Lesson A3–19

Maintaining and Repairing Plumbing Systems

Unit A. Mechanical Systems and Technology

Problem Area 3. Construction Systems

Lesson 19. Maintaining and Repairing Plumbing Systems

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: **VIII:** Plan, implement, manage, and/or provide support services to facility design and construction; equipment design, manufacture, repair, and service; and agricultural technology.

Benchmark: **VIII-B:** Follow architectural and mechanical plans to construct building and facilities.

Performance Standard: **2.** Install plumbing equipment and fixtures.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain how to prevent and solve drain problems.
2. Demonstrate how to maintain water heaters and bathroom stools.
3. Discuss how to repair faucets and leaky lines.
4. Describe how to prevent frozen pipes and how to thaw frozen pipes.

List of Resources.

The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Black & Decker. *The Complete Guide to Home Plumbing*. Minnetonka, Minnesota: Creative Publishing, 1998.

Burkybile, Carl. *Designing, Installing, Maintaining, and Repairing Plumbing Systems*. University of Illinois: Information Technology & Communication Systems (U3056).

Hogan, Elizabeth L. *Basic Plumbing Illustrated*. Menlo Park, California: Sunset Publishing Corp., 1992.

Hometime Video. *Common Home Repairs*. Sponsored by Chevrolet Trucks.

Phipps, Lloyd J., et al. *Introduction to Agricultural Mechanics,* Second Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2004. (Textbook, Chapter 16)

Other Resources. The following resources will be useful to students and teachers:

Burke, Stanley R., and T.J. Wakeman. *Modern Agricultural Mechanics*. Danville, Illinois: Interstate Publishers, Inc., 1992. (Textbook, Chapter 16)

Herren, Ray V., and Elmer L. Cooper. *Agricultural Mechanics Fundamentals & Applications.* Albany, New York: Delmar Publishers, 2002. (Textbook, Chapter 35)

Hometime Video. *Plumbing*. Sponsored by Chevrolet Trucks.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheet
Drain snake, Closet auger, Water ram
Plumbing tools
Worn faucet sets

Terms.

The following terms are presented in this lesson (shown in bold italics):

Bowl
Cartridge faucet
Ceramic disc faucet
Closet auger
Drain snake
Float

Flush tank
Heat tape
Plunger
Rotating ball faucet
Seat dressing tool
Tank ball stopper
Water ram
Wax ring

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have students share ideas on what can be done to keep the plumbing system functioning. Identify common plumbing problems and explain that this lesson will teach them how to solve these problems.

Summary of Content and Teaching Strategies

Objective 1: Explain how to prevent and solve drain problems.

Anticipated Problem: How can drain problems be prevented and solved?

I. A good plumbing system is more than a convenience. It is a necessity that has contributed much towards the prevention of disease. The plumbing system often goes unnoticed and unappreciated when working properly. When problems do occur, however, it can be very frustrating. A few minutes spent regularly on maintenance will help to prevent plumbing problems.

A. To avoid clogged drains, keep grease, food particles, hair, and other unnecessary solids from entering drains. Drain stoppage is usually the result of gradual build-up over time. Use of the prepared drain cleaners on a regular schedule, especially at the kitchen sinks, is helpful to prevent clogged drains. Follow the manufacturer's recommendations and usage directions. It is also helpful to regularly lift out the pop-up part of the sink drain and clean it thoroughly. Many sink traps have a clean-out plug. If a clean-out plug is present, remove it from time to time to clean out the trap.

B. A clogged sink or toilet drain is one of the most common plumbing problems, but fortunately is easy to cure. When all sinks and toilets seem to have a drain problem, the sewer line is probably clogged. The clean-out plug in the sewer line should be loosened enough to allow water and waste to flow into a catching container. Remove the clean-out plug and insert a drain snake. A ***drain snake*** is a flat steel flexible tape or coiled spring that is uncoiled and pushed forward into the drain to break through the blockage.

C. If the sewer line is clear and the drain problem is confined to one sink, check the sink stopper (pop-up valve) for hair or other blockage. Most stoppers are removed simply by

twisting counter-clockwise and lifting. If this does not clear the drain, stuff rags in the overflow vent of the sink, add 2 or 3 inches of water to the sink, and use a plunger with up and down motion over the drain hole. A ***plunger***, sometimes called the "plumber's friend", is a cup-shaped rubber cone attached to a wooden handle. If after using the plunger, the drain is still blocked, it is time to use a chemical drain cleaner. Scoop excess water from the sink and then pour the chemical cleaner directly into the drain. After waiting a few minutes, turn on the hot water to test the drain. If the drain is not cleared, remove the sink trap. Catch the drain water in a bucket. Force a straightened coat hanger (with a small hook on the end) through the trap.

D. For clogged toilet drains, try the plunger to force water through the drain under pressure. In most cases, the pressure will be enough to remove the blockage and return the drain to normal. Another option, a ***water ram***, uses air pressure to force the blockage through the pipe. A third option, a ***closet auger***, is a flexible coiled steel wire with an enlarged end that is hand pushed or cranked into the obstruction and then pulled back, bringing the blockage into the toilet bowl. If none of these techniques work, the last resort is removing the toilet from the floor and turning it upside down to remove the blockage. When the toilet is re-installed, use a new preformed ***wax ring*** to seal the stool to the drain flange.

