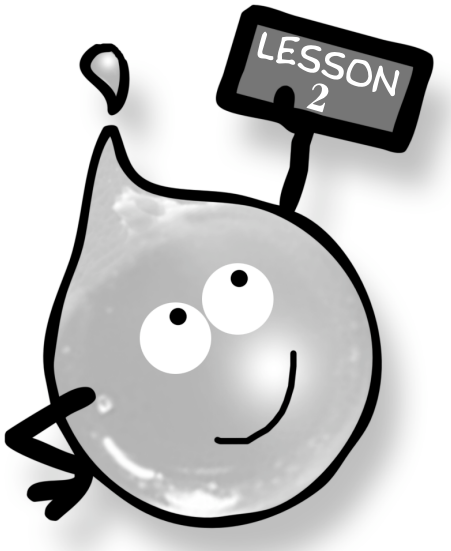



(pre-tour)

# TRICK OR TREATMENT?

## CONCEPTS:

**Students will learn:**

- how water is cleaned in nature
- how wastewater is cleaned at treatment plants

## Activity Overview:

Students will:

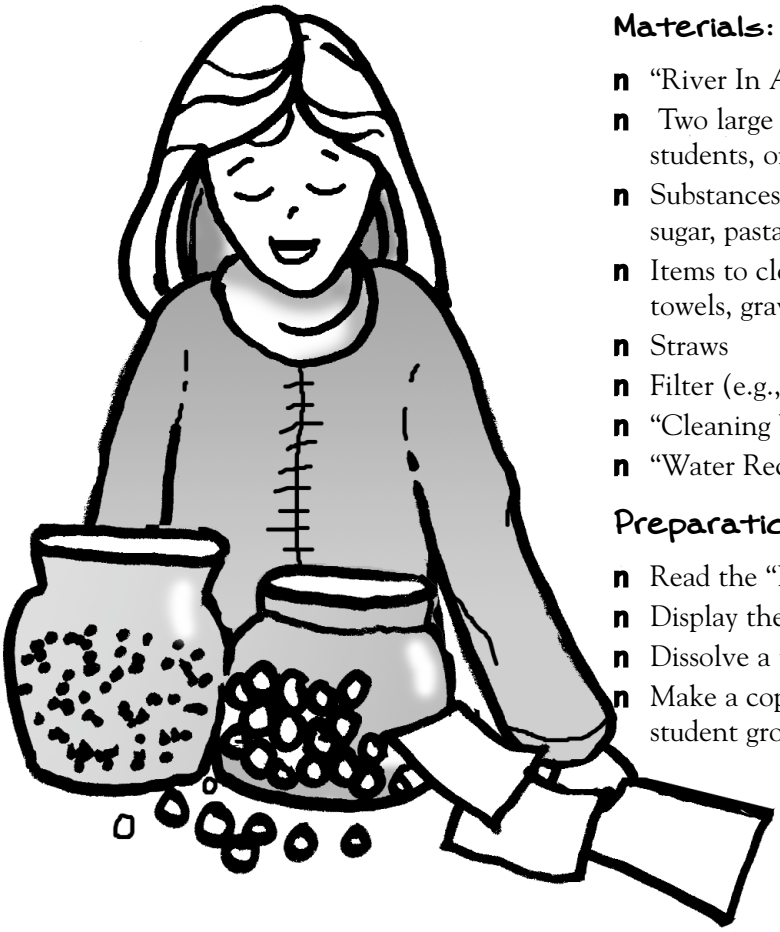
- discuss the need for cleaning wastewater
- experiment with cleaning wastewater
- determine what shouldn't go down the drain
- prepare for a field trip to San Jose Creek Water Reclamation Plant

## Vocabulary:

- combustible
- corrosive
- dissolved
- flammable
- hazardous waste
- impurities
- irritant
- microorganisms
- poison
- purification
- reclamation
- sewer
- suspended
- toxic
- wastewater

## Time Requirement:

- Approximately 50 minutes



## Materials:

- "River In A Concrete Box" poster
- Two large jars (e.g., large mayonnaise or pickle jars) for each group of students, one almost full of water and one empty
- Substances to make "wastewater," e.g., soil, sand, oil, grease, liquid soap, sugar, pasta, coffee grounds, marbles, scraps of paper, cotton balls
- Items to clean "wastewater" for each group, e.g., spoons, strainers, paper towels, gravel
- Straws
- Filter (e.g., coffee filter, charcoal filter)
- "Cleaning Wastewater Worksheet"
- "Water Recycling" brochure

## Preparation:

- Read the "Background Information" at the end of this lesson.
- Display the poster.
- Dissolve a teaspoon of sugar in a glass of water and set aside.
- Make a copy of the "Cleaning Wastewater Worksheet" for each student group.

