PLANKTON LAB (3-6)

Overview: In this activity, students will collect a plankton sample from the slough and study the sample under microscopes. Then they will build a slough food pyramid to show the importance of plankton in the slough food chain.
Content Standards Correlations: Science, p. 293

Grades: 3-6

Key Concepts: The open water and sloughs of San Francisco Bay contain an abundance of microscopic or nearly microscopic life called phytoplankton (small, drifting plants) and zooplankton (small, drifting animals). Plankton plays an important role in the Bay, forming the base of food pyramids that support mud creatures, fish, birds, and even humans.

Objectives:
Students will be able to:
- collect a plankton sample, using a plankton net
- observe, draw, and identify a variety of planktonic plants and animals
- describe the importance of plankton in food pyramids

Materials:
Provided by the Refuge:
- 1 plankton net with rope
- 2 plankton net bottles
- 12 petri dishes
- 12 slides
- 12 eyedroppers
- 12 handlenses
- 1 set plankton identification cards
- 1 wooden food pyramid blocks (16 blocks)
- 6 microscopes
- 1 set prepared plankton specimens on glass slides

Provided by the Educator:
- data sheet (p. 206), one per student *(optional).*
- pencils

TIME FRAME FOR CONDUCTING THIS ACTIVITY

Recommended Time: 30 minutes
Introduction (5 minutes)
- discuss the slough habitat
- introduce the terms "phytoplankton" and "zooplankton"
- discuss the use of the plankton net

Collecting Plankton Sample (10 minutes)
- walk to the bridge with the students and the plankton net
- help the students collect two plankton samples

Observing Plankton (10 minutes)
- distribute the plankton samples between the petri dishes
- observe and identify plankton, using the hand lenses and microscopes
- ask discussion questions while observations are being made

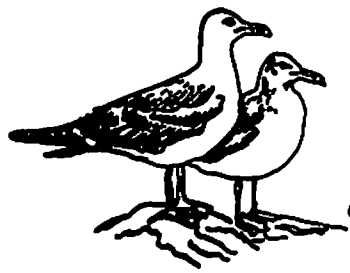
Building a Food Pyramid (5 minutes)
- hand out wooden food pyramid blocks
- guide the students through construction of the slough and mudflat food pyramid

HOW THIS ACTIVITY RELATES TO THE REFUGE'S RESOURCES

What are the Refuge's resources?
- significant wildlife habitat
- endangered species
- migratory birds

What makes it necessary to manage the resources?
- Pollution, such as oil, paint, and household cleaners, when dumped down storm drains enters the slough and travels through the food chain, harming animals.

What can students do to help?
Refuge staff study pollutants found in the Bay to see how they affect wildlife, but we need your help.
- Never dump anything down storm drains.
- Label storm drains with warnings.
- Tell others what you have learned.



California Gull

Supporting Information for This Activity

Slough

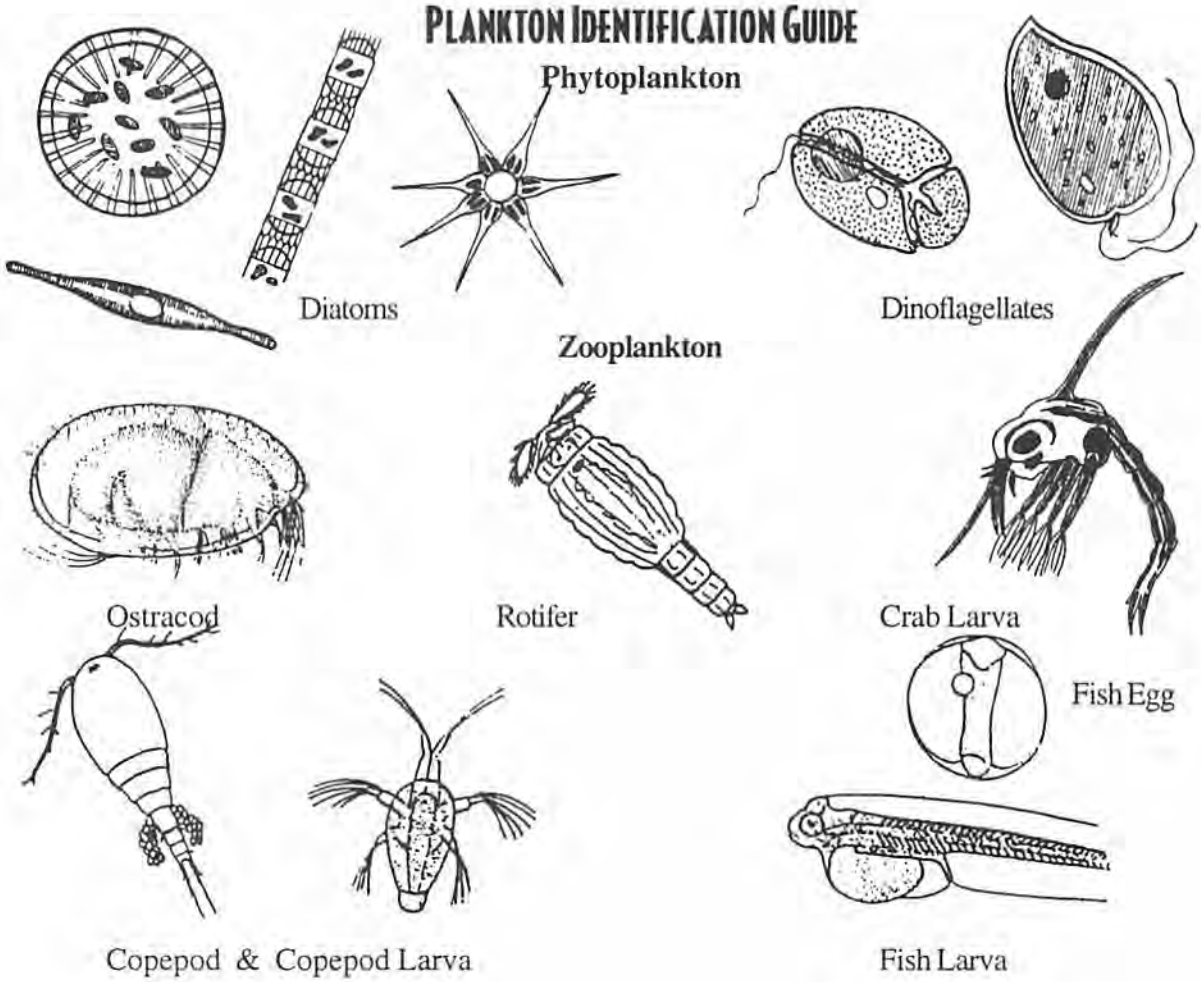
- If the palm of one's hand is used to represent San Francisco Bay, tidal sloughs may be thought of as "fingers of the Bay," winding through the salt marshes.
- Sloughs are natural waterways that carry water from the Bay into salt marshes as the tide comes in, and returns the water to the Bay as the tide goes out.
- Sloughs carry Bay water into the marshes twice a day during the flood (incoming) tide and back to the Bay twice a day during the ebb (outgoing) tide.
- Mudflats appear in the slough channels during when ebb tide.
- Tidal waters transport detritus (decomposing marsh plants and animals), phytoplankton (small, drifting plants, and zooplankton (small, drifting animals).
  - Detritus and plankton form the base of food pyramids in the slough, mudflats, and open Bay, supporting mud creatures, fish, waterbirds, shorebirds, harbor seals, birds of prey, and even humans.
- Phytoplankton exists in high abundance in estuaries, such as the San Francisco Bay, where the combination of river currents and tidal currents trap the nutrients necessary for plankton growth.

Plankton

- The word "plankton" comes from the Greek word *planktos* meaning "drifting."
  - This ecological term refers to the community of plants and animals that drift in both fresh and marine bodies of water.
  - Currents and tides carry plankton through the water.
  - Some plankton are fairly large, such as jellyfish, but most are microscopic in size (not visible by the naked eye).
- Planktonic plants are called **phytoplankton**.
  - The primary importance of these plants, like plants on land, is their ability to photosynthesize. Using chlorophyll, they capture the energy of the sun to make food, releasing oxygen in the process.
    - Virtually all aquatic life depends upon these microscopic single-celled organisms for food. Phytoplankton is the main source of food for zooplankton.
    - Phytoplankton also contribute a significant portion of the oxygen found in the air we breathe.
- There are three main types of phytoplankton: nanoplankton, diatoms, and dinoflagellates.
  - The **nanoplankton** are defined by their extremely small size. Nanoplankton's importance has only recently been discovered—off the central California coast; for example, nanoplankton account for 60-99% of the food and oxygen produced!
  - **Diatoms** are much larger than nanoplankton, yet it still takes a microscope to see them.
    - They are single-celled algae encased in two-part silicon (glass-like) shells.
    - Like all plants, diatoms need sunlight. They have various adaptations to keep them near the surface and near sunlight.
      - Increasing surface area is one strategy for retarding sinking. Diatoms may have long spines, may be round and flat, or may form long chains.
      - Diatoms can also regulate their density. Some contain oils while others may have a gas bubble inside their bodies.
  - **Dinoflagellates**, while considered members of phytoplankton, have characteristics of both plants and animals.
    - Like plants they contain chlorophyll which allows them to convert sunlight into food and they have a plantlike cell structure.
    - However, like animals, many varieties eat microscopic pieces of matter found in the water. Some dinoflagellates even eat each other! Dinoflagellates also have two whiplike appendages which provide some mobility.
    - Some dinoflagellates produce a toxin which causes mussel poisoning. During the summer months, mussels or other shellfish eat large amounts of these dinoflagellates. Quarantines are established to prevent people from eating these shellfish because they would become seriously ill.
    - A "plankton bloom" or plankton population explosion, results when the water is unusually rich in nutrients.
      - Some species of dinoflagellates may occur in such numbers that they color the water a dark red, otherwise known as "red tides."