Have the students read the suggested chapters in the recommended resource texts. Display the tools used to clear clogged drains. Use TM: A3–19A to discuss preventative maintenance techniques that are used to keep drains flowing, including the use of chemical drain cleaners. Display TM: A3–19B to illustrate the use of various techniques in unclogging bathroom stools. Use the video Common Home Repairs section on unclogging bathroom stools.

Objective 2: Demonstrate how to maintain water heaters and bathroom stools.

Anticipated Problem: How can water heaters and bathroom stools be maintained?

II. Maintenance of the water heater and the bathroom stool are jobs that are commonly overlooked. Basic maintenance can help result in trouble-free long life.

A. Every three to four months, the water heater should be drained of any accumulated sediment along with 3 to 5 gallons of water. Be sure to shut off gas and water valves to the water heater before you start draining water.

B. Most water heaters have a pressure relief valve that should be opened periodically to see that it is working. If this valve does not shut off completely, a new washer is probably needed.

C. The bathroom stool is another fixture that should be checked periodically. A flush toilet has two major parts, the flush tank and bowl. The ***flush tank*** is the upper unit of the stool that holds a reservoir of water for flushing. The ***bowl*** is the lower portion of the stool that is attached to the drain flange. Lift off the lid of the flush tank. Noise in the tank is a good indication that there is a leak. If water is going into the top of the overflow

pipe, adjust the float. The ***float*** controls the water level in the flush tank. Bending the float arm down will result in a lower water level in the flush tank.

D. The ***tank ball stopper*** is a rubber plug that seals the flush tank to hold the water. If you suspect the stopper is allowing water to leak through the flush outlet valve into the bowl, add a few drops of food coloring to the flush tank. In an hour or so, if the water in the toilet bowl has become colored, the stopper ball should be replaced.

E. Be sure to check the outside of the flush tank and bowl for leaks. Clean the inside of the flush tank and use a disinfectant-type bowl cleaner regularly in the bowl. Also check at the base of the bowl for leaks that would mean that the wax ring needs to be replaced.

F. If you have a septic tank, it should be inspected every year or two. The length of time between clean outs depends on the size of the tank, the flow of sewage to it, and the ability of the leach field to carry away sewage. Typically septic tanks need to be emptied once every 2 to 5 years. Commercial compounds are available to help bacteria and yeast break down the waste in the septic system.

Refer students to assigned readings in the suggested chapters in the recommended texts. The readings will be helpful to students in fully comprehending the content. TM: A3–19C can be used to show water heater maintenance. TM: A3–19D can be used to show bathroom stool maintenance. Obtain a stool that has been replaced. Use the stool to illustrate stool maintenance check.

Objective 3: Discuss how to repair faucets and leaky lines.

Anticipated Problem: How can faucets be repaired?

III. Making simple plumbing repairs yourself, such as fixing dripping faucets and leaking pipes, can save money and avoid delays. Faucets are either washer type or washer less type. When fixing faucets, identifying the faucet type and brand will help in the purchase of replacement parts.

A. Start by shutting off the water supply to the leaking faucet. For a washer-type faucet, remove the faucet handle, and to prevent scratching, wrap the packing nut with tape. After removing the packing nut, lift or turn out the valve stem assembly. Check the condition of the rubber washer at the lower end of the stem. A worn or damaged washer is the most common cause of dripping faucets. Loosen the screw holding the old washer and put on a new washer. Be sure to match the washer size and design to the type of faucet you have. Examine the condition of the valve seat. Some faucets have a replaceable valve seat. Replaceable seats are usually removed with an allen wrench. If a non-replaceable seat is rough or chipped it should be "dressed" or smoothed. A ***seat dressing tool*** grinds a new smooth valve seat. Check the condition of the packing around the valve stem. If the packing looks damaged or the faucet has been leaking around the stem, replace the packing. After replacing the packing, reassemble the faucet.

B. The new washer less faucets tend to be more trouble free. Replacement parts are expensive so in some cases a new faucet may be the best option. The ***cartridge faucet*** uses a rotating cylinder with holes and ports to control water flow. As the handle moves back

and forth and side to side, water flows only when a hole in the cylinder aligns with a port in the inlet of the faucet. Worn seals and O-rings cause leaks When a leak develops replace the rotating cylinder.

C. The ***rotating ball faucet*** works similar to the rotating cylinder except it uses a ball instead of a cylinder. Some leak repair kits contain only the springs and and neoprene valve seats, but the better kits also include the cam and cam washer. If the rotating ball is obviously worn or scratched , replace it.

D. The ***ceramic disc faucet*** uses one stationary disc and another disc that moves with the handle. When holes in the two discs line up, water flows. By moving the handle from side to side the top disc is rotated to control the mixing of hot and cold water. Lifting the handle raises the top disc causing an increase in water flow. Leaks can usually be fixed by lifting out the cylinder and cleaning the neoprene seals and the cylinder openings. A Scotch Brite pad is used to clean the cylinder openings. If the cleaning does not stop the leak, replace the cylinder.

E. If the leak is in the water supply replace the fitting or the section of pipe with the leak. This can best be accomplished by using a coupling and union.

TM: A3–19E, A3–19F, A3–19G, and A3–19H show the repair procedures for the various types of faucets. The Complete Guide to Home Plumbing has detailed explanations and pictures. Use faucets that have been replaced to show the parts of a faucet and demonstrate how to disassemble, repair, and reassemble. Use the video Common Home Repairs section on repairing leaky faucets to show the repairs being done.

Objective 4: Describe how to prevent frozen pipes and how to thaw frozen pipes.

Anticipated Problem: How can frozen pipes be prevented and how can frozen pipes be thawed out?