# PROCEDURES

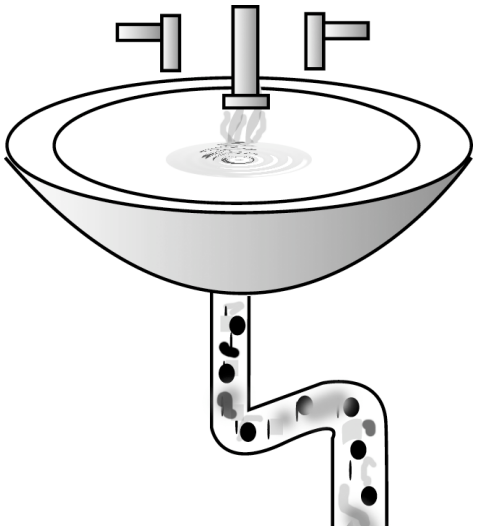
## I. DISCUSS WHAT GOES DOWN THE DRAIN

(approximately 12 minutes)

**A.** Ask students the following questions.

1. **What happens to water after you use it? Where does it go?**
   *(It goes down drains, through pipes, and into sewers that lead to a wastewater treatment plant. In some rural areas or older communities, water that goes down the drain may also go into septic tanks underground.* **Note:** *Point out the sewer system on the "River In A Concrete Box" poster.)*

2. **What gets carried away with the water that goes down your drains?**
   *(Make a list as students state things that get put down drains, e.g., soap, toothpaste, food scraps, cleansers, paint, hair, drain cleaners. Encourage them to think about all drains in their home – kitchen, bathroom, garage – and about drains in other places – schools, businesses, industries.* **Note:** *Keep this list to take on the field trip.)*



**B.** Ask students how they think all these things get taken out of the wastewater. Have students write and/or draw what they think happens at a wastewater treatment plant. Encourage them to be descriptive, including sights, sounds, and smells. When students have finished, **collect their papers to take on the tour to the wastewater treatment plant.**

## II. CLEAN WASTEWATER

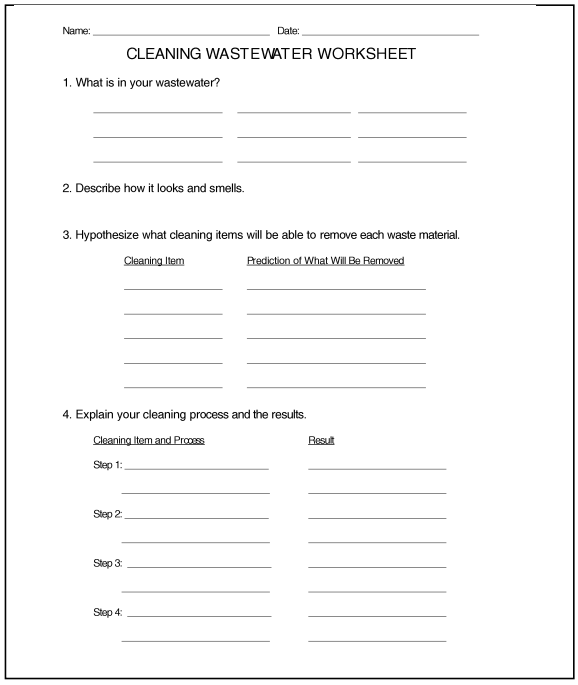
(approximately 20-30 minutes)

**A.** Remind students that there is no "new" water, so all the water they use must go back into the water cycle. Explain that nature has been purifying water since the beginning of time. Point out the poster and have students read the text at the top.

**B.** Explain nature's purification process by following the numbers along the river at the top of the poster and reading the accompanying text at the bottom of the poster. *(***Note:** *Do not read the "At the treatment plant" text at this time.)*

**C.** Explain that because of the amount of wastewater created and because of what we now put in our wastewater, nature cannot keep all our water clean. Tell students that in Los Angeles County, several wastewater treatment plants clean millions of gallons of wastewater **every** day.

