

## Activity (Reactivity) Series

**Unit:** Chemical Reactions

**NGSS Standards/MA Curriculum Frameworks (2016):** HS-PS1-2

**Mastery Objective(s):** (Students will be able to...)

- Use the activity series to predict whether or not a single replacement reaction will occur.

**Success Criteria:**

- Prediction is correct about whether or not a reaction occurs.
- Cation & anion are correct if reaction does occur.
- Products have correctly balanced charges.

**Tier 2 Vocabulary:** product, replacement, activity

**Language Objectives:**

- Explain how you can tell using the activity series whether or not a reaction will occur.

**Notes:**

In the reaction between aluminum metal and copper (II) chloride:



the beaker got hot. This means the reaction gave off heat, which was lost to the surroundings (the water that the chemicals were dissolved in, the beaker, the air, your hand). Once the energy was given off, the chemicals didn't have enough energy to go the other direction. In other words, the reverse reaction does not happen:



Is it possible to predict which direction the reaction will go?

For single replacement reactions, there is a list, called the activity series, (or reactivity series), which lists metals in order from most reactive to least, based on how much energy they give off when they lose electrons to form a positive ion. A metal that's higher on the list can replace anything lower on the list (because more energy is given off), but a metal that's lower on the list doesn't have enough energy to replace one that's higher up.

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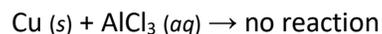
## Activity (Reactivity) Series

Metal	Ion		Reacts With	Method of Extraction
Cs	Cs <sup>+</sup>	↑ increasing reactivity ↓	cold H <sub>2</sub> O dilute acids O <sub>2</sub>	electrolysis
Rb	Rb <sup>+</sup>			
K	K <sup>+</sup>			
Na	Na <sup>+</sup>			
Li	Li <sup>+</sup>			
Sr	Sr <sup>2+</sup>			
Ca	Ca <sup>2+</sup>			
Mg	Mg <sup>2+</sup>		steam dilute acids O <sub>2</sub>	metal oxide reduction with carbon or CO <sub>2</sub>
Be	Be <sup>2+</sup>			
Al	Al <sup>3+</sup>			
Mn	Mn <sup>2+</sup>			
Zn	Zn <sup>2+</sup>		dilute acids O <sub>2</sub>	smelting with coke
Cr	Cr <sup>3+</sup>			
Fe	Fe <sup>2+</sup>			
Cd	Cd <sup>2+</sup>			
Co	Co <sup>2+</sup>		O <sub>2</sub>	heat or physical extraction
Ni	Ni <sup>2+</sup>			
Sn	Sn <sup>2+</sup>			
Pb	Pb <sup>2+</sup>	some strongly oxidizing acids	heat or physical extraction	
H <sub>2</sub>	H <sup>+</sup>			
Cu	Cu <sup>2+</sup>			
Cu	Cu <sup>+</sup>	some strongly oxidizing acids	heat or physical extraction	
Hg	Hg <sup>2+</sup>			
Ag	Ag <sup>+</sup>			
Au	Au <sup>3+</sup>	some strongly oxidizing acids	heat or physical extraction	
Pt	Pt <sup>2+</sup>			

To answer the original question, notice that aluminum is higher than copper on the activity series. This means aluminum can replace copper:



but copper can't replace aluminum:

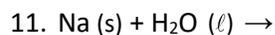
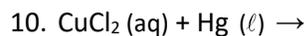
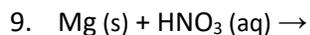
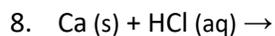
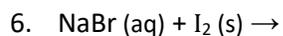
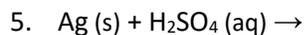
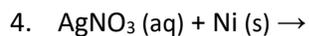
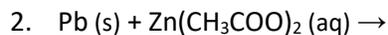
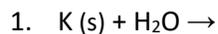


Use this space for summary and/or additional notes:

**Homework Problems**

For each of the following single replacement reactions:

- Check the activity series to see whether the reaction happens.
- If the reaction happens, predict the products. If the reaction does not happen, write "N.R." ("No Reaction").



Use this space for summary and/or additional notes: