Lesson 2 - Student Activity #2 Guide

Modifying the Silver Nitrate and Copper Reaction Model

Remix the base model: “silver nitrate and copper reaction” and change its name to include your name and your partner’s name.

Challenge #1:
Modify the code to add or remove some or all of the water molecules in the model.

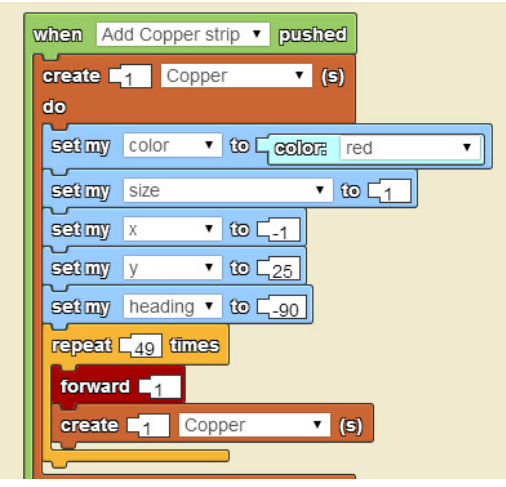
Reminder: Execute your model every time you add a piece of code. Debug as needed. Save often.

Hint: Look at the setup instructions for the water agents.
After you change the code, go up to the SpaceLand interface, save the model and click on “Run Code’ before running the model by clicking on the interface buttons. Debug the model as needed.

Q: Does removing the water molecules affect the execution of the model and real-world representation?
If time allows after you are done, think about what is included in this model and what is missing.

Challenge #2:
Modify the code to move the copper rod somewhere else in the solution keeping the number of agents of copper the same. Please note: The base model gives 150 copper agents to represent 150 copper atoms.

Hint: Look at the setup instructions for the copper agents (section shown below)



After you change the code, go up to the interface and hit “Save” and “Run Code” before executing the model. Debug the code as needed.

What does the command “set my x to” do? What does the command “set my heading to” do? What happens if you change the number of times the loop repeats?

Lesson 3 - Student Activity #1 Guide

Modifying the Model

Your Challenge: Change the code to add copper nitrate agents to represent the missing chemical product from the model.

The reaction modeled is:
Aqueous silver nitrate added to solid copper will react to form solid silver and aqueous copper nitrate.
Chemical reaction: 2 $AgNO_3$ (aq) + Cu (s) ---> $Cu(NO_3)_2$ (aq) + 2 Ag (s)

Start with base model - StarLogo Nova base model: “silver nitrate and copper reaction”
Remix the base model and change its name to include your name and your partner’s name.

Reminder: Save and test your model every time you add a piece of code. Debug if needed. Save often.

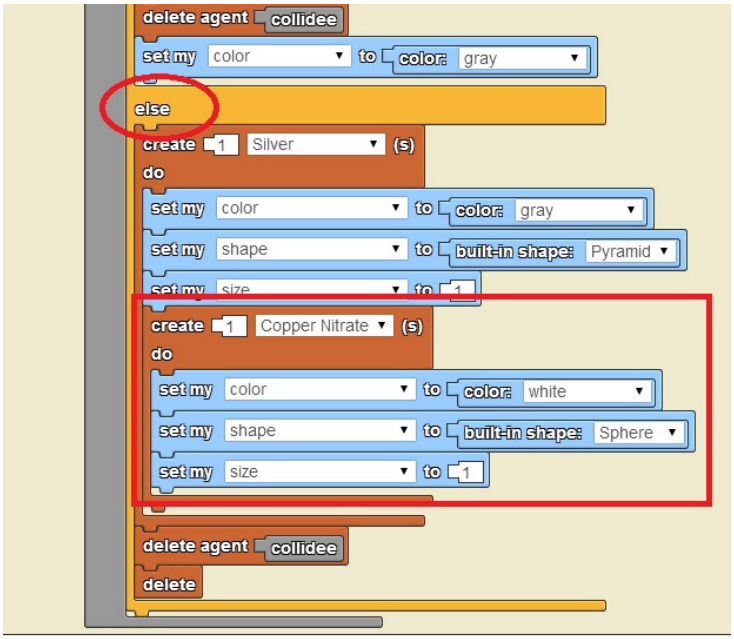
[Hints: (A) Add breed for new agent, (B) create agents inside a collision block, (C) give the agent some movement in water, since it is a soluble ionic compound.]

One solution to the Challenge:

A- Add the copper nitrate agent as a new breed.
Click on edit Breed. Click on add Breed. Name the breed 'copper nitrate". Exit edit breed.