IV. To prevent water pipes from freezing, wrap them with insulation and/or heat tape. ***Heat tape*** is a tape, that when plugged in, uses electrical resistance to create heat. In extremely cold weather allowing faucets to drip can prevent frozen water pipes.

A. If water pipes freeze, they may expand and burst. Before heating the pipe, open water faucets in the area of the frozen pipe. The open faucets will provide an escape route for steam that may form inside from rapid heating of the pipe. A propane torch may be the fastest method for thawing iron or copper pipe. When using a torch, move it constantly back and forth and remove the flame every couple of minutes or so to let the pipe cool. Also be sure to start by heating the end of the pipe nearest the faucet instead of starting at the middle of the pipe.

B. Other methods of thawing pipes include: wrapping pipes with rags and pouring on boiling water, warming pipes with heat lamps, and heating pipes with electrical resistance from an arc welder. Note that both the welder and the torch methods for thawing pipes may only be used on iron and copper pipes.

C. If the frozen pipe is a drain rather than a supply pipe, it can be thawed easily by running hot water into the drain. In case this does not work after several minutes, pour in a mixture of chemical drain cleaner and cold water.

Assign readings in the appropriate chapters of the recommended resource texts. The readings will help students to understanding these topics. Ask students who has had frozen water pipes. Have them describe the technique they used to thaw the pipes. Ask how the frozen pipes could have been prevented. Use TM: A3–19I to show thawing techniques.

Review/Summary. Discuss maintenance that can be done to prevent clogged drains, stool problems, and frozen pipes. Summarize the procedures for unclogging drains, fixing leaky faucets, and thawing frozen pipes. If the plumbing repairs sections of the video *Common Home Repairs* was not used earlier use it now for review.

Application. Have students use the lab sheet to check the condition of the home plumbing system and to perform routine maintenance.

Evaluation. Take the written test and evaluate the lab sheet work.

Answers to Sample Test:

Part One: Matching

1 = d, 2 = f, 3 = h, 4 = e, 5 = g, 6 = j, 7 = i, 8 = b, 9 = c, 10 = a

Part Two: Completion

1. washer, washer less
2. dressed
3. rotating cylinder
4. ball
5. ceramic discs
6. sediment
7. wax ring
8. float (float arm)
9. clean-out plug
10. pop-up
11. washer

Part Three: Short Answer

1. Keep grease, food particles, hair, and other unnecessary solids from entering drains. Use a commercial drain cleaner on a manufacturer's recommended schedule. Clean the sink

pop-up valve periodically. If the sink trap has a clean-out plug, periodically remove it and clean out the trap.

2. Water pipes (steel or copper only) can be thawed with a propane torch, wrapping pipes with rags and pouring on boiling water, warming pipes with heat lamps, heating the area where the pipes are with an electric or kerosene heater, or heating pipes (steel or copper only) with electrical resistance from an arc welder.

Sample Test Name _____

Test

Lesson A3–19: Maintaining and Repairing Plumbing Systems

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. bowl
b. closet auger
c. drain snake
d. float
e. flush tank
f. heat tape
g. plunger
h. tank ball stopper
i. water ram
j. wax ring

_____ 1. The part of a stool that controls the water level in the flush tank.

_____ 2. Used to provide heat created from electrical resistance.

_____ 3. Used to seal the water outlet in the flush tank.

_____ 4 Upper unit of the stool that holds a reservoir of water for flushing.

_____ 5 Used to remove stool blockage, sometimes called the "plumber's friend".

_____ 6. Used to seal the stool to the drain pipe.

_____ 7. Uses air pressure to remove a stool blockage.

_____ 8. Flexible steel coil wire with an enlarged end that is hand pushed or cranked into a stool obstruction and then pulled back to remove the blockage.

_____ 9. Flat steel flexible tape or coiled spring that is uncoiled and pushed forward into the drain to break through a blockage.

_____ 10. The lower portion of the stool attached to the drain flange.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. Faucets are either _____ or _____ type.
2. Faucet seats that are rough or chipped should be _____ or replaced.
3. Leaks with cartridge faucets are stopped replacing the _____.
4. Leaks with rotating ball faucets are stopped by replacing the _____.

5. Ceramic disc faucets use two _____ to control mixing of hot and cold water along with water flow.
6. Every 3 to 4 months water heaters should have _____ and 3 to 5 gallons of water drained.
7. If the bathroom stool is leaking at the base replace the _____ _____.
8. If the flush tank is overflowing adjust the _____ to solve the problem.
9. If the whole plumbing system does not drain remove the _____ _____ and insert a drain snake.
10. Periodically lift out the sink _____ valve and remove accumulated hair.
11. Leaking washer-type faucets can usually be fixed by replacing the stem _____.

Part Three: Short Answer

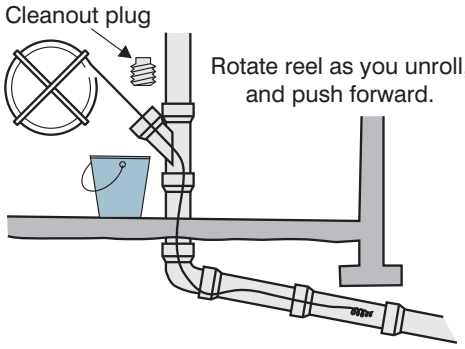
Instructions. Provide information to answer the following questions.

