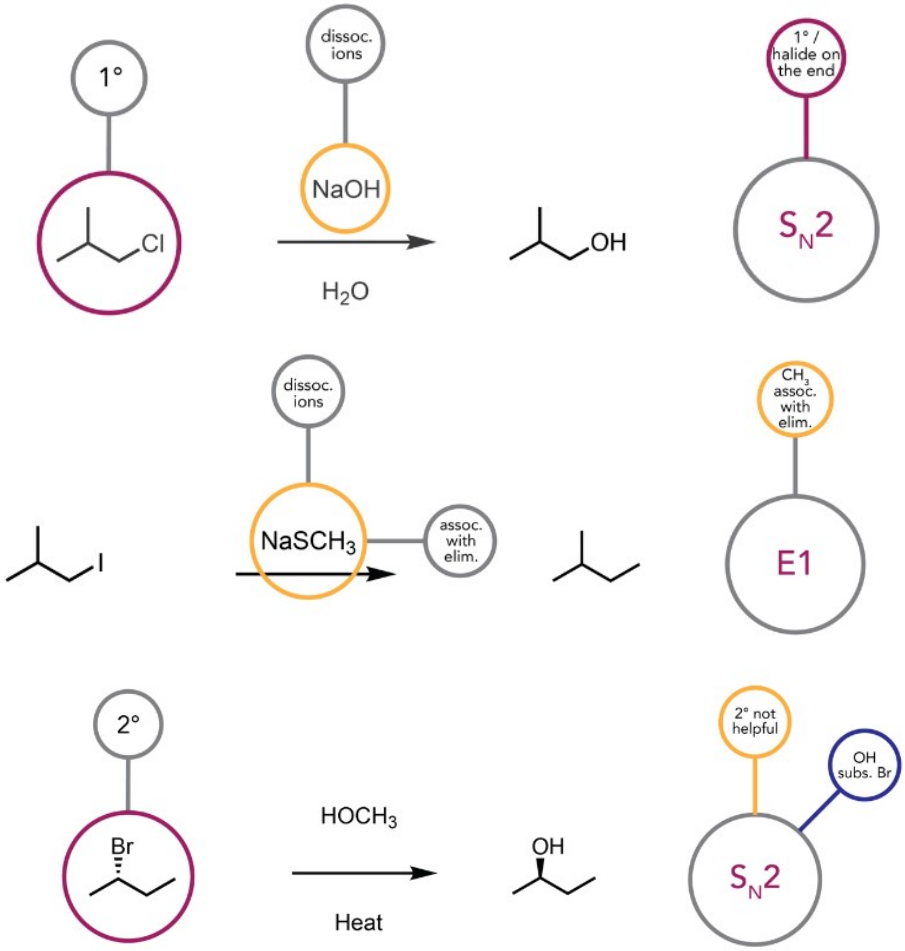
Resource graph for Lucille which contains the knowledge elements and extractions the student associates with each reaction mechanism. Knowledge elements are circles with solid lines and extractions are circles with dashed lines. Resources shared between two mechanisms are indicated by a straight dashed line. Maroon lines are associated with the substrate, gold the reaction conditions, blue the product, and light grey the mechanistic process.



