

## UNIT VI - PLUMBING

### Lesson 4: Measuring, Cutting, and Connecting Pipes

**Competency/Objective:** Measure, cut, and connect pipes and tubing.

#### **Study Questions**

1. What factors must be considered before proper measurement of a pipe system can be accomplished?
2. How are different types of pipe cut properly?
3. What methods are available to join different types of pipe?

#### **References**

1. *Agricultural Structures (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, 1999, Unit VI.
2. Activity Sheet
  - a) AS 4.1: Cutting and Joining Plastic Pipe
3. Job Sheet
  - a) JS 4.1: Sweating Copper Pipe



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#### Teaching Procedures

#### B. *Review*

Lesson 3 described the types and sizes of pipe and fittings used for plumbing and how they are sized to deliver a certain flow rate. After a particular type and size of pipe is chosen, it must be installed. Measuring, cutting, and joining pipe is an essential part of installing plumbing lines.

#### C. *Motivation*

Have students observe the pipes located in the agriculture facility or elsewhere in the school. Ask them how they would cut and join the pipes for that particular application.

#### D. *Assignment*

#### E. *Supervised Study*

#### F. *Discussion*

1. With a metal tape measure or folding ruler, demonstrate how to measure by measuring around a room to find the total distance. Lay out pipes to fit a certain distance and then show how much attaching fittings to the pipes increases the length.

#### **What factors must be considered before proper measurement of a pipe system can be accomplished?**

- a) Distance from the water source to the desired outlet along the exact path that the pipe will take
  - b) Length of the pipe being installed
  - c) Fittings used to join the sections of pipe, since they increase the length of the system
    - 1) The amount of increase is dependent on the size of the fittings as well as any angles made by the fittings.
    - 2) The length of the pipes may have to be adjusted to account for the fittings.
2. If possible, demonstrate how to cut pipe using a hacksaw or pipe cutter. Let the class examine the cut before and after smoothing it with sandpaper or some other tool, such as a knife or file. Cut some copper pipe and or tubing for the class and let them examine the joint before and after smoothing the cut with a file. Describe the process for using the different cutting tools.

#### **How are different types of pipe cut properly?**

- a) Carefully measure the pipes with a tape measure or folding ruler.
  - 1) Make an allowance for the fittings; add the length to which the pipe will slide or screw into the fitting to the length that will run between fittings.
  - 2) With a pencil, mark the point where the pipe should be cut.
  - 3) The marking should extend all the way around the pipe.
  - 4) Measurements should be made to the nearest 1/32 of an inch.
- b) Cut the pipe.
  - 1) Use a wheel-type cutter for copper pipe.
    - (a) Open the cutter by turning the handle until the pipe will fit between the wheel and roller.
    - (b) Place the pipe in the base of the cutter and turn the handle until the pipe touches the cutter wheel.
    - (c) Position the wheel on the point where the pipe is to be cut.
    - (d) Turn the handle to press the wheel into the pipe.
    - (e) Rotate the tool around the pipe once.

- (f) Tighten the handle and rotate the tool again.
    - (g) Repeat this process until the pipe is cut.
  - 2) Use a hacksaw for plastic pipe.
    - (a) If possible, place the pipe in a vise to hold it still.
    - (b) Position the hacksaw blade on the mark for cutting.
    - (c) Pull the hacksaw backwards, placing no pressure on the pipe.
    - (d) Bring the blade forward with pressure exerted to cut into the pipe.
    - (e) Hold the saw at a 90-degree angle to the pipe, resulting in a square cut.
    - (f) Repeat this process until the pipe is sawn through completely.
  - c) Smooth any burrs and ridges left on the inside or outside of the pipe from cutting.
    - 1) With copper pipe, use a small file, sandpaper, or a special reaming tool.
    - 2) Use sandpaper or a knife for plastic pipe.
- 3. Discuss the different methods of joining pipe. If time and materials are available, demonstrate joining plastic pipes and fittings with cement. Let the students try to pull the joint apart to show how solid they can be. Have students complete AS 4.1 and JS 4.1.

