Parts list for investigation of pressure:

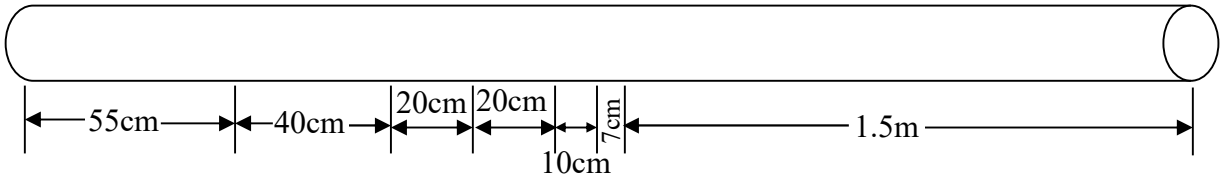
Several different diameters of syringe plus tubing to connect them together. I have used 10cc, 20cc, 30cc, and 60cc syringes.

Parts list and instructions for assembling the fluid flow apparatus:

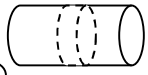
Apparatus: Student groups need to have four or five students to successfully carry out these experiments, and each group will need one version of the following apparatus. Depending on class size and budget, you will have to decide how many to make, but you will need at least two versions with different diameters in order to investigate the full range of variables, and four versions of the apparatus are ideal, using 2", 1.5", 1" and 0.5" diameter PVC pipe. Few students will really believe that the diameter of the tube does not affect their results unless they see it for themselves, and this idea is crucial to the development of the concept of energy density. A few extra connectors allow all four versions to be attached together for a nice demonstration of this point.

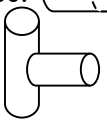
For each diameter of pipe (2", 1.5", 1", and 0.5") obtain the following parts.

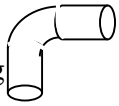
1 10ft section of PVC tubing. Cut this piece into segments of length 55cm, 40cm, 20cm, 20cm, 10cm, and 7cm. The remaining piece should be about 1.50m long. I had little problem cutting these with a hand saw.



1 end cap – put it on one end of the 55cm long piece. 

4 couplings – used to attach the 40cm, 20cm, and 10cm pieces to the 55cm piece. 

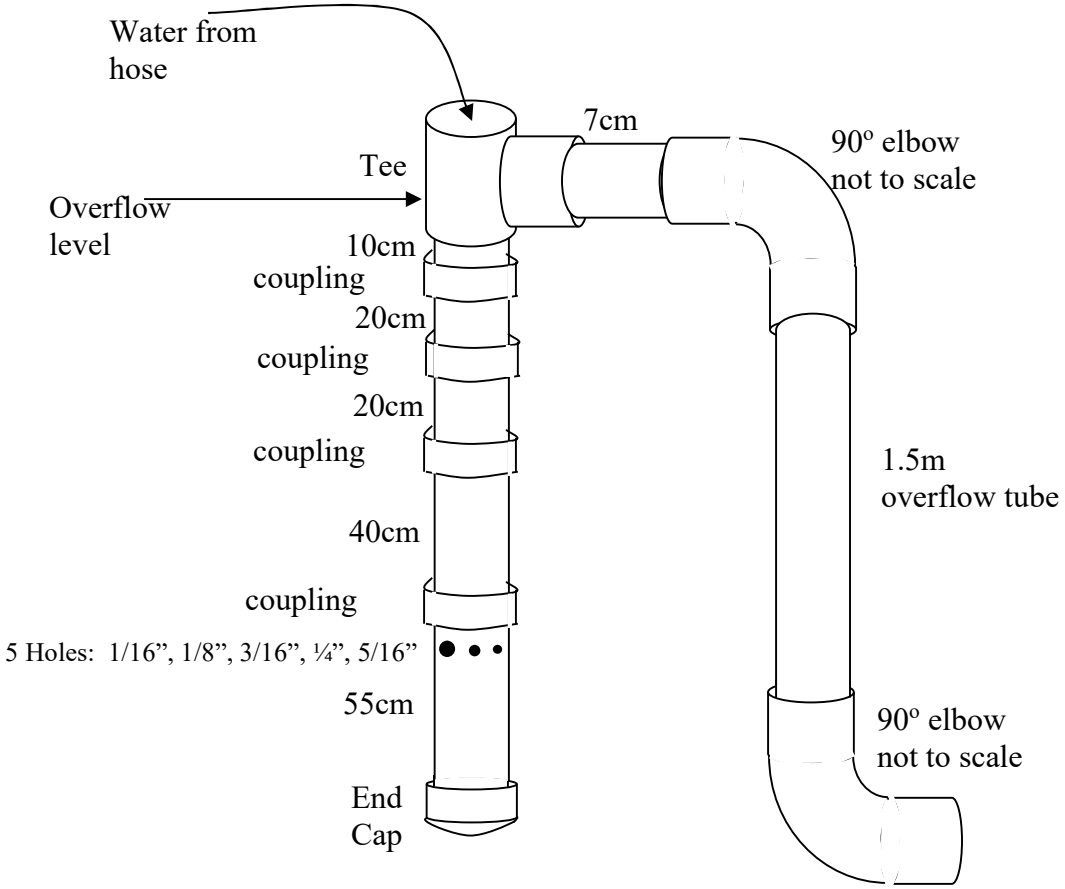
1 Tee – At the top of the coupled pieces. Used to connect an overflow tube. 