- Some red tides may result in the death of large numbers of fish, because the plankton use up so much oxygen; there is not much left over for other marine organisms.
- Dinoflagellates are luminescent at night, producing a soft glow when the water in which they float is disturbed.

- Planktonic animals are referred to as **zooplankton** (zoo is pronounced like toe). Many zooplankton are able to move up and down in a water column, pursuing food and escaping predators. However, their small size prevents them from moving against the currents.
  - Some zooplankton live their entire lives as part of this drifting community.
    - **Copepods** are the most numerous of all animals; they are small crustaceans that grow to 2 mm long and use their long, sensory antennae as rudders to direct movement.
    - **Ostracods** are also small crustaceans, with a hinged, two-sided carapace (shell) that resembles a clam. Their antenna are used as sensors and to assist in swimming. Ostracods crawl along surfaces using two pairs of legs with clawed tips.
    - Another common type of zooplankton are **rotifers.** Rotifers are almost constantly in motion, beating the cilia at their heads to move and to bring food to their mouths. When feeding, rotifers attach themselves to a bit of debris and the rapid beating of the cilia draws a current of water towards the mouth.
  - Other species of zooplankton are planktonic (drifters) only as **eggs or larvae**, then become free swimming or sedentary (stay in one place) during their adult stages. Among the myriad of organisms included in this latter group are sea urchins, sea stars, crabs, barnacles, clams, mussels, sea snails, and many species of fish.



How to Lead This Activity by Following the "Do, Read, Ask" Teaching Format

Introduction (5 minutes)

Read

"We are going to study the microscopic life of the slough habitat and its importance in this slough food pyramid."

Ask

? **What is a definition for "habitat"?** (A habitat is a home for a plant or animal. A habitat provides food, water, shelter, and space suitable to the organism's needs.)

? **What is the slough?** (If the palm of one's hand is used to represent the San Francisco Bay, tidal sloughs may be thought of as "fingers of the bay," winding through the salt marshes. It is a natural waterway that carries bay water into and out of the marsh with the tides.)

? **What are some animals that live or feed in the slough?** (Several different kinds of fish, including gobies and smelt, mud creatures, such as crabs, mussels, clams, and snails, and many different types of birds, including egrets, herons, terns, shorebirds, and ducks.)

? **What are the small animals drifting in the water of the slough called? You need a microscope to see some of these animals.** (Zooplankton.)

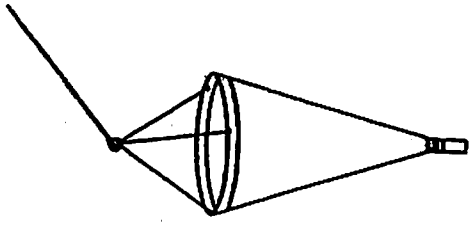
? **What are the small, drifting plants living in the slough water called?** (Phytoplankton.)

Read

"There are many different types of phytoplankton and zooplankton living in the slough. We are going to collect our own plankton samples at the slough, using a plankton net. We will bring the samples back to the table so that we can study the plankton, using microscopes."

Do

Show the students the plankton net.



Read

"The thin netting of the plankton net will allow water to flow through, but not all of the plankton. Very small plankton will be able to get through the netting, but larger plankton will be collected in the bottle attached to the bottom of the net."