**D.** Tell students that before learning how these wastewater treatment plants actually work, they are going to experiment with cleaning wastewater. Divide students into working groups and hand out a **"Cleaning Wastewater Worksheet"** to each group.



Name: _____ Date: _____

CLEANING WASTEWATER WORKSHEET

1. What is in your wastewater?

2. Describe how it looks and smells.

3. Hypothesize what cleaning items will be able to remove each waste material.

| Cleaning Item | Prediction of What Will Be Removed |
|---|---|

4. Explain your cleaning process and the results.

| Cleaning Item and Process | Result |
|---|---|
| Step 1: | |
| Step 2: | |
| Step 3: | |
| Step 4: | |

E. Give each group two large jars – one almost full of water and one empty. Tell students that first they must create their wastewater. Display the waste that they can add to their water (e.g., soil, sand, oil, coffee grounds, paper) and ask students to predict what will happen to the various waste items (sink, float, dissolve). Have each group add "waste" to their jar of water and record on their worksheets what they added and how the water now looks and smells.

F. Display some "cleaning" items – spoons, forks, strainers, paper towels, gravel. Ask students to hypothesize what cleaning items will be able to remove what waste items. Then have students test their hypotheses by trying to clean their water. Ask them to write down the process that they use and the results.

G. After each group has gotten the water as clean as they think possible, have each group share what they did and why, and explain if their hypotheses were correct. Vote on which group's water looks the cleanest. Ask students if they would drink their cleaned water. *(**Note:** Even if they say yes, do not allow students to drink the water.)*

H. Explain that they have removed some of the impurities that are **suspended** in the water, but not those that are **dissolved**. Hold up the glass of sugar water that you have prepared and ask if it looks clean. Use a straw to taste the water and ask another student to volunteer to taste it using another straw and to tell the class what's in the water. Pour the water through a filter (e.g., coffee filter, charcoal filter) into another glass. Ask if they think the filter removed the sugar. Have students use straws to taste the filtered water to discover that it still tastes sweet. Explain that like the sugar, some harmful bacteria that can't be seen can remain in the water. Tell students that the last step of wastewater treatment involves adding a disinfectant to kill any harmful bacteria. *(**Note:** To demonstrate this, use the Extension activity "Bleach Water.")*

## III. DISCUSS WHAT SHOULDN'T GO DOWN THE DRAIN

(approximately 5-10 minutes)

A. Ask students if they think – after their experiment cleaning wastewater – that some things should not be poured down drains. Why?

B. Explain that some substances should not be poured down drains either because they are hazardous or because they can damage the sewage system.

C. Tell students that a typical home contains a wide variety of hazardous products. Ask what products they think are in their houses that are hazardous. Explain that a product is considered hazardous if its label has the words:

- toxic
- poison
- corrosive
- flammable
- combustible
- irritant

Examples of such products include:

- Beauty products, such as nail polish and remover, hair relaxers and dyes
- Household cleaners, such as oven cleaners, window cleaners, furniture polish
- Lawn and garden-care products, such as bug spray, weed killer, fertilizer
- Paint and paint-related products, such as rust remover and paint thinner
- Automotive fluids, such as motor oil, wind shield washer solution, antifreeze
- Old or unused medicines
- Other products, such as photographic chemicals, lighter fluid, shoe polish, glue

D. Tell students that these products should not be poured down drains; they should be taken to household hazardous waste collection sites. (For further information, call 1-888-CLEAN-LA or go to www.888cleanla.com.)

E. Ask students if they think anything non-hazardous should be kept out of drains. Tell students that cooking oil, fat, and grease should not be put down drains. Explain that these substances stick to the sides of pipes, and then other substances stick to them, until eventually the pipes are clogged. Point out that fat, oil, and grease can either be composted or saved in biodegradable containers and put into the trash.