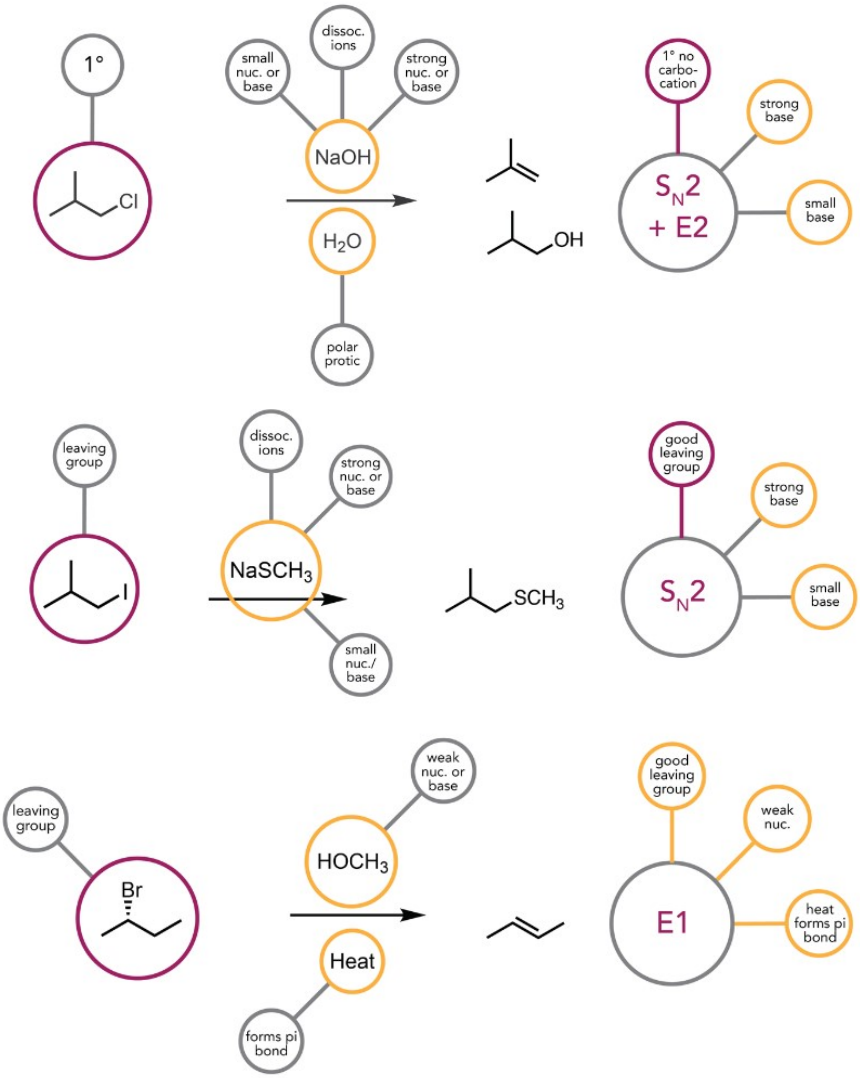
Reaction resource graphs for Phyllis.



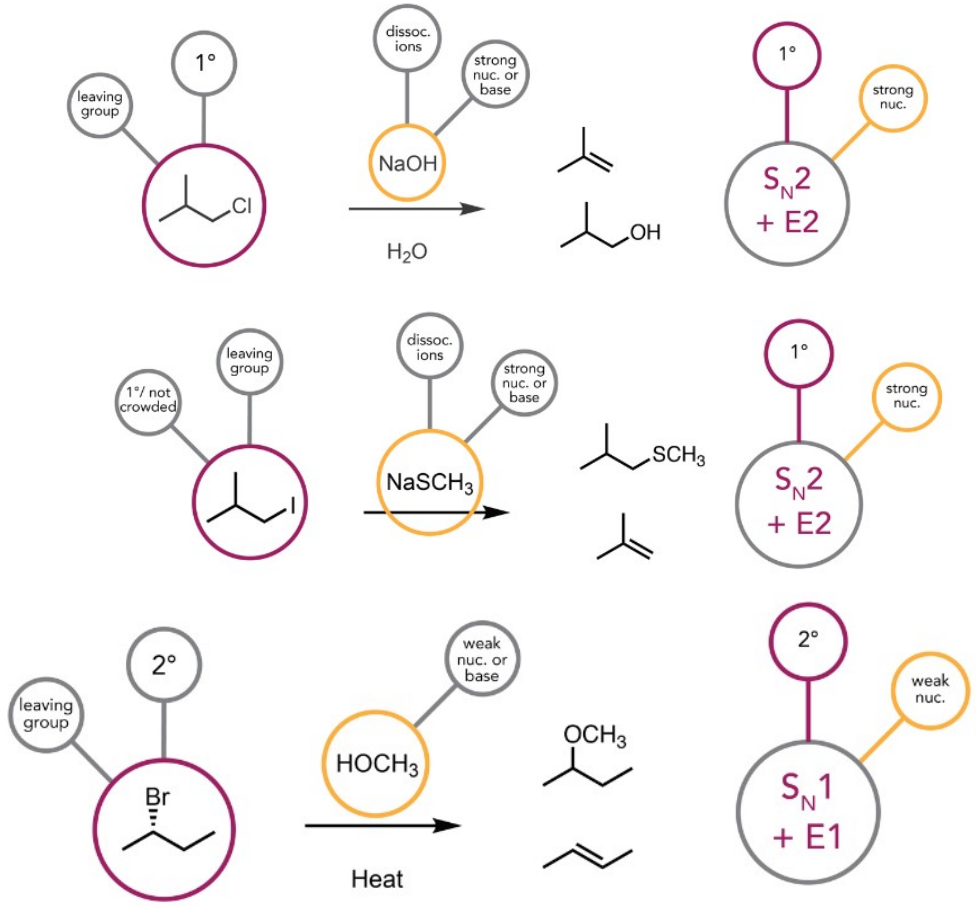
Reaction resource graphs for Pam.



