Field Theory

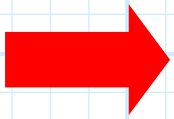
Coulomb's and Ampere's Laws of Force describe an **"action at a distance"** approach to describing the basic electromagnetic forces. In this approach, we can state:

1. A **charge** at one location in space will exert a force on a **charge** at another location in space.

2. **Current** flowing at one location in space will exert a force on **current** flowing at another location in space.

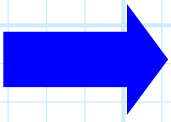
Alternatively, we can use a **"field theory"** of electromagnetics. In this field theory, we describe the forces in this manner:

1. A **charge** at one location in space will create an **electric** (vector) **field** at any and all other locations in space.



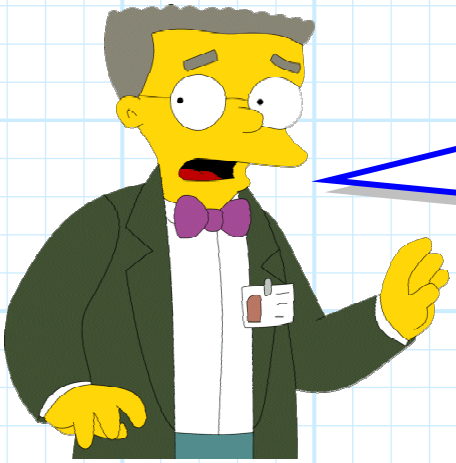
This **field** will then exert a force on any other **charges** that exist in space.

2. **Current** flowing at one location in space will create a **magnetic flux density** (vector) field at any and all other locations in space.



This **field** will then exert a force on any other **current** that exist in space.

In other words, in **field theory**, we state that **sources create fields** (everywhere)—and then the **fields apply the force** to **other** charges or currents!



Q: *Good Heavens! This seems to make electromagnetics even more difficult!* ***Why*** *do we use the concept of electric and magnetic* ***fields****??*

A: Field theory is helpful because it allows us to **divide** the electromagnetic force problem into **two** more manageable pieces. Specifically:

1. We can determine the **fields** generated by **source** charges or currents, **without** every having to consider the other charges or currents that they affect!

2. We can determine the effect (i.e., **forces**) of fields on charges or currents, **without** every having to consider the sources that created those fields!