Collecting the Plankton Sample (10 minutes)

Do

Take the plankton net and two of the plankton net bottles and walk with the group of students to the bridge that crosses the slough. Attach one of the plankton bottles to the bottom of the plankton net.

Ask

? **What is the color of the slough?** (Green-Brown.)

? **What factors alter the water color of the slough?** (The phytoplankton that grow in the water, the amount of small particles that are suspended in the water, water depth, and the soil color.)

Read

"I need one student to tie the end of the string connected to the plankton net to the bridge railing, so we won't accidentally lose the plankton net. I need another student to throw the plankton net into the slough."

Do

After the student throws the plankton net into the slough water, allow the net to drag at the top of the water for a couple of minutes, Do not allow the plankton net to drag along the bottom of the slough or the sample will be muddy.

Read

"I need two students to work together to pull up the plankton net and sample."

Do

- When the sample is pulled in, remove the bottle from the bottom of the net. Be careful to not spill the sample. Put a lid on the bottle.
- Put a new, empty bottle on the plankton net. Collect one more sample, allowing different students to participate in the collection. Walk back to the study area with the plankton net and the two samples.

Observing the Plankton Sample (10 minutes)

Do

Back at the study area, distribute the plankton sample (from the plankton bottles) among the students' petri dishes (put very little water in each of the petri dishes).

Have the students observe their samples under the microscopes. Encourage students to move their dish around under the microscope in order to examine the entire sample.

If copies of the plankton data sheet and pencils were provided by the teacher, direct the students to draw several of the organisms they see under the microscope.

Using the plankton identification cards on the table, instruct the students to attempt to identify each organism they draw or find. Do not worry if they cannot find the exact species— there are thousands of different kinds of plankton. For example, there are some 20,000 different species of diatoms!

While observations are being made, ask the students the following questions.

Ask

? **What is a definition for "plankton"?** (Plants or animals that drift in water.)

? **How do plankton move?** (Plankton, as their Greek name "planktos" tells, drift in the water. Currents and tides carry them from place to place.)

? **What is the difference between phytoplankton and zooplankton?** (Zooplankton are animals (consumers) and phytoplankton are plants (producers).)

? **Can you describe a food chain in the slough, having at least 3 members, including phytoplankton and zooplankton? Hint: the producers need to be on the bottom** (One example: phytoplankton —> zooplankton —> fish —> people.)

? **Are diatoms a type of zooplankton or phytoplankton?** (Phytoplankton. Diatoms are single-celled algae encased in silicon (glass-like) shells.)

? **Why is it important for diatoms (phytoplankton) to float near the surface, rather than sink to the ocean bottom?** (Diatoms need sunlight to make food. Floating near the surface allows them to capture as much light as possible.)

? **Dinoflagellates convert sunlight into food using chlorophyll and they eat microscopic matter in the water. They also have two whip-like appendages which allow some mobility. Are dinoflagellates phytoplankton or zooplankton?** (They are actually considered plants, but they have characteristics of both plants and animals.)

? **What part of a life cycle of a fish could be considered a zooplankton: eggs, juvenile, or an adult?** (Eggs. Many aquatic animals are planktonic (drifters) as eggs or larvae, then become free swimming or stay in one place during their adult stages, including crabs, clams, mussels, barnacles, snails, and many fish species.)

? **Can you think of an example of a very large animal in the ocean that feeds only on plankton?** (Some baleen whales, such as humpbacks and blue whales, feed primarily on krill, a zooplankton.)

? **What is the connection between phytoplankton and oxygen?** (Phytoplankton are the prime producers of oxygen. Without them the Earth's atmosphere would lose a major source of oxygen.)

? **Why is plankton important to humans?** (We breath oxygen produced by phytoplankton, we eat fish, shellfish, and ducks that depend on plankton.)

? **How are phytoplankton important to all life in the Bay and the sloughs?** (Phytoplankton are the base of Bay and slough food pyramids, along with detritus (decomposing marsh plants). Phytoplankton and detritus support mud creatures, fish, and birds.)

Building a Food Pyramid (5 minutes)

Do

Ask the students to set aside their samples and clear table center to have room for constructing a slough and mudflat food pyramid from the wooden blocks.

Read

"We have been studying the plankton that lives in the slough. Next we are going to build a food pyramid."

Ask

? **What is a food pyramid?** (A food pyramid represents passage and loss of energy as levels of producers and consumers feed on each other.)

Do

Pass out one or two wooden blocks to each student

Do
Pass out one or two wooden blocks to each student (16 blocks total). Guide students through the construction of the food pyramid (see illustration below).

