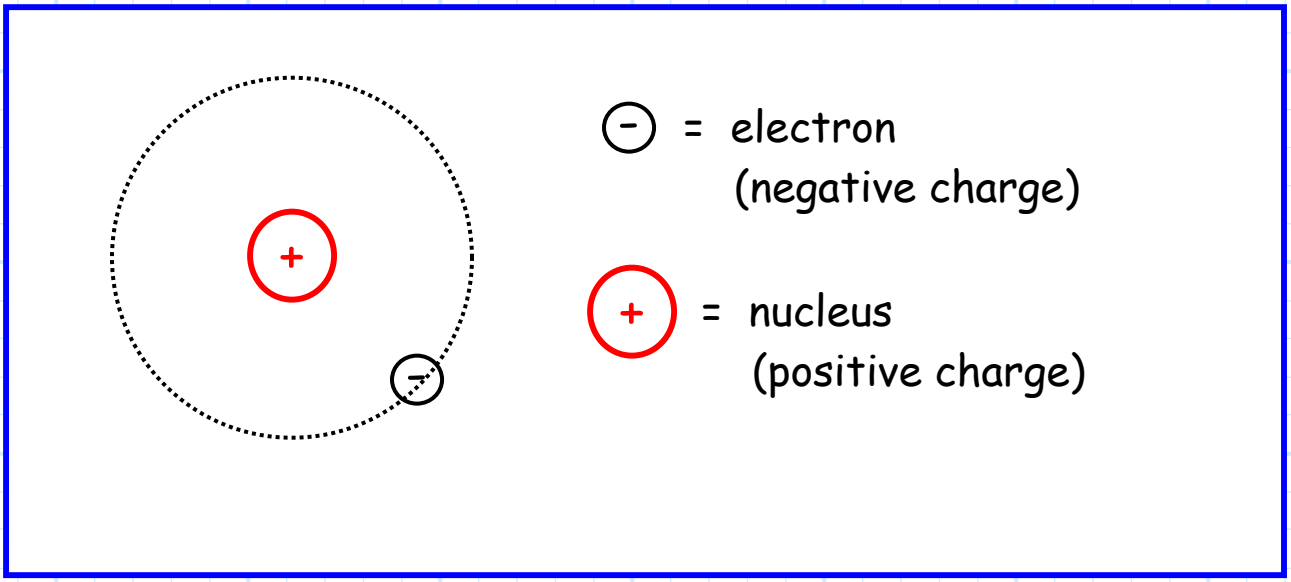
Dielectrics and Conductors

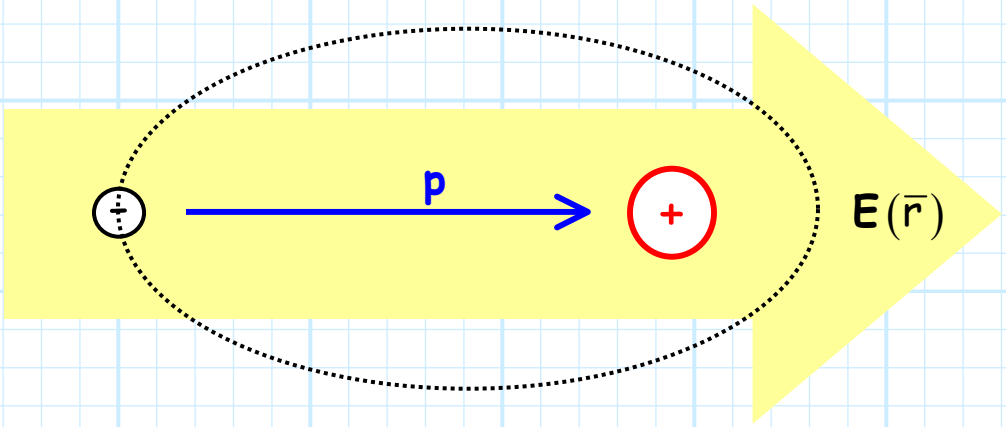
Consider a very **simple** model of an **atom**:



Say an **electric field** is applied to this atom.

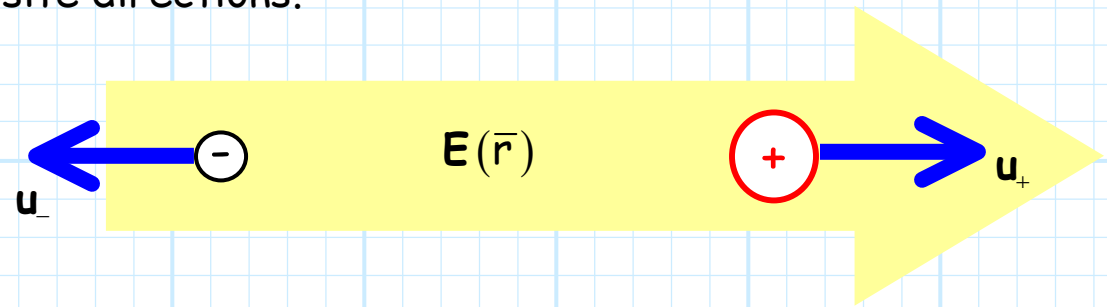
Note the field will apply a **force** on both the positively charged nucleus and the negatively charged electron. However, these forces will move these particles in **opposite** directions!

Two things may occur. In the **first** case, the atom may **stretch**, but the electron will remain **bound** to the atom:



Note, an **electric dipole** has been created !

For the **second** case, the electron may be **break free** from the atom, creating a positive ion and a **free electron**. We call these free charges, and the electric field will cause them to **move** in opposite directions.



Moving charge! We know what moving charge is. Moving charge is **electric current** $\mathbf{J}(\bar{r})$.

These two examples provide a simple demonstration of what occurs when an electric field is applied to some **material** (e.g., plastic, copper, water, oxygen).

1) Materials where the charges remain bound (and thus dipoles are created) are called **insulator** (or **dielectric**) materials.

2) Materials where the electrons are free to move are called **conductors**.

Of course, materials consists of molecules with **many electrons**, and in general some electrons are **bound** and some are **free**. As a result, there are no **perfect** conductors or **perfect** insulators, although some materials are **very** close!

Additionally, some materials are lie between being a good conductor or a good insulator. We call these materials **semi-conductors** (e.g., Silicon).