Metallic Bonds Activity:
Goal: Have students arrange themselves in a metal with the majority number of atoms satisfying all bonding requirements.

Metallic bonds form via a sea of electrons.

- Bonds are formed simply by being near enough to a belt wearer to touch hands
- Velcro not necessary for this specific activity

Activity Procedure:

1. Have students group together in no particular order
2. Begin by attempting to form bonds with nearest neighbors without moving
   (a) Discuss if they believe this material would form a solid, given the number of dangling bonds
3. Add "energy" to the system in the form of heat by allowing students to move around to satisfy all bonds within the crystal
   (a) Discuss how the structure of the crystal changed between Step 2 & 3 and about close packed structures
   (b) Discuss impact of dangling bonds on the surface of the crystal
4. Discuss how this type of structure/bond combination would effect various properties, such as melting temperature and conductivity.

Additional Activities for Discussion:

- Have someone act as an impurity ion by walking with their arms outstretched or tightly at their sides. Discuss how this effects the energy of the structure.
- Have someone act as a vacancy. Discuss how this effects the energy of the crystal.
- Shift the crystal to mimic an edge dislocation. Discuss of this effects the energy of the crystal.

Covalent Bonds Activity:
Goal: Have students arrange themselves in a covalent crystal with the majority number of atoms satisfying all bonding requirements.

Covalent bonds are formed via shared electrons.

- Electrons (flags) are shared by connecting the velcro strips.
- Velcro bonds must be kept intact in order for electrons to be "shared".

Activity Procedure:

1. Have students group together in no particular order
2. Begin by attempting to form bonds with nearest neighbors without moving
   (a) Discuss if they believe this material would form a solid, given the number of dangling bonds
3. Add "energy" to the system in the form of heat by allowing students to move around to satisfy all bonds within the crystal
   (a) Discuss how the structure of the crystal changed between Step 2 & 3 and about close packed structures
   (b) Discuss impact of dangling bonds on the surface of the crystal
4. Discuss how this type of structure/bond combination would effect various properties, such as melting temperature and conductivity.

Additional Activities for Discussion:

- Have someone act as an impurity ion with either an extra belt/electron or a missing belt. Discuss how this effects the energy of the structure.
- Have someone act as a vacancy. Discuss how this effects the energy of the crystal.
- Shift the crystal to mimic an edge dislocation. Discuss of this effects the energy of the crystal.

Ionic Bonds Activity:
Goal: Have students arrange themselves in an ionic crystal with the majority number of atoms satisfying all bonding requirements.

Ionic bonds are formed via cations donating electrons to anions.

- Pick two colors to be cations and two to be anions
- Remove one or two belts from the cation atom belts
- Cation belt wearers should give their electrons to anion belt wearers, but must stay close to the anions to ensure charge neutrality throughout the crystal.

Activity Procedure:

1. Have students group together in no particular order
2. Begin by attempting to form bonds with nearest neighbors without moving
   (a) Discuss if they believe this material would form a solid, given the number of dangling bonds
3. Add "energy" to the system in the form of heat by allowing students to move around to satisfy all bonds within the crystal
   (a) Discuss how the structure of the crystal changed between Step 2 & 3 and about close packed structures
   (b) Discuss impact of dangling bonds on the surface of the crystal
4. Discuss how this type of structure/bond combination would effect various properties, such as melting temperature and conductivity.

Additional Activities for Discussion:

- Have someone act as an impurity ion with either an extra belt/electron or a missing belt. Discuss how this effects the energy of the structure.
- Have someone act as a vacancy. Discuss how this effects the energy of the crystal.
- Shift the crystal to mimic an edge dislocation. Discuss of this effects the energy of the crystal.