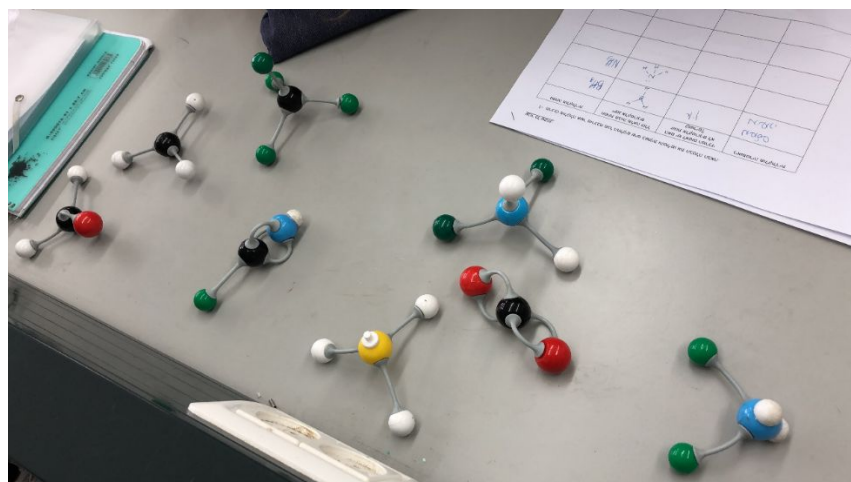


## Crafting Molecular Geometries: Implications of neuro-pedagogy for teaching chemical content

### Second lesson: Active rehearsal with “molecular bags”

**Lesson plan:** This lesson takes one 45-minute period. It is devoted to rehearsing the content seen in the previous lesson in an elaborate way. Instead of having the teacher draw 2D representations of the molecules on the board, students receive little bags with models of a molecule (“molecular bags”). Students work in pairs and the teacher goes around the classroom answering students’ questions if they arise but tries to intervene as little as possible in students’ dialogs. The teacher should prepare beforehand about 8 different models and bags. Figure 3 shows some examples of the models that can be put in each bag. The students are required to fill the table handed to them in the worksheet (presented ahead). They will have to: 1- understand which molecule can be represented by the model according to the bonding laws of each of the elements in the molecule and assemble its model, 2- draw 2D representations of the correct molecular structure seen in the 3D models, 3- refresh the concept of non-bonding electrons, and 4- determine the geometry of the molecule.

The following is a picture showing examples of simple molecular models to be introduced (dismantled) in each “molecular bag” for rehearsing the content taught in the previous lesson.



**To conclude** the second lesson, students are invited to the board to present the molecular structures that they draw. There can be more than one answer for each molecular bag, so this is an excellent exercise to discuss equivalent answers. In addition, the teacher should encourage students to agree on the correct structures (if a structure is incorrect, then this is the time to ask students “is this correct?”, “why/why not?”). The lesson should end with a summary of all molecular geometries drawn on the board by the teacher.

**Neuro-pedagogical considerations:** Collaborative work in pairs during the assignment (presenting independent outcomes among students and then discussing them) brings students to engage more deeply in the learning process. There is a negotiation of knowledge that induces a higher level of processing of the rehearsed content.

In addition, whenever students present their work, first to another student and later to the classroom, affective arousal is involved, which in turn increases the effectiveness of memory encoding. The need to rethink the outcomes, find or agree on an explanation as well as reveal the explanation involves higher activity of the prefrontal cortical area (an area that is highly involved in analytical and knowledge integration processes).

A printable version of the worksheet that accompanies the activity can be found in the following page.

## Molecular Geometry

### - rehearsing with molecular models -

For each of the “molecular bags” that the teacher brought, use the molecular model inside the bag and complete the row in the following table.

Molecular bag number	Molecular formula	Molecular structure (drawn considering molecular geometry)	Are there non-bonding electrons to the central atom? How many?	Molecular geometry name
1				
2				
3				
4				
5				
6				
7				
8				