Is there a new page/tab in Workspace now that they created copper nitrate breed?

B- When "gray" copper collides with silver nitrate, copper nitrate is created.
Give the copper nitrate agent the following traits:
Shape is sphere, color is white and size is 1.



Where is the correct location of this procedure? Why?

C- Add movement to copper nitrate: copy and paste Wiggle Walk procedure from water page or silver nitrate page to the copper nitrate page.
To copy, with the mouse clicked, drag a box over the piece of code you want to copy, and click on the copy button under the drawers.

Lesson 3 - Student Activity #2 Guide

Running Experiments

Start with the modified base model.

Your Challenge: Run experiments with different initial quantities of copper or silver nitrate and get the amount of silver produced. How much silver is produced in each case? Note when the copper is in excess and when the silver nitrate is in excess.

Use the Experimental Design Form to guide you.
Multiple trials are needed at every different setting of initial amounts used.

Can you predict what amount of silver nitrate is needed to use up all the copper with no excess left of either?

Lesson 4 - Student Activity #1 Guide

Modifying the Model Further

Your Challenge: Alter your model to include the formation of hydrated copper ions. First you will need to create additional breeds Cu(II).H_2O, Cu(II).$2H_2O$, Cu(II).$3H_2O$

Copper in water forms a complex with 3 water molecules which makes the solution slowly turn blue as the complex Cu(II).$3H_2O$ forms.

1. Start with modified model from Lesson 3
2. Remix the base model and change its name to include your name and your partner's name.

Reminder: Save and test your model every time you add a piece of code. Debug if needed. Save often.

3. In the Interface (Spaceland) add 3 additional breeds:

Cu(II).$1H_2O$
Cu(II).$2H_2O$
Cu(II).$3H_2O$

Hint: Refer to Lesson 3 on how to add new breeds.

Check the Workspace area. Did new pages/tabs appear?

4. Change the code using collision blocks to create the following agents with their own traits:

Cu(II).H_2O: Shape is sphere, color is cyan and size is 1. It is created when one copper nitrate agent collides with one water molecule.
Cu(II).$2H_2O$: Shape is sphere, color is sky blue and size is 1. It is created when one Cu(II).H_2O agent collides with one water molecule.
Cu(II).$3H_2O$: Shape is sphere, color is blue and size is 1. It is created when one Cu(II).$2H_2O$ agent collides with one water molecule.

The complex Cu(II).$3H_2O$ is the final ionic product created in the solution turning the solution blue.

Tip: It is possible to drag a selection box around a group of blocks on one page, and "copy and paste" them to a new page. This is a real time-saver.

Reminder: Execute your model every time you add a piece of code. Debug if needed. Save often.

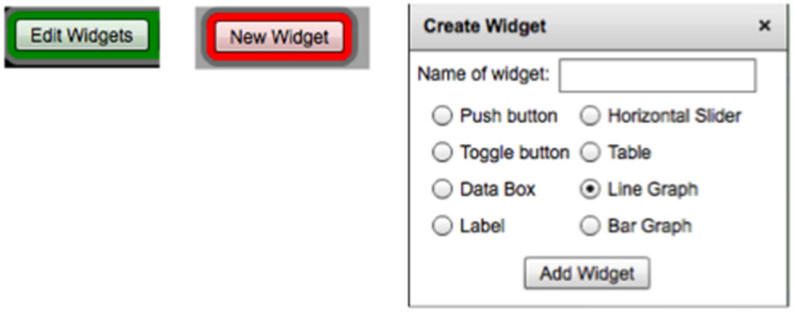
5. These new agents are ions moving about in water.
Set up a Wiggle Walk procedure for each agent on its own page.

Lesson 4 - Student Activity #2 Guide

Running Experiments

Your Challenge: Add instrumentation to your model so you can observe the rate of reaction, then characterize the rate of reaction.

Start with modified model from Activity 1 and add a new widget, a line graph.



On the line graph window, add a new series to the graph by double clicking on New Series and changing the name and line color. For example,

- Create a new series called “Silver” then select gray as its line color.
- Create a new series called “Cu(II).1H2O” then select cyan as its line color.
- Do the same for the other products you want to monitor.

Finally, add the corresponding commands to the World’s page to update the line graph as time advances (clock tick).

Use the experimental design form to design and document your experiment. Try to determine the impact of reactant availability on the rate of reaction (production of products).

What do you observe?
Did the rate of the reaction increase as the number of reactants increased? Or vice versa?