## IV. PREPARE FOR FIELD TRIP

(approximately 10 minutes)

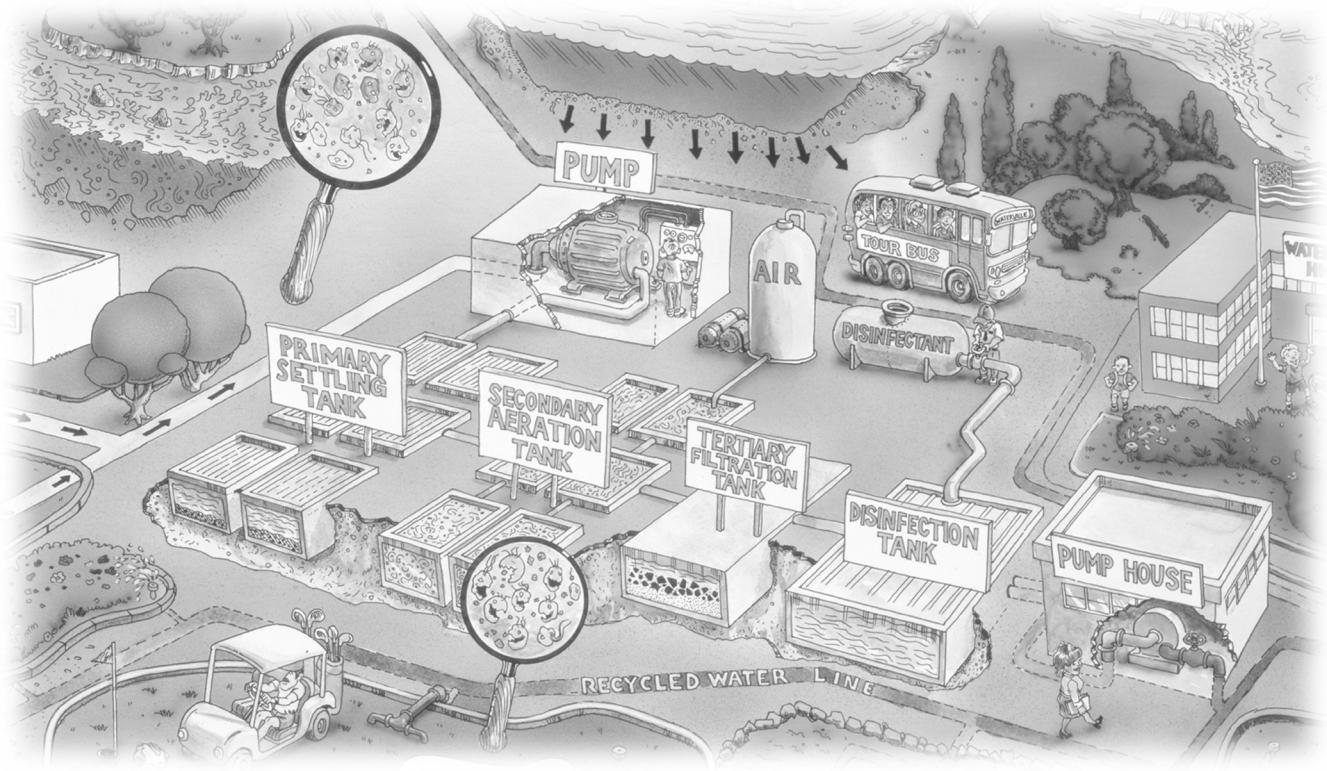
**A.** Have students read the information on the poster describing the steps taken at the treatment plant to clean wastewater. At each step, show students the photos of a treatment plant in the "WaterRecycling" brochure.

**B.** Display the diagram of the San Jose Creek Water Reclamation Plant found in the supplemental materials with the brochure. Ask students to relate each step to what happens in nature *(see comparisons on the poster)* and to what they did to clean their wastewater.

**C.** Tell students that they will be visiting the San Jose Creek Water Reclamation Plant to see first-hand how a wastewater treatment plant operates. Ask students to think of questions that they would like to have answered on the tour. If students are having trouble deciding what to ask, prompt them with a few questions, such as:

- What do you do with what is removed from the water?
- What are the microorganisms that "eat" the wastewater solids?
- What chemicals are added to the water?
- What problems can household hazardous waste cause?
- Where does the water that's been cleaned go?

Create a class list to take on the tour, along with students' descriptions of wastewater treatment and the list of things that students do put down their drains.



# EXTENSIONS

- **Research the history of wastewater treatment.** Visit www.aquaventure.org for an extensive water timeline. Discuss the various methods of wastewater treatment. Determine what diseases have been reduced because of wastewater treatment. Research the origins of wastewater treatment in your community.