1. What are some things that can be done to prevent clogged sink drains?

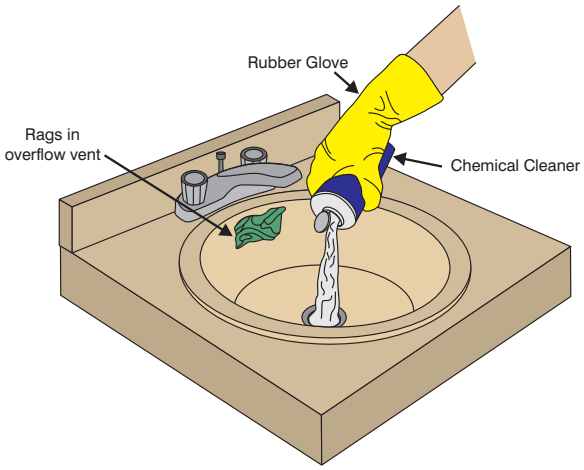
2. What are some ways to thaw frozen water pipes?

TM: A3–19A

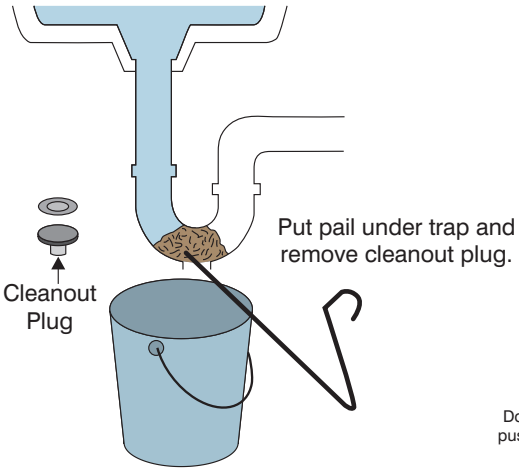
SOLVING CLOGGED DRAIN PROBLEMS



Cleaning a clogged sewer line.

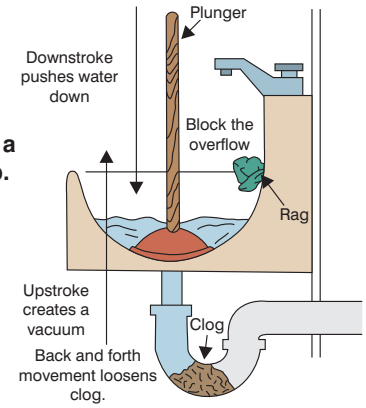


When using a chemical drain cleaner, wear gloves, keep your face away from the drain, and ventilate well.



After removing the trap cleanout plug, use a hanger or drain snake to clear out the trap.

If the trap has no cleanout plug, remove the trap for cleaning.

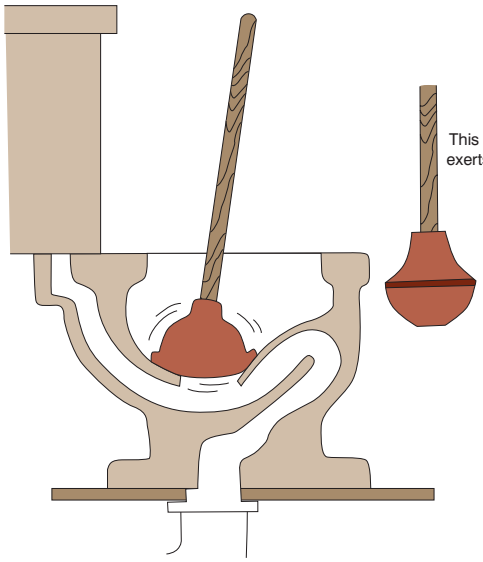


Using a plunger to remove a clog.

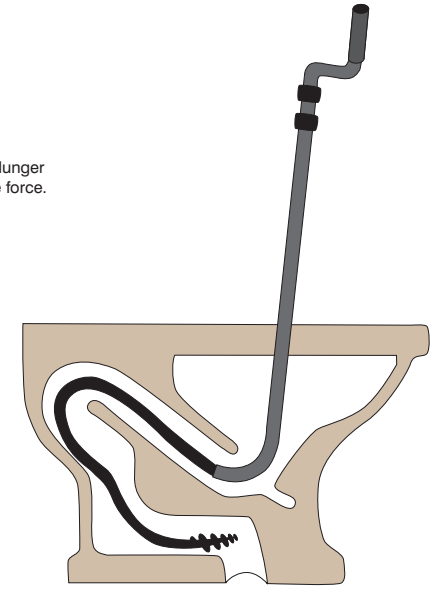
(Courtesy, Interstate Publishers, Inc.)

TM: A3–19B

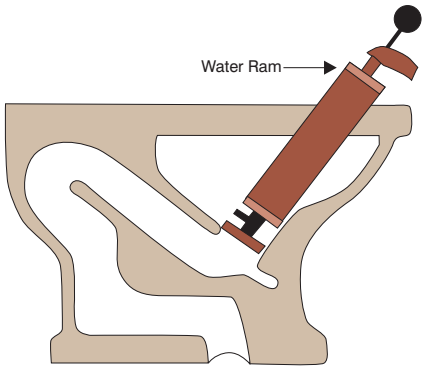
UNCLOGGING BATHROOM STOOLS



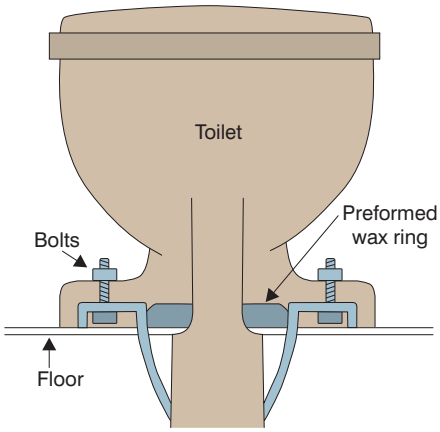
Most clogged toilet drains can be opened by using a plunger.