**What methods are available to join different types of pipe?**

- a) Cements for plastic pipe
  - 1) The end of the pipe and the fitting must be smooth and clean; a chemical cleaner is the best way to clean this material.
  - 2) Once the fitting and pipe end are clean, they are covered with an even coating of cement on the pipe and fitting socket.
  - 3) The cement usually acts quickly, so the pieces need to be joined together immediately and firmly.
  - 4) The pipe should be given a quarter turn to make sure it is seated securely.
  - 5) A solid and permanent joint will be created after the pipe and fitting are held together ten seconds to a minute.
  - 6) A line of cement should appear all the way around the joint, indicating that enough cement was used.
  - 7) The directions and recommendations for cements should always be read before they are used.
- b) Soldering for copper pipe
  - 1) The end of the pipe and the fitting must be clean; very fine sandpaper or emery cloth works well.
  - 2) The use of soldering material, which looks like heavy wire, is enhanced by flux; flux may need to be placed on the joint before soldering.
  - 3) Since different kinds of solder have different compositions and recommended uses, the manufacturer's instructions should be read before the material is used.
  - 4) The fitting is placed on the pipe or tubing.
  - 5) A propane torch is used to heat first the pipe and then the fitting until the solder melts when touching the joint.
  - 6) The solder is held to the rim of the fitting and is drawn into the joint.
  - 7) The solder is applied around the joint until it is found around the entire rim of the fitting.
  - 8) The excess solder is wiped away while the pipe and fitting are still hot.
- c) Flare joints for copper tubing
  - 1) A flare nut is placed on the tubing.
  - 2) The pipe is flared using some type of flaring tool; one common type of flaring tool is a yoke and screw flaring tool.
  - 3) The tubing is placed in the correctly sized opening of a flaring block and secured in position, with the end of the tubing extending above the block about        the depth of the block chamfer.
  - 4) The yoke of the flaring tool is placed over the block, with the compression cone centered over the tubing.
  - 5) The screw is tightened to form the flare between the block and the cone.
  - 6) The screw should not be turned too far, since the tubing may split.
  - 7) When the flare is finished, the fit of the flare is checked to the seat of the flare nut.
  - 8) The fitting is then placed against the flare.
  - 9) The nut is tightened to hold it in place.

G. **Other Activities**

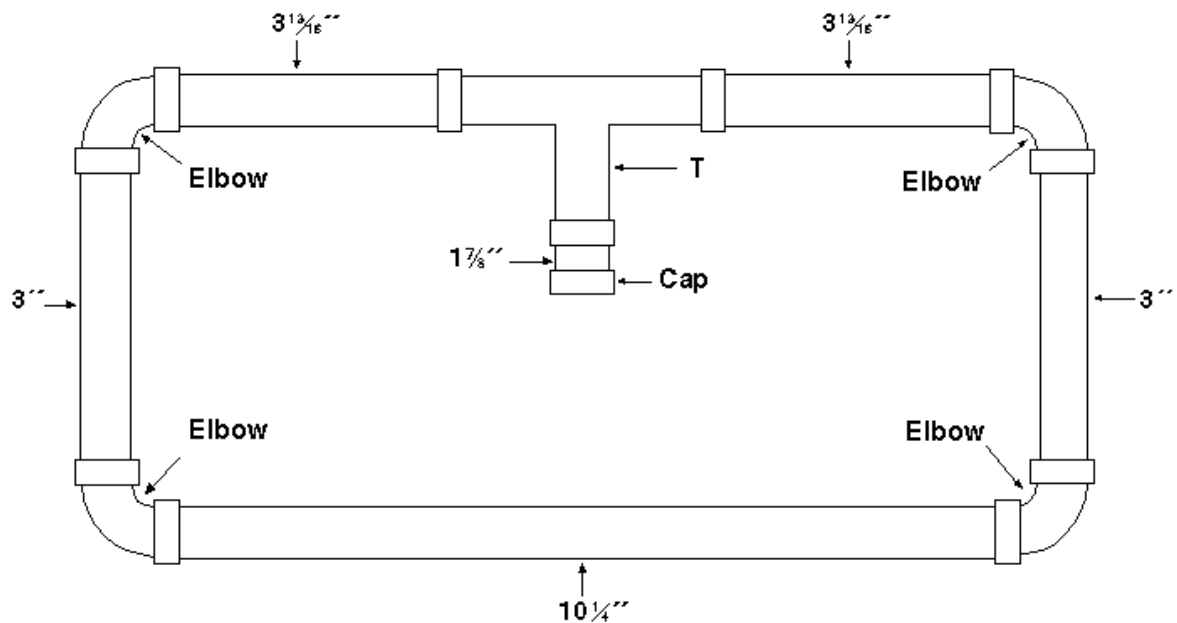
1. Have the class figure how much plumbing material would be needed to span a given area. Specify the length of the pipes used and the types of fittings required.
2. Have the students measure and cut some pipe material. Check the length of the pipe for accuracy.

H. **Conclusion**

Precise measurements are necessary to determine the lengths of the materials in a plumbing system. Pipes are then cut to the appropriate length. When pipe has been cut, the pipes and fittings are joined. The goal is to produce a solid, watertight joint using pipes and fittings that have been cut to provide plumbing that is the proper length for installation.

I. **Answers to Activity Sheet**

To achieve the correct dimensions, students will have to cut the pipe accurately. The correct lengths for the different pieces of pipe are shown below.



1. Answers will vary.
2. Answers will vary.
3. The same skills are used in preparing and constructing PVC pipe projects in structures.

J. ***Answers to Evaluation***

1. c
2. b
3. d
4. The distance from the water source to the desired outlet along the exact path that the pipe will take, the length of the pipe being installed, and the fittings used to join the sections of pipe
5. That enough cement was used
6. Because different kinds of solder have different compositions and recommended uses

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## EVALUATION

**Circle the letter that corresponds to the best answer.**

1. Because accurate measurements are very important, measurements should be made to the nearest \_\_\_\_\_ of an inch.
  - a. 1/8 of an inch
  - b. 1/16 of an inch
  - c. 1/32 of an inch
  - d. 1/64 of an inch
2. A plastic pipe and fitting should be held together for at least \_\_\_\_\_ seconds to be sure the joint will hold.
  - a. 5
  - b. 10
  - c. 15
  - d. 20
3. When cutting pipe with a hacksaw, the saw should be held at a \_\_\_\_\_ angle to the pipe to produce a square cut.
  - a. 30-degree
  - b. 45-degree
  - c. 60-degree
  - d. 90-degree

**Complete the following short answer questions.**

4. What three factors should be considered when measuring pipe?
  - a.
  - b.
  - c.
5. What does a ring of cement around a joint indicate?
6. Why should the manufacturer's instructions be read before soldering material is used to join pipes?