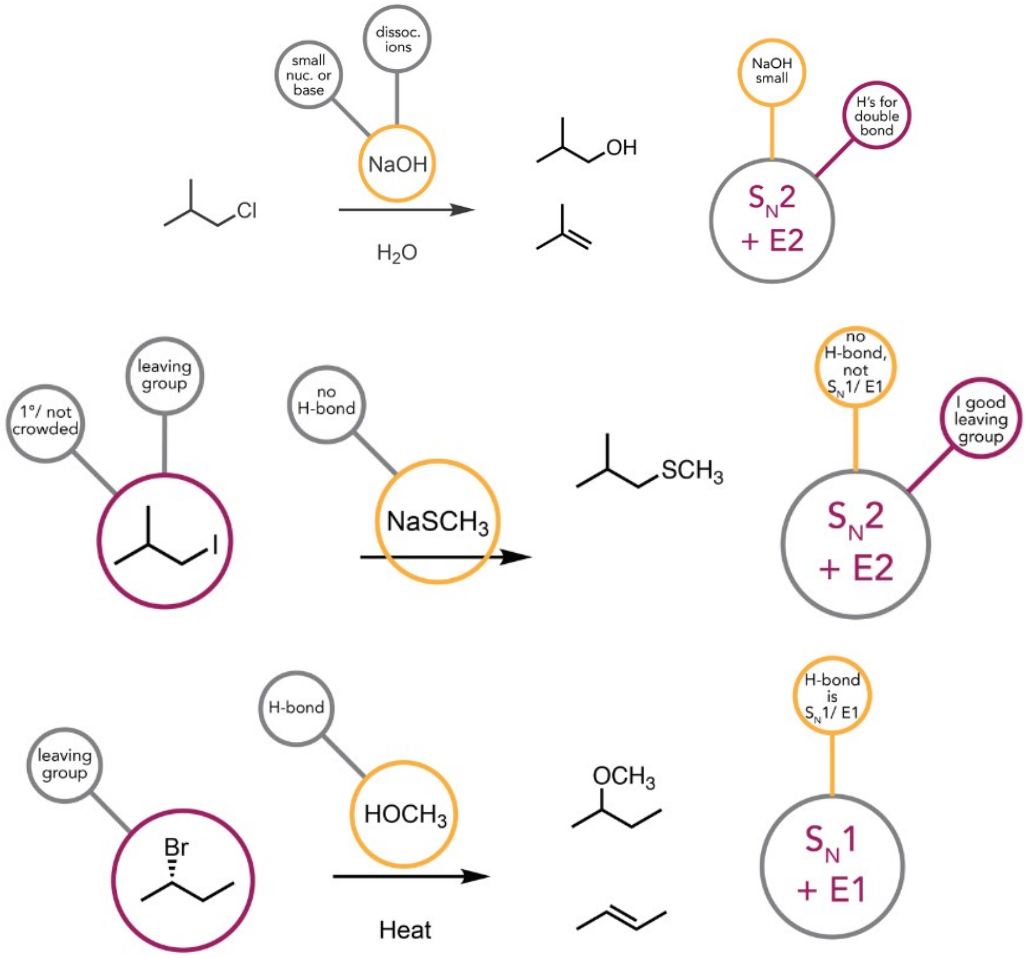
Reaction resource graphs for Holly.