The closet auger is a flexible steel cable that can be cranked into the blockage. Pulling back on the closet auger may bring blockage into the toilet bowl.



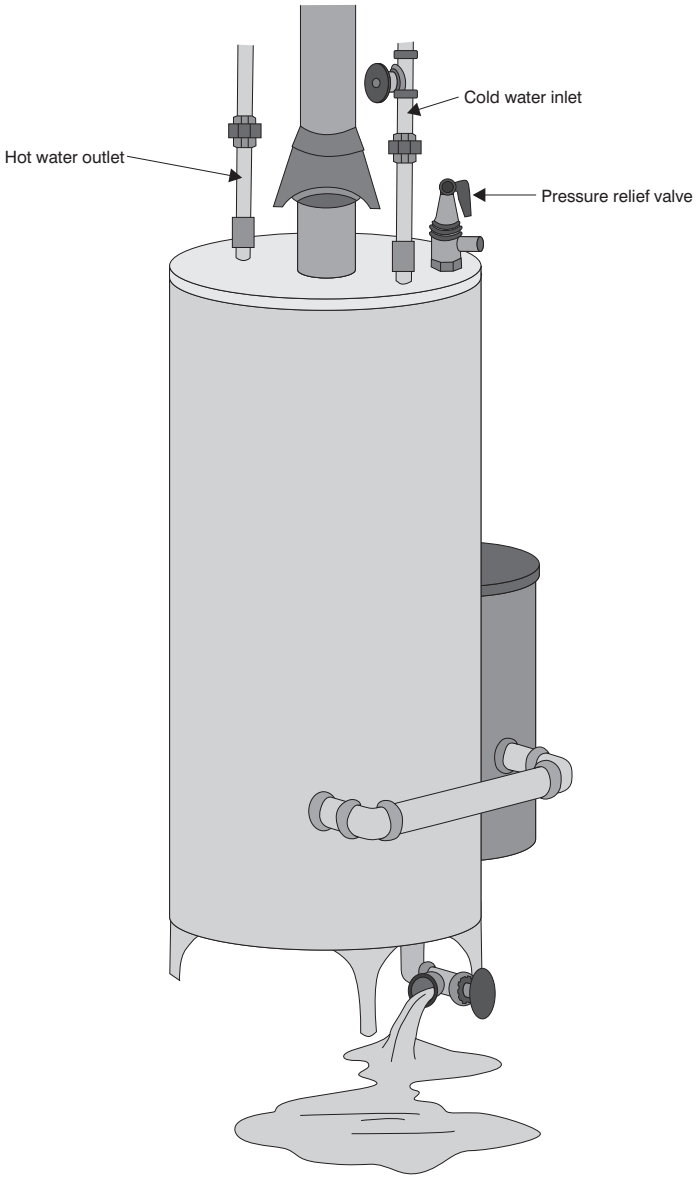
This water ram uses compressed air to open clogged drains.



If all else fails to unclog a toilet, drain it, unbolt it, and turn it upside down to remove the obstruction. When replacing the stool, use a new wax ring seal where the bowl and soil pipe meet.

(Courtesy, Interstate Publishers, Inc.)

WATER HEATER MAINTENANCE

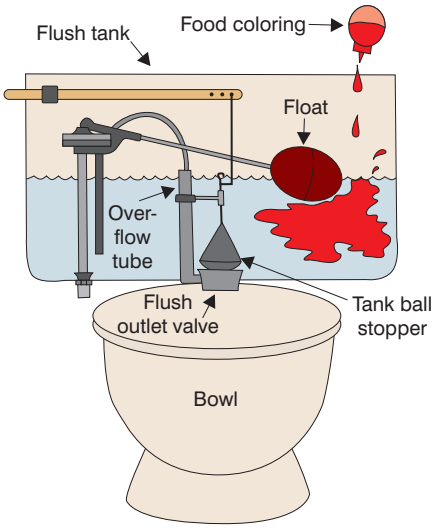


Sediment should be removed from the water heater every 3 or 4 months by draining 3 to 5 gallons of water from the heater. Check the water heater pressure relief valve periodically for proper operation.

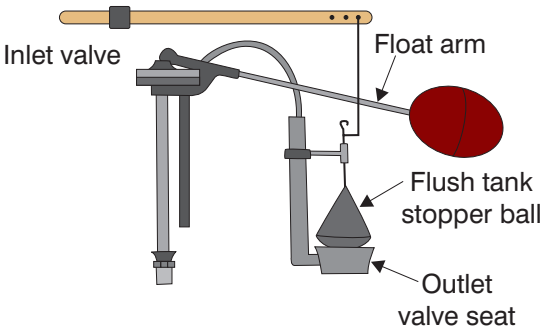
(Courtesy, Interstate Publishers, Inc.)

TM: A3–19D

BATHROOM STOOL PARTS IDENTIFICATION AND MAINTENANCE



If food coloring added to the flush tank moves to the toilet bowl, the tank stopper ball probably needs to be cleaned or replaced.



If water runs into the flush tank continuously, check the inlet valve washer, tank stopper ball, and the outlet valve seat.