- **Draw the journey of a water drop.** Draw and write about the journey one water drop might take from a river, to a water treatment plant, to a home, down a drain, to a wastewater treatment plant, and then back to a river or into a pipe for recycled water.

- **Make non-hazardous cleaning products.** Discover alternatives to some hazardous cleaning products (www.888cleanla.com). Make and use some of these alternatives, perhaps comparing them to their hazardous counterparts.

- **Research hazardous liquid waste from industries.** What waste products are generated by various industries (e.g., dry cleaning, auto repair, paper manufacturing). What happens to these waste products?

- **Survey community to determine what goes down the drain.** Develop a survey listing items that are commonly – and perhaps uncommonly – poured down household drains. Include hazardous waste. Survey residents in your community and summarize the results. If the results show many items being put down drains that shouldn't be, create and conduct a campaign to inform the community what not to pour down drains.

- **Bleach water.** Explain to students that chlorine ($Cl_2$) is used in both drinking water and wastewater treatment as a disinfectant. Point out that sodium hypochlorite (NaOCL), commonly known as bleach, contains chlorine and can be used to show how chlorine disinfects water. Obtain 4 bottles of pond water. *(You can create "pond water" by stirring a teaspoon of fertilizer into a quart of water from an aquarium and placing the water in a window sill for about a week.)* Add 1 drop of bleach to one bottle, 2 drops of bleach to another bottle, and 4 drops of bleach to another. Leave one bottle without bleach. Let the bottles sit for 30 minutes, then look at water samples from each bottle under a microscope and record observations, noting the number of organisms in each sample.

- **Create a sewage flow chart.** Find out where the wastewater treatment plant for your community is located. Contact them to determine the area that they serve. Use a local map to create a sewage flow chart, showing pipes leading into the wastewater treatment plant and pipes leading out.

# BACKGROUND INFORMATION

All the water that goes down our drains is wastewater. This includes water from toilets, baths, showers, kitchen sinks, dishwashers, and washing machines – as well as wastewater from businesses and industries. Wastewater consists of about 97% water and 3% solids, consisting of:

32% solids from sinks, baths, laundry (e.g., hair, soap, cleansers, fabric)
20% urine
18% food
16% feces
8% toilet paper and tissue
6% water softeners and miscellaneous

*(Metcalf and Eddy, Wastewater Engineering: Treatment, Disposal, Reuse, 1979.)*

## Wastewater Treatment

Once, our rivers, lakes, and ocean were capable of carrying off and "cleaning" our wastewater. Sewage from homes and businesses was pumped directly into rivers or the ocean. Water that had been used in manufacturing processes was piped into waterways. But as the population grew, and more and more waste was entering our water, nature could not keep up with the cleaning, and serious health hazards were imminent.

Therefore, it became necessary for people to start cleaning their own wastewater. Treatment plants were built, and as more complicated materials showed up in the wastewater, the treatment got more complicated as well.

The process used in wastewater treatment plants today is similar to the natural process that cleans water as it moves through the water cycle.

The first step – **primary treatment** – removes 45 to 50% of the waste through screening and settling procedures, as well as by skimming off waste materials that float.

**Secondary treatment** removes from 85 to 90% of the remaining pollutants, mainly through a biological process. The water is aerated to provide oxygen for microorganisms, which consume organic waste material. The water then moves to settling tanks, where the microorganisms and any remaining solids are separated.

**Tertiary treatment** uses filters to remove suspended substances, such as microorganisms, from the water. A disinfectant – such as chlorine – is added to kill any remaining disease-causing organisms.

After being treated, the reclaimed water is returned to the environment – rivers, lakes, ocean, or groundwater – or can be recycled; that is, it can be used for irrigation, industrial purposes, recreational uses, toilet flushing, and water supply for livestock.

The solid material that is removed from or settles out of wastewater is given further treatment. These biosolids are often used as fertilizer or as a soil amendment. They can also be buried in landfills.

Wastewater treatment plants throughout Southern California clean millions of gallons of wastewater every day. These plants typically operate 24 hours a day 7 days a week. The Sanitation Districts of Los Angeles County provide wastewater treatment services to most of Los Angeles County. Information and locations of the Sanitation Districts' facilities can be found in the supplemental materials included with these lessons or at www.lacsd.org.