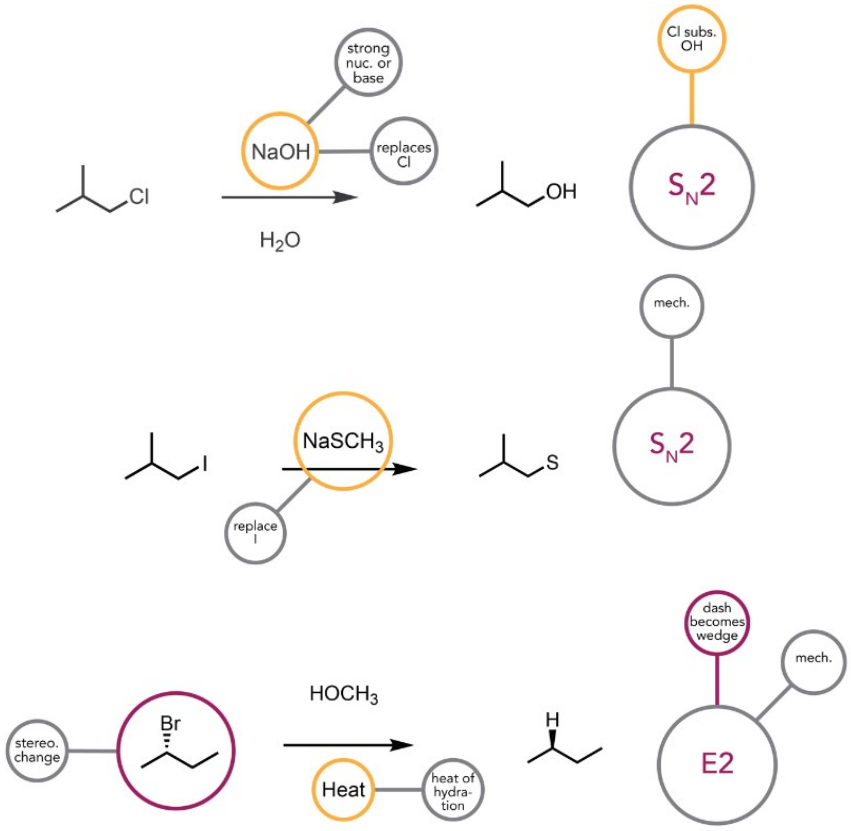
Reaction resource graphs for Ben.



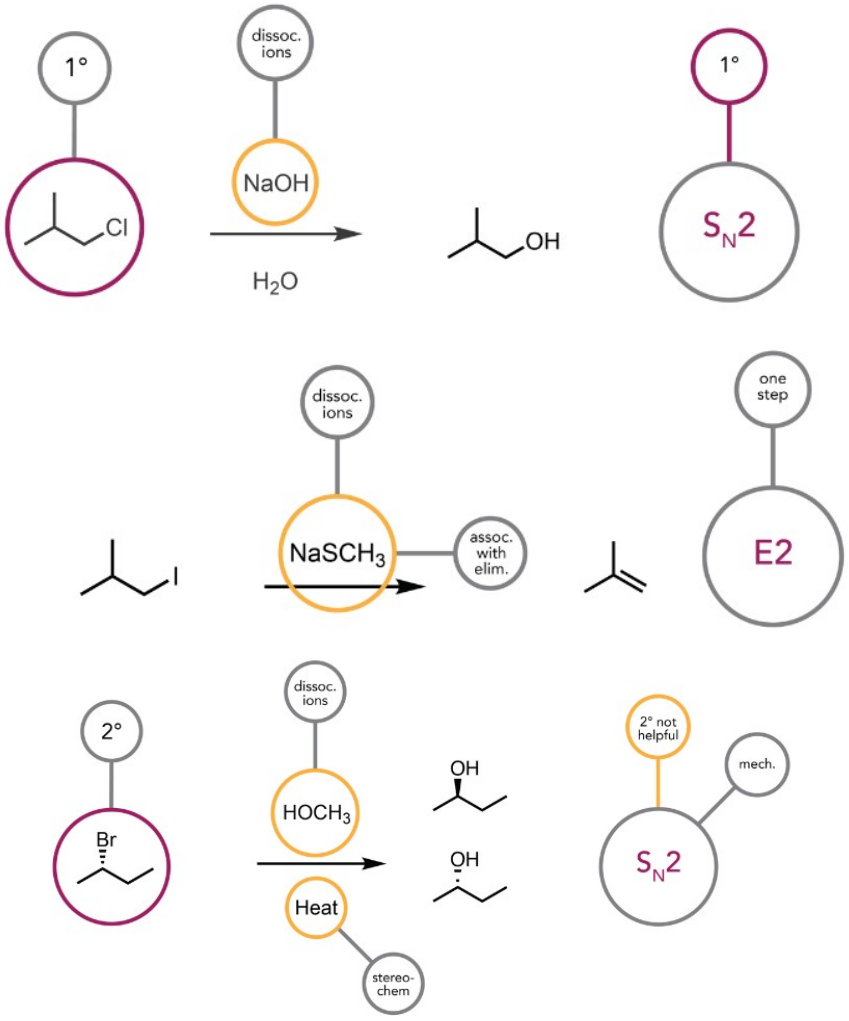
Reaction resource graphs for Jan.



