Basics of Wire Wrapping:

See http://www.me.umn.edu/courses/me2011/robot/wrap/wrap.html for more information and images of the wire wrapping tool. The tool included in the kit is called the "silver tool" on this site.

Wire wrapping is a method of making electrical connections for a circuit as an alternative to soldering. It is often used for prototyping but is also found in some types of commercial electronic equipment. Generally it employs perf-board (also called vector board), a circuit board with a grid of pre-drilled holes surrounded by solder pads. Components are inserted through the holes, tack-soldered to the pads to hold them in place, and connected to each other by wrapping stripped wire around the pins. It is a simple and reliable way to build a circuit that doesn't require much technical knowledge and can be done with simple hand tools.

The fundamental component of this process is the wire wrap tool. This tool resembles a mini-screwdriver with a round shaft. It has a hollow center at the end that a component pin can fit through. It also has a parallel hole on the edge which holds the wrapping wire which will wind around the pin in the center hole. Unlike soldering, wire wrapping requires extra-long pins so that a wire can be wrapped along its length. When more than one connection to a pin is needed, these long pins also allow for the additional wraps of wire.

Many different types of components can be wire wrapped to form a circuit. Some examples of components include integrated circuits (ICs), discrete components (resistors, capacitors), LEDs, connectors, and pin headers.

Wire Wrapping Step-By-Step:

I. Place the components in the desired locations.
   1. Determining a good layout may involve trying components in a variety of positions. It is good to experiment with this before wiring since changes are much easier to make at this time.
   2. Tack soldering: All of the parts need to be tack-soldered onto the perf board to keep them from shifting or falling out. Here we are simply using solder as a means of mechanical attachment, not as an electrical connection.
      - Solder enough pins to the pads so that they are held in place, and use just enough solder to tack it down so that you can get the wrapped wire close to the surface of the board.
      - For IC components just tack down the four corners. For pin headers that will be plugged into a breadboard it is best to tack each pin. For resistors, LEDs and other smaller components tack down both leads, in this case the leads will become the pins around which you will wrap the connection wires.

II. Translate your schematic drawing into wire routes.
   1. Examine the spec sheets for each component and draw a wiring diagram that details how the components need to be connected together. Draw and double-check your schematic drawing before you start wiring, then you'll have a road map to follow.
   2. ID labels should be placed on the bottom side of the board for IC sockets to help identify the pin numbers easily.
   3. Choose a color scheme for the wires so that they are easy to trace later when debugging.
   4. Red wire is commonly used for positive voltage lines (Vcc) and black is used for ground

lines. It is normally recommended that red and black be reserved for these purposes.

5. Normally using the same color wire for every connection is a bad idea. This increases the difficulty of tracing wires and troubleshooting the circuit, because wires are harder to distinguish from each other.

III. Start wiring:

1. The basics of wire wrapping consist of stripping the ends of a piece of wire and using the wire wrapping tool to attach the wire to the pins of the components.
2. There is a stripping tool built into the back end of the wire wrapping tool (remove the end cap and it will slide out). This flat piece of metal has a wire stripper on one end. Just place the desired length of wire into the slot in the stripper and pull.
    - Depending on the thickness of the pin, you will need at least an inch of stripped wire, but not more than two inches. This length will provide a good number of wraps around the pin. Too few makes the wire fall off easily, too many wastes wire and pin length.
3. The wire wrapping tool has two holes in the end of it: one in the center for the pin being wrapped and the other for the stripped wire that will be wrapped around the pin.
4. Feed the stripped piece of wire through the side hole of the tool until the insulation meets the end of the shaft and stops.
5. Feed the pin through the middle hole of the tool until the tool bottoms out against the board.
6. Rotate the tool clockwise around the pin to make the wrapped connection.
    - Be sure to hold on to the insulated portion of the wire (pinching it against the board usually works well), this stops the insulated portion from wrapping around the pin. Always rotate the tool in the same direction.
    - Keep rotating until all of the stripped wire is on the pin and the tool comes off freely. This should result in approximately 6 to 12 wraps around the pin.
    - The proper amount of pressure on the tool will ensure that the wraps are directly adjacent to each other without overlapping. Too little pressure will result in space between the wraps; too much pressure will result in overlapping wraps.
    - Make sure that the insulated portion of the wire starts right at the pin, or is slightly wrapped around. If there is un-insulated wire extending from the pin it may short to another pin.
7. If you need to remove a wrapped wire, insert the tool over the wrapped pin and turn counter clockwise until the wrapped wire is loose enough to pull off.
8. Route the wire to where the other end needs to connect to a pin. Mark where the bare portion needs to start wrapping around the pin and strip the wire to this point leaving 1-2" of bare wire. Repeat the wrapping process.
    - You should experiment with different lengths of insulated wire between the pins they connect.
    - Also pay attention to how corners and other routing concerns affect the length of wire needed, and how much slack needs to be left in the wire so that it doesn't get too tight or short onto any other part of the circuit.
    - In general, err on the side of wires that are too long, you can tuck away extra wire somewhere but if it gets too short you'll have start over.

IV. Employ a clever system to keep track of your connections.

1. Use a color scheme that makes sense both conceptually and logistically. Since you'll be sharing wire spools, sometimes it's nice to be able to use one color at a time.
2. Sometimes it's easier to keep track of if you make the connections in a logical order, such as the in the path that the electricity follows, or to make connections one component at a time.

3. However you do it, try to be organized rather than just choosing connections at random, it's easier to lose track of or forget connections this way.
4. As always, when you think you're done double-check every connection. Check them off on your schematic diagram as you go so that you you're sure to find them all.