Ask
? What is at the base of any food pyramid? (Plants, which produce their own food or energy from sunlight.)
? What are the producers in the slough? (Phytoplankton (tiny, drifting plants) and detritus (decomposing marsh plants).)

Do
Ask the students with the blocks labeled **phytoplankton** and **detritus** to put together the first level of the food pyramid on the table.

Ask
? Feeding on the producers are the first level of consumers. What are the small, drifting animals that feed on phytoplankton and detritus? (Zooplankton.)

Do
Ask the students with **zooplankton** blocks to construct the second level of the pyramid.

Ask
? What animals will feed on the detritus, phytoplankton and zooplankton in the slough? (Mud creatures (crabs, clams, mussels, snails, and worms), and fish (gobies and smelt).)

Do
Ask the students with the **mud creature** and **fish** blocks to construct the third level of the food pyramid, on top of the zooplankton.

Ask
? What animals will feed on the mud creatures and fish? (Birds. Shorebirds - such as dowitchers and sandpipers - and ducks feed on mud creatures, egrets and herons feed on fish and large mud creatures.)

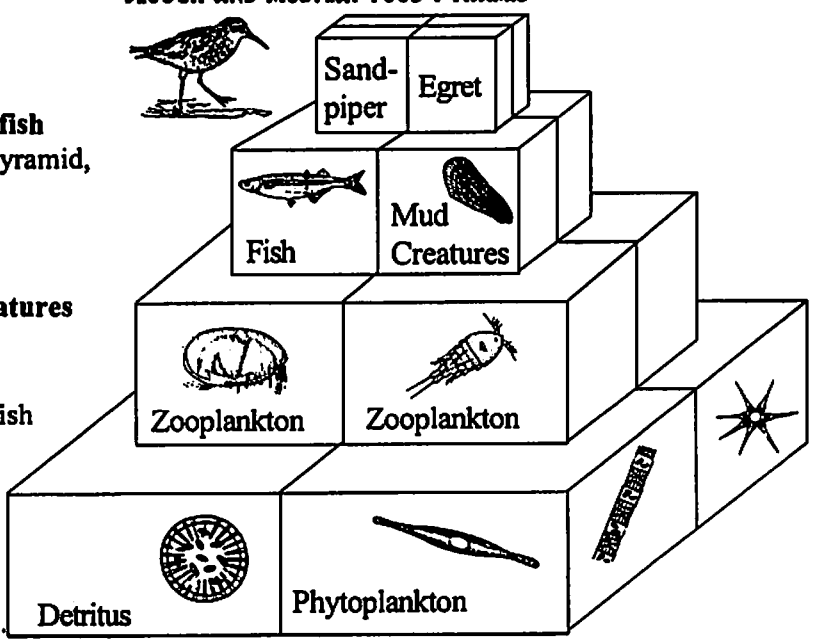
Do
Ask the students with the **bird** blocks (**duck, dowitcher, egret,** and **sandpiper**) to complete the construction of the food pyramid.

Ask
? Do you think plankton is important? (Plankton is a primary source of food for many animals. Without plankton, many animals would starve. Phytoplankton produces oxygen that humans and other animals breath.)
? What happens when pollution, such as motor oil, paint thinner, or pesticide, is poured down storm drains? Could this pollution affect plankton? (Storm drains run directly to creeks and rivers which drain to San Francisco Bay. The plankton in the Bay and sloughs can be killed by pollution or plankton can absorb or eat pollution and then be eaten by mud creatures and fish which are then eaten by birds, causing health problems in the fish, mud creatures, and birds.)
? What would happen to the food pyramid we built if the plankton died because of pollution? (The food pyramid would collapse.)

Do
Have two students pull out the two phytoplankton blacks to make part of the food pyramid collapse.

Ask
? What can you do to prevent pollution from entering the slough? (Tell others not to put pollutants down the storm drain by recycling motor oil and taking leftover paint thinner and pesticides to designated hazardous waste centers.)