## Hazardous Household Waste

Most homes have shelves, closets, and cupboards stocked with household products for cleaning, painting, beautifying, lubricating, and disinfecting. Stores carry hundreds of these products that promise to make our lives easier. Unfortunately, many of these products carry labels that read "Danger" or "Warning" or "Caution" because they are hazardous.

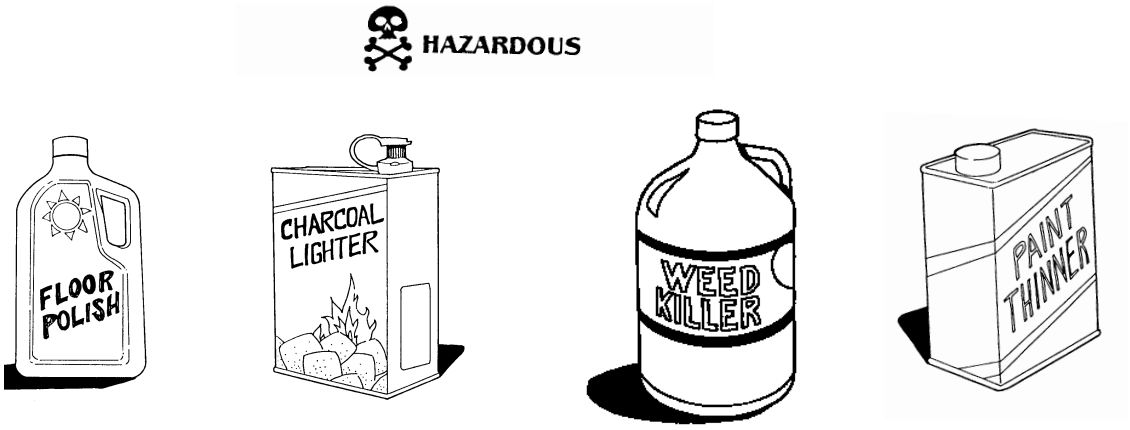
When flushed down a toilet or poured down a drain, hazardous waste goes through the sewage system to treatment plants. Some of the chemicals in these products can damage the pipes and equipment in the sewage system. At treatment plants, the hazardous waste can interfere with the biological treatment process by killing bacteria and contaminating the solids that are removed so that they cannot then be used as fertilizer. And some of the chemicals may not be able to be removed from the water during treatment, which means they are released back into the environment.

Hazardous waste from a single home may not seem significant; but when millions of homes dispose of these products, the combined effect becomes a major problem.

Because some pollutants are extremely difficult to remove from wastewater, the best solution is to avoid putting them in water in the first place. Household hazardous waste should be taken to a specific collection site. Los Angeles County holds Hazardous Waste Roundups in different areas throughout the County, usually on a weekly basis. At these roundups, the public is invited to drop off their hazardous waste. The City of Los Angeles also holds collection events for County residents. Other cities have set up their own processes for collecting household hazardous waste.
Call 1-888-CLEAN-LA or go to www.888cleanla.com for more information.

Of course, reducing the amount of hazardous waste we produce is the best solution. To help keep hazardous materials out of our water, we should:

- Think carefully before buying a hazardous product.
- Look for a non-hazardous or less hazardous substitute.
- Read the label and follow use, storage, and disposal directions carefully.
- Keep leftover products in their original labeled containers so that you can refer to directions for use and proper disposal.
- Locate auto repair shops and gas stations that recycle used motor oil, antifreeze, and batteries.
- Give unused household hazardous products to someone who can use them.
- Completely finish products before disposing of cleaned containers.



**Name:** _____ **Date:** _____

# CLEANING WASTEWATER WORKSHEET

**1. What is in your wastewater?**

_____ _____ _____

_____ _____ _____

_____ _____ _____

**2. Describe how it looks and smells.**

**3. Hypothesize what cleaning items will be able to remove each waste material.**

| Cleaning Item | Prediction of What Will Be Removed |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

**4. Explain your cleaning process and the results.**

| Cleaning Item and Process | Result |
|---|---|
| Step 1: _____ | _____ |
| _____ | _____ |
| Step 2: _____ | _____ |
| _____ | _____ |
| Step 3: _____ | _____ |
| _____ | _____ |
| Step 4: _____ | _____ |
| _____ | _____ |