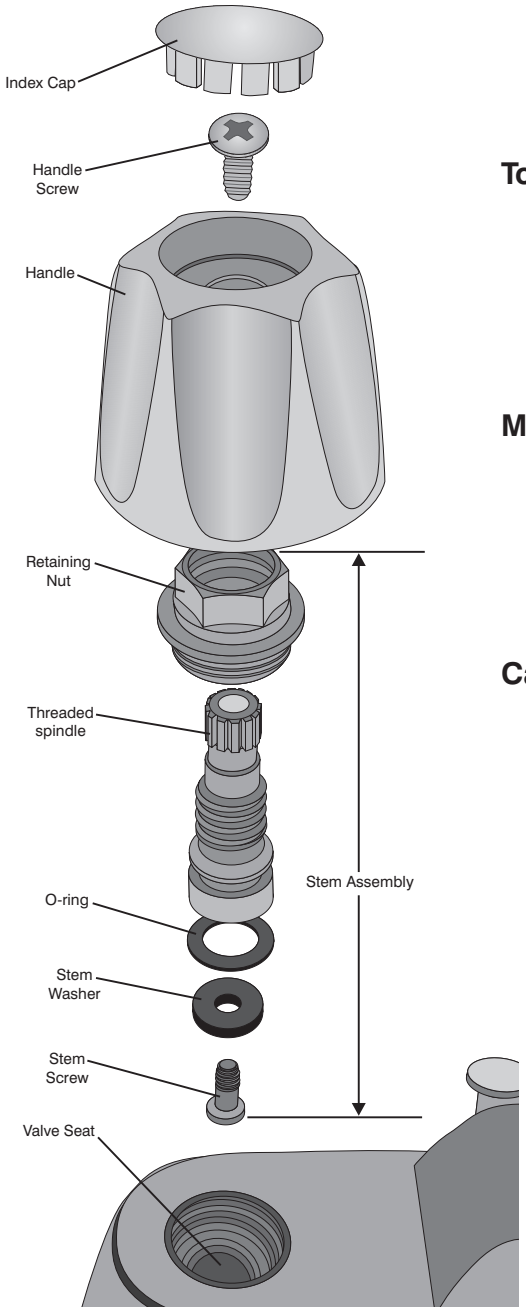
Adjust the float arm to prevent overflow.

Clean the tank stopper ball and outlet valve seat. If the stopper ball needs to be replaced, simply unscrew it and put on a new one.

(Courtesy, Interstate Publishers, Inc.)

TM: A3–19E

REPAIRING WASHER TYPE FAUCETS



Tools Needed:

Screwdriver, channel lock pliers, utility knife, seat wrench, seat dressing tool

Materials:

Universal washer kit, packing string, heat-proof grease, replacement valve seats (if needed)

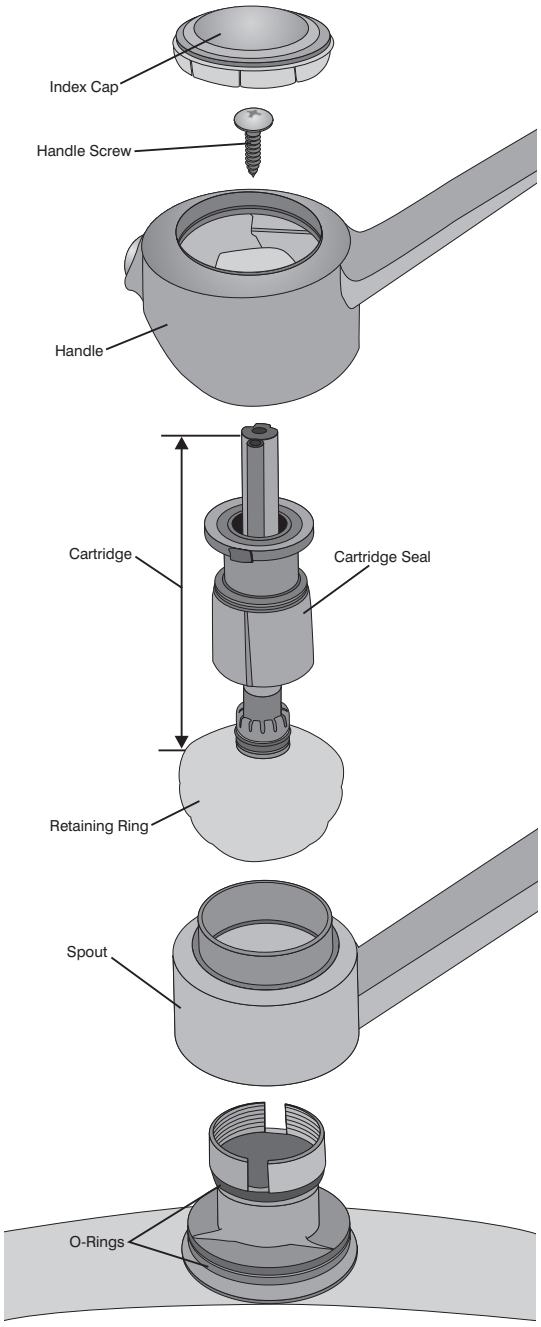
Cause of Drips:

Worn washer, worn O-ring, worn valve seat

(Courtesy, Interstate Publishers, Inc.)