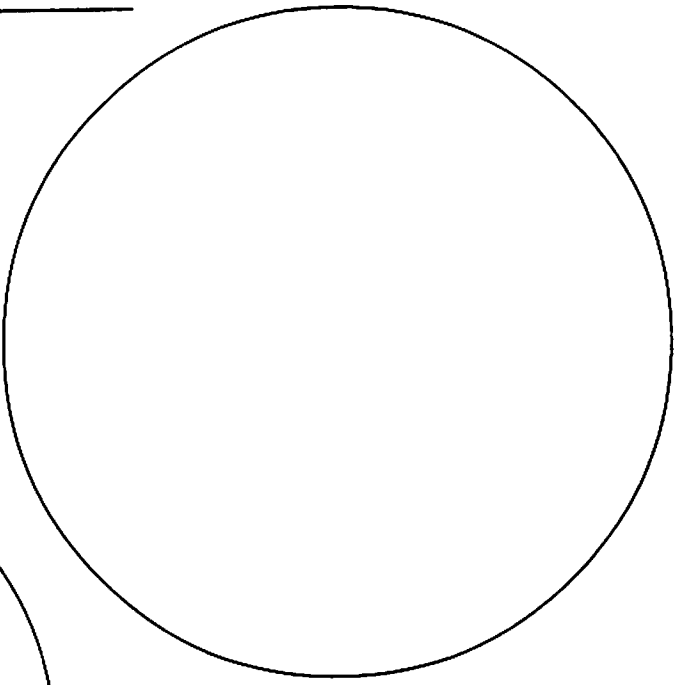
SLOUGH AND MUDFLAT FOOD PYRAMID



Plankton Lab Data Sheet

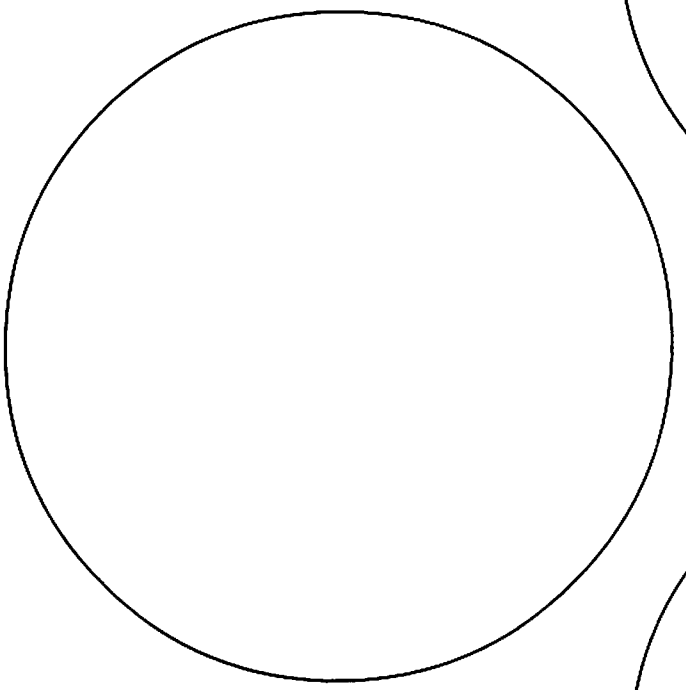
Your Name:_____

Draw and identify any plankton that you discover.



Circle one: Phytoplankton or zooplankton

Name:_____



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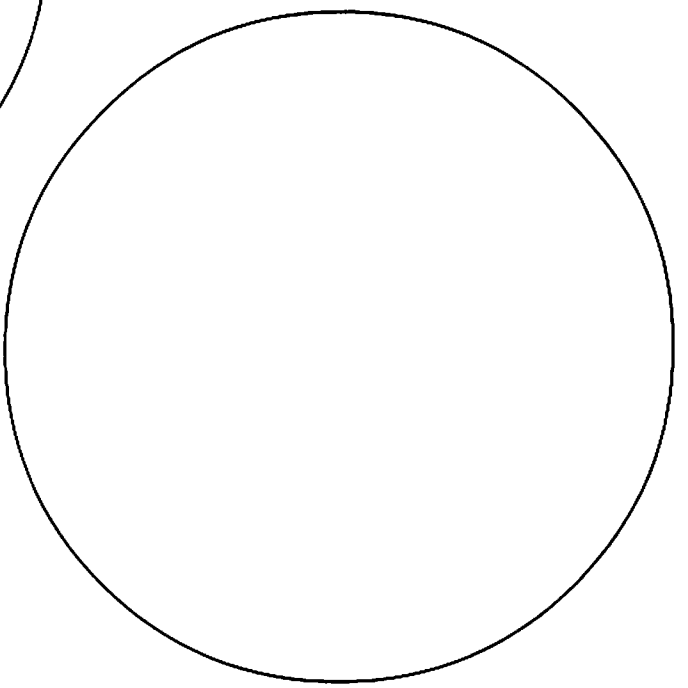

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