**Cutting and Joining Plastic Pipe**

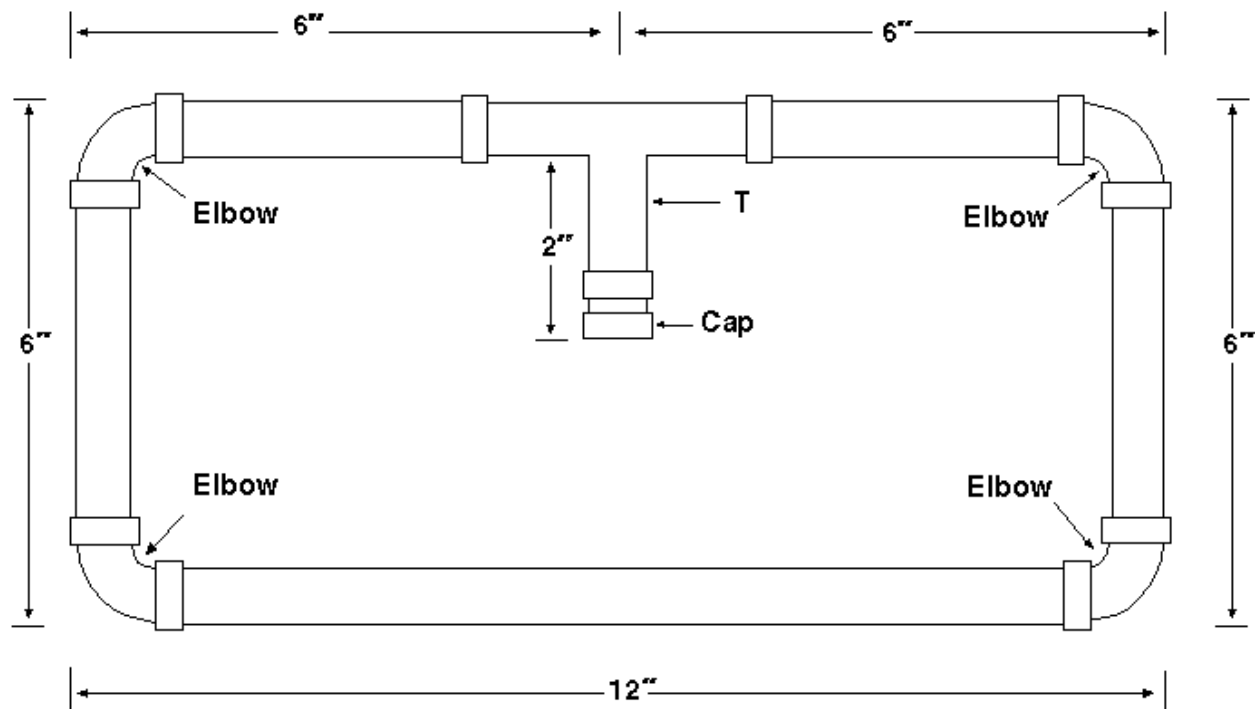
**Objective:** Cut and join plastic pipe.

**Materials and Equipment:**

1" PVC pipe, 4 feet in length  
 4 1-inch 90-degree PVC elbows  
 1 1-inch PVC T  
 1 1-inch PVC cap  
 Tape measure  
 Hacksaw  
 PVC primer and glue (optional)  
 Sandpaper

**Procedure:**

Using the diagram below, construct the PVC apparatus shown. Measure each piece carefully because you do not have much extra material. Once you have the pieces of pipe cut, either glue or stick the



pieces together, depending on your instructor's directions.

**Key Questions:**

1. Does your project have the correct dimensions? If not, why not?

2. What changes would you make in your procedure in constructing this project?

3. How could these skills be used in real world applications?

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Name \_

**Sweating Copper Pipe****Objective:** Join a copper pipe and fitting.**Materials and Equipment:**

1 1/2" copper pipe, 4 inches in length

1 1/2" cap

Flux

Brush

Propane torch

Stationary vise

Steel wool or sandpaper

**Procedure:**

1. Place the pipe in the stationary vise.
2. Apply flux to the inside of the cap and the outside of the pipe using the brush.
3. Join the cap and pipe.
4. Begin heating the cap as shown in Figure 1.1.
5. When the flux starts to bubble, add a small amount of solder to the rim of the fitting on the opposite side of the fitting from the heat source.
6. After the solder is drawn into and around the joint and seals the cap, use the steel wool or sandpaper to clean off the excess solder.
7. Allow the pipe to cool.

