Properties of Ionic and Covalent Compounds
Remember...properties of metals are a result of the characteristics of metallic bonds.

https://www.uwgb.edu/dutchs/EarthSC202Notes/minerals.htm
What are the properties of covalent compounds?
Properties of Covalent Compounds

- Can be any state of matter (solid, liquid, gas)
- Lower melting points
- Don't conduct electricity
- Low solubility (some)
What are the properties of ionic compounds?
Properties of Ionic Compounds

- Crystalline solids-crystal lattice
- Solids at room temperature
- High melting point
- Hard, brittle
- Conducts electricity when in liquid state or when dissolved in water
- High solubility

Copper sulfate

NaCl (Sodium Chloride)

[Images: Copper sulfate and NaCl (Sodium Chloride)]

Ionic compounds conduct electricity

• For a material to conduct an electric current, there must be charged particles that can move.
• Ionic compounds in a liquid state or dissolved in water can conduct electricity
  > Ions are free to move
• An aqueous solution of an ionic compound that conducts electricity is called an electrolyte.
Ionic bonds are very strong

- Ionic bonds are very strong so lots of energy is needed to break them apart.
- Therefore, ionic compounds have very high melting points and boiling points.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Melting Point (°C)</th>
<th>Boiling Point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaI</td>
<td>660</td>
<td>1304</td>
</tr>
<tr>
<td>KBr</td>
<td>734</td>
<td>1435</td>
</tr>
<tr>
<td>NaBr</td>
<td>747</td>
<td>1390</td>
</tr>
<tr>
<td>CaCl₂</td>
<td>782</td>
<td>&gt;1600</td>
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<tr>
<td>NaCl</td>
<td>801</td>
<td>1413</td>
</tr>
<tr>
<td>MgO</td>
<td>2852</td>
<td>3600</td>
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</table>

http://highered.mcgraw-hill.com/sites/007874637x/student_view0/chapter7/section2/self_check_quizzes.html
Crystal Lattice

• Ionic Compounds form crystals.
• Positive and negative ions are packed into a regular, repeating pattern that balances the attraction and repulsion between ions.
  > Positive and negative ions are attracted to each other, repelled by same charge
• This results in a **crystal lattice**: a 3-dimensional geometric arrangement of particles.
  > Each positive ion is surrounded by negative ions
  > Each negative ion is surrounded by positive ions
http://chemistry.umeche.maine.edu/~amar/spring2012/crystal.html
When an external force is applied to a crystal (you hit it with a hammer), it causes the crystal to crack
• The force repositions the like-charged particles next to each other
• Repulsive force cracks crystal
Energy of ionic bonds

- **Lattice energy**: energy needed to break apart one mole of an ionic compound.
  - The greater lattice energy is, the stronger the force of attraction
- Lattice energy is greater for small ions, and greater charges (remember Coulomb's law?)
Remember periodic trends: ionic radius.

- Cations are always smaller than their neutral atom
- Anions are always bigger than their neutral atom
- Moving down a group: ionic radii increases
- Moving across a period: ionic radii of cations decreases, ionic radii of anions decreases
Example 1: Which of the following has a greater lattice energy?

NaCl or LiCl? Why?

KF or KCl? Why?

MgCl$_2$ or NaCl? Why?
<table>
<thead>
<tr>
<th>Compound</th>
<th>Lattice Energy (kJ/mol)</th>
<th>Compound</th>
<th>Lattice Energy (kJ/mol)</th>
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<tbody>
<tr>
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<tr>
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<tr>
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<tr>
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</table>
Example 2

Which compound has greater lattice energy? Why?
• KI or KBr? SrCl$_2$ or AgCl?

Order the following compounds from lowest to highest melting point.
• KI, KCl, KBr, KF