TM: A3–19F

REPAIRING CARTRIDGE (CYLINDER) FAUCETS



Tools Needed:

Screwdriver, channel lock pliers, utility knife

Materials:

Replacement cartridge, O-rings, heat-proof grease

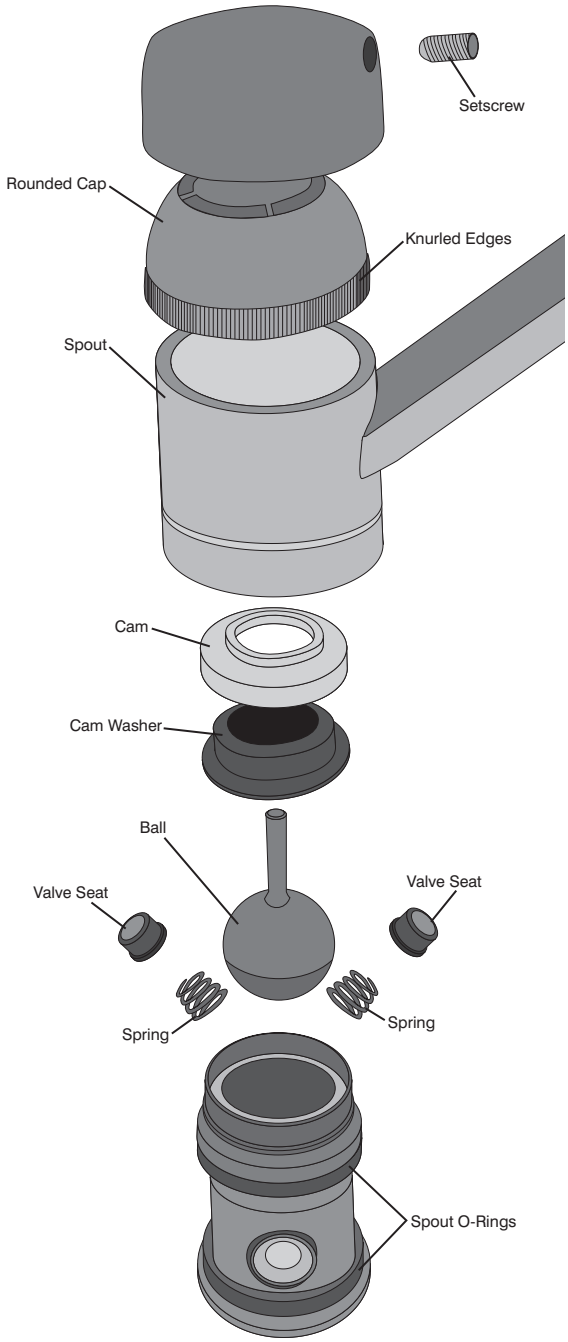
Cause of Leaking:

Worn cartridge seals, worn O-rings

(Courtesy, Interstate Publishers, Inc.)

TM: A3–19G

REPAIRING ROTATING BALL FAUCETS



Tools Needed:

Screwdriver, channel lock pliers, allen wrench, utility knife

Materials:

Ball faucet repair kit, new rotating ball (if needed), masking tape, O-rings, heatproof grease

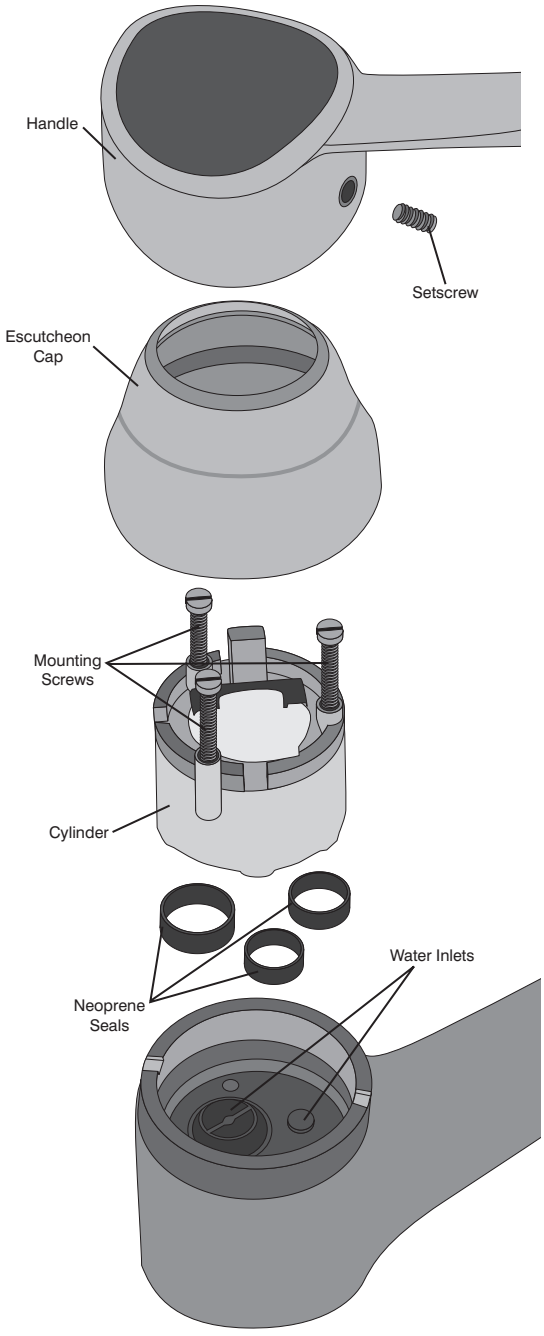
Cause of Leaking:

Worn out valve seats, worn springs, a damaged ball, worn O-rings

(Courtesy, Interstate Publishers, Inc.)