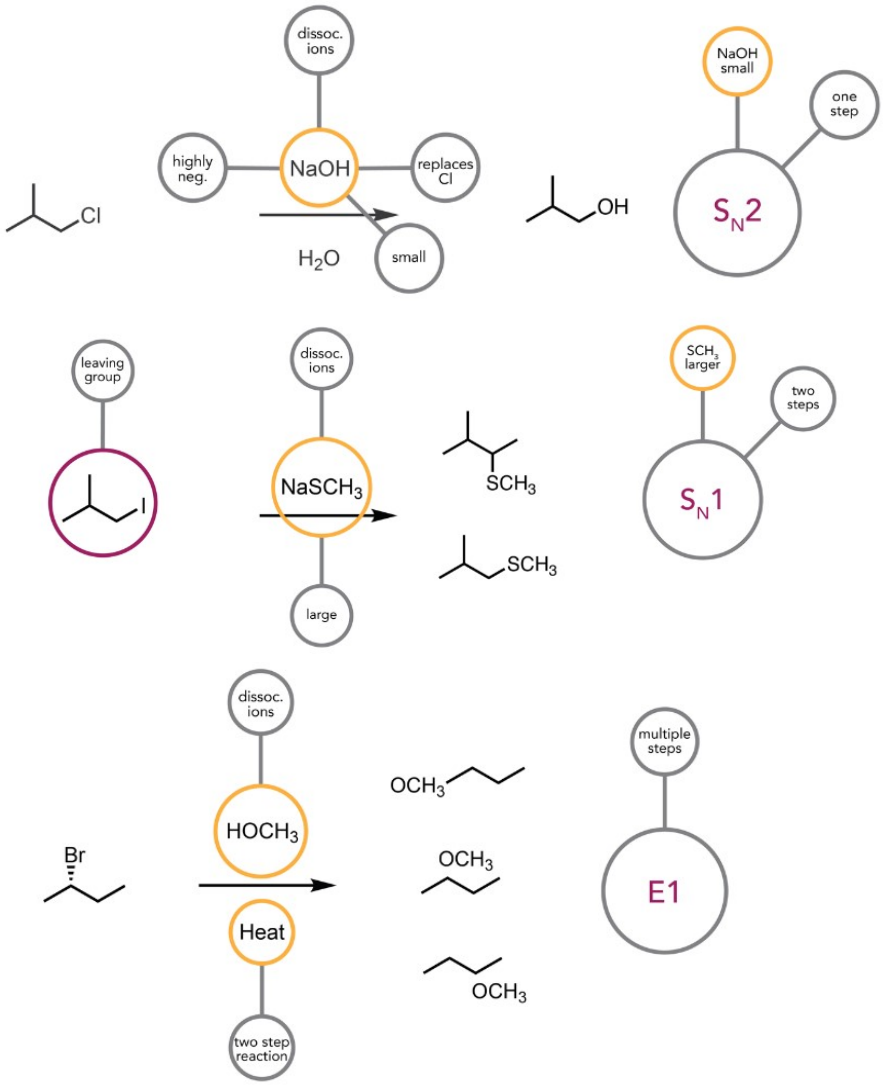
Reaction resource graphs for Anne.



Reaction resource graphs for Lindsay.



Reaction resource graphs for Leslie.

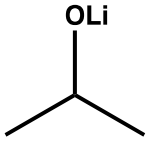


Reaction resource graphs for Lucille.

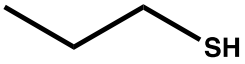
Appendix 4: Full activity to support students in attending to all aspects of a reaction setup before making an informed conclusion.

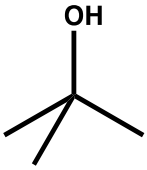
For the nucleophiles below, indicate if they are charged or uncharged and which atom is the nucleophilic piece. Based on this, draw what the acting nucleophile is in the reaction. Also, indicate if you would consider the nucleophile to be strong or weak. An example is provided for methanol below.

