Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Semiconductor (Sim)

**Notes on L.O.2.30 – I can explain the representation that connects properties of a covalent solid to its structural attributes and to the interactions present at the atomic level.**

c. Silicon is a covalent network solid and a semiconductor.

1. Silicon forms a three-dimensional network similar in geometry to diamond.

2. Silicon’s conductivity increases as temperature increases.

3. Periodicity can be used to understand why doping with an element with one extra electron converts silicon into an n-type semiconducting (negative charge carrying) material, while doping with an element with one less valence electron converts silicon into a p-type semiconducting (positive charge carrying) material. Junctions between n-doped and p-doped materials can be used to control electron flow, and thereby are the basis of modern electronics.

**Scientific Equation: How does the N-P junction of a semiconductor control electron flow?**

<https://phet.colorado.edu/en/simulation/legacy/semiconductor>

1. Set the “Segments” toggle 1 “One (1)”, drag the P-type doped semiconducting material and set the voltage to 4 V. What do you observe? At what energy does conduction occur?

1. Reduce the voltage until it reaches a value -4 V. What changes are observed in the circuit as the voltage is reduced? What is happening at the conduction band?
2. Clear the dopant and drag the N-type doped semiconducting material an set the voltage to 4 V. What do you observe? At what energy does conduction occur?

1. Reduce the voltage until it reaches a value -4 V. What changes are observed in the circuit as the voltage is reduced? What is happening at the conduction band?
2. Set the “Segments” toggle 2 “Two (2)”, drag the P-type doped semiconducting material to the left segment and set the voltage to 4 V. What do you observe? (Note the battery force and the internal force direction.)
3. Drag the N-type semiconducting material to the right segment. What happens to the circuit, what happens at the conduction band? (Note the battery force and the internal force direction.)

1. Change the battery voltage slowly from 4 V to – 4V. What do you observe? (Note the battery force and the internal force direction.)

1. Clear the dopants. Drag the N-type doped semiconducting material to the left segment and set the voltage to 4 V. What do you observe? (Note the battery force and the internal force direction.)
2. Drag the P-type semiconducting material to the right segment. What happens to the circuit, what happens at the conduction band? (Note the battery force and the internal force direction.)
3. Change the battery voltage slowly from 4 V to – 4V. What do you observe? (Note the battery force and the internal force direction.)
4. Is direction of the electron flow important in the observed behavior? Answer the Scientific Question.