TM: A3–19H

REPAIRING CERAMIC DISC FAUCETS



Tools Needed:

Screwdriver

Materials:

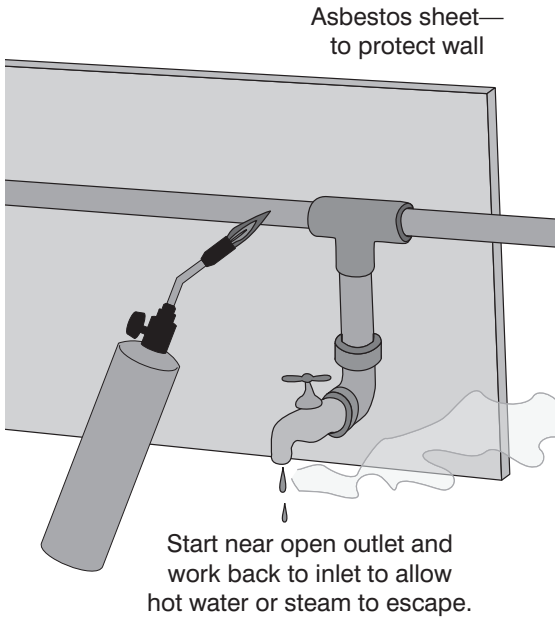
Scotch Brite pad, replacement cylinder (if needed)

Cause of Leaking:

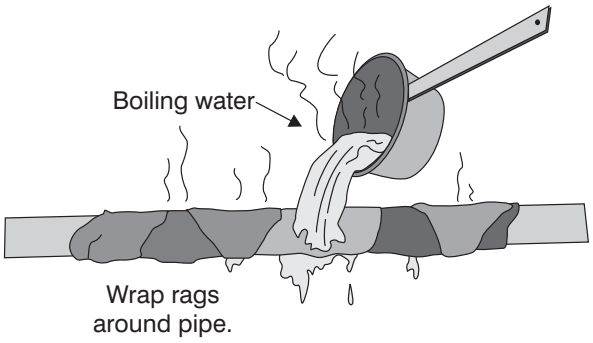
Dirty neoprene seals, dirty cylinder openings, worn cylinder

(Courtesy, Interstate Publishers, Inc.)

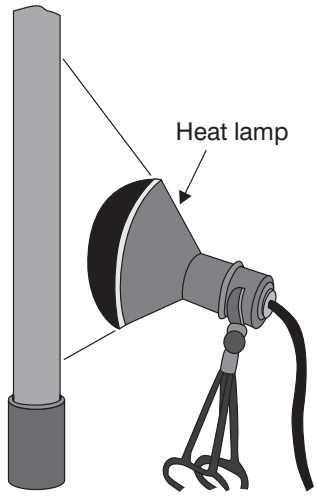
THAWING FROZEN PIPES



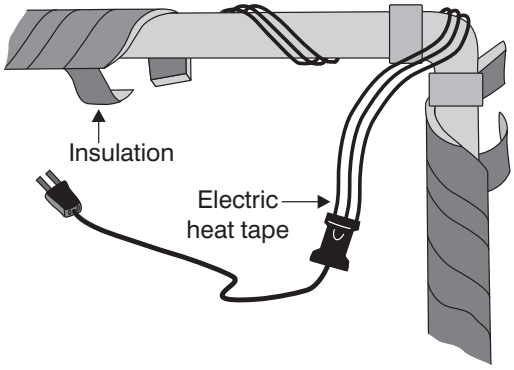
Thawing pipes with a torch.



Thawing pipes with boiling water.



Thawing pipes with a heat lamp.



Wrapping pipes with insulation and/or an electric heat tape can prevent frozen pipes.

(Courtesy, Interstate Publishers, Inc.)

LS: A3–19A Name_____

Lab Sheet

Home Plumbing System Maintenance Checklist

Supply lines:

1. Locate the main water shut off
   … close the valve and reopen to see that it works properly
2. Are there any line leaks?
3. Are lines secured to prevent vibration?
4. Are there leaks at shut off valves?
   … close the shut off valves and reopen to see that they work properly

Drain-waste-vent lines

1. Locate the soil stack, main sewer line and clean-out plug
   … remove the clean-out plug and run a drain snake into the sewer line
2. Examine drain lines for any evidence of leaks
3. Locate vent lines that come through the roof

Fixtures (sinks, tubs, showers)

1. Examine faucets for leaks
   … determine if the faucets are washer type or washer less type
2. Give drains a preventative maintenance treatment with a commercial drain cleaner
3. Remove and clean sink pop-up valves
4. Examine traps for leaks and loose connections

Water heater

1. After shutting off the water and gas valves, drain the sediment along with 3 to 5 gallons of water
2. Test the working condition of the pressure relief valve
3. Check to see if the temperature setting is appropriate

Bathroom stool

1. Check for flush tank leaks

   … examine the connection between the tank and the bowl and retighten if necessary

   … examine the connection of the supply line to the tank and retighten if necessary

2. Examine the base of the bowl for leaks

   … if leaking is occurring first retighten the hold down bolts

   … if leaking continues take up the stool and replace the wax ring

3. Lift the lid on the flush tank

   … check for a freely operating flush level

   … if a chain is present check its length and operation by flushing the stool

   … check the sealing condition of the tank ball stopper by adding a few drops of food coloring to the flush tank (if the bowl water becomes colored in an hour, replace the tank bowl stopper)

   … adjust the float arm if the float position allows water to run into the overflow tube