CH_3OH:
methanol is uncharged (does not dissociate) and therefore considered a weak nucleophile
The lone pair on the O is the nucleophilic piece

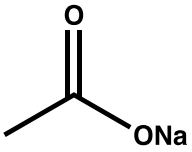


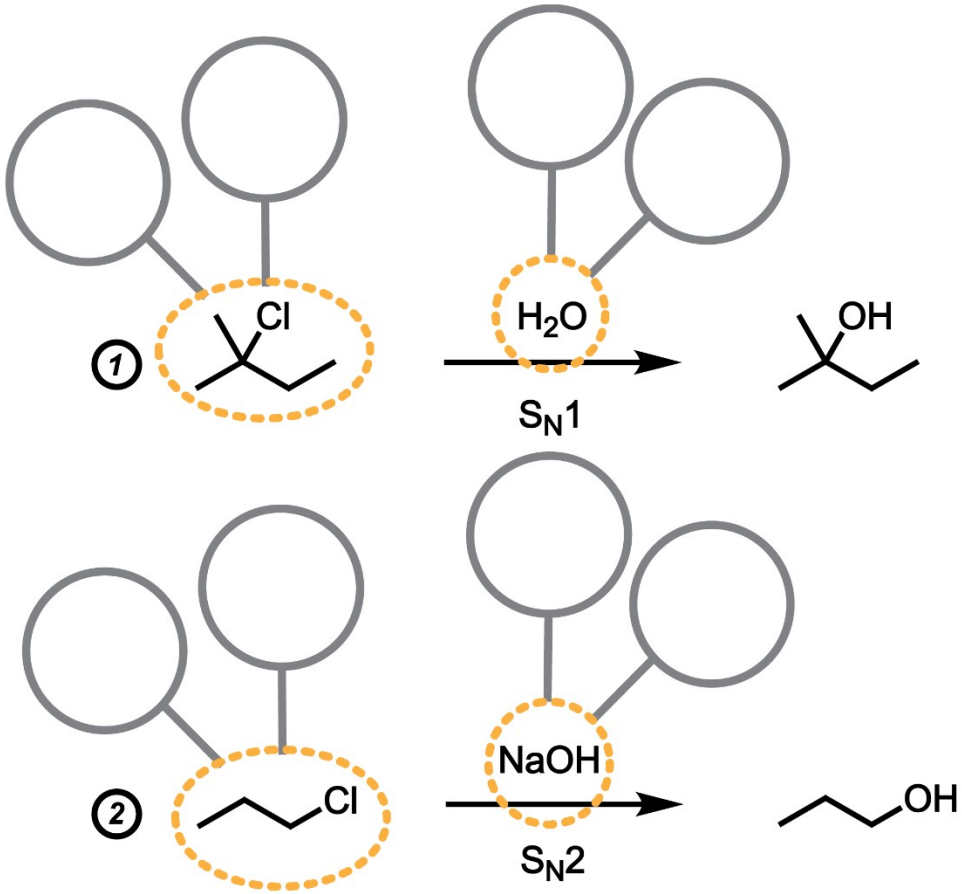
NaOH





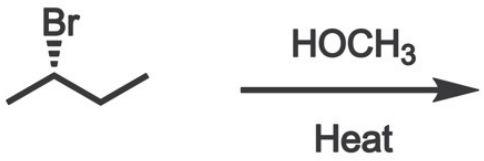
KCN





The above reactions present two contrasting reactions: One S_N1 reaction and one S_N2 reaction. The dotted yellow lines indicate important species in the reaction. Fill in each grey circle connected to the dotted yellow lines with a feature you can infer from each species (i.e.: strong nucleophile, primary leaving group, good leaving group, etc.). Also, please indicate why you can infer your chosen feature (i.e., why it is a good leaving group).

In the space below, indicate how all of the features you indicated for each species help explain why reaction 1 goes through an S_N1 mechanism and reaction 2 goes through an S_N2 mechanism. Provide a connection for each feature you indicated.



For the above reaction, circle the important species in this reaction. Then, connect features to those reaction species as you did in the last example.

Based on your indicated features, what mechanism would you predict this reaction to go through? Again, as you did in the last example be sure to connect those features to your choice of mechanistic outcome.

Now that you have chosen the mechanism, draw the steps of the mechanism and the ultimate product that would be formed. Use arrow-pushing formalism to indicate the flow of electrons.

Use the process above to predict the major product(s) for the following reactions and indicate what mechanism each would proceed through.