2 elbows. These go on either end of the 1.50m long piece. Then connect this to the center of the Tee using the 7cm segment. Together, the two elbows and the 1.50m long piece make the overflow tube. 

For the 2", 1.5", and 1" pipes, drill holes of diameter 1/16", 1/8", 3/16", ¼", and 5/16" 5cm from the open end of the 55cm tubing. Make sure to space them so the streams from each hole will not interfere with each other, but also leave a place where a person can stand behind the tube and not get squirted.

For the ½" pipe, obtain an additional 10ft section and cut it into four more 55cm long pieces. Buy four more end caps to cap the ends of these pieces. Drill one hole 5cm from the open end of each of these pieces using the same diameters as above so that each 55cm length has one hole of a different diameter.

The assembled apparatus looks like this. The couplings can be used to add and remove the 40, 20, and 10cm pieces in any combination to change the height from the holes to the overflow while keeping the distance from the holes to the ground constant at about 50cm. The overflow tube can rotate forward or back to accommodate any height.



Additional materials needed: meter sticks, stop watches, buckets or large beakers (2000mL is good), graduated cylinders (250mL is a good size), garden hose and outdoor faucet, cooperative maintenance staff

Parts list for investigating resistance and dissipated energy density:

Various lengths and diameters of clear, vinyl tubing to siphon water.
OD: 5/8", ID: ½" one 2m long length (about 6 feet, 6 ¾")
OD: ½", ID: 3/8" one 2m long length (about 6 feet, 6 ¾")
OD: 3/8", ID: ¼" two 20ft rolls. Cut one roll into lengths of 5m and 1m. Cut the other roll into lengths of 2m, 3m, and 0.75m.
OD: ¼", ID: 0.170" one 2m long length (about 6 feet, 6 ¾")

Total cost: about $40, but could be as low as $20 depending on how many versions you build. (See spreadsheet for details of what I spent.)

Additional materials needed: containers large enough to hold up to 1500mL of water with only a small change in fluid level (a 1 to 1.5 ft diameter round bucket or approximately 1.5ft square container works well), stop watch, beakers (up to 2000mL) graduated cylinders (250mL is a good size), water from sink, meter stick.

In addition, a standard Venturi tube demonstration is helpful.
I like the version available from Sargaent Welch for $43 (Part number CP31043-00). A similar apparatus is available from almost any other physics supplier.