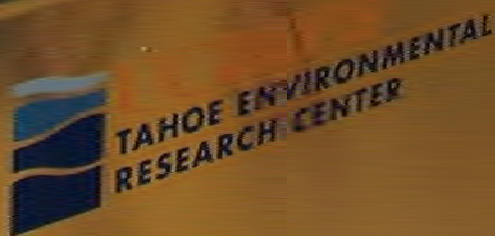


JUNIOR LIMNOLOGIST CHALLENGE

ANSWER KEY



UC DAVIS
Tahoe Environmental
Research Center

BECOME A JUNIOR LIMNOLOGIST!

Name

Name

Date

Date

Limnology is the study of fresh water bodies, such as lakes and ponds.

Earn your Junior Limnologist certificate by completing the activities in this book while exploring the UC Davis Tahoe Science Center. Present your completed book to a volunteer docent or staff member to sign your official Junior Limnologist certificate and receive a prize.

Completing the Junior Limnologist challenge will provide you with the scientific knowledge and decision-making skills that will help protect Lake Tahoe and other lakes around the world.

Find answers to the questions by visiting all of the exhibits, trying the hands-on activities, taking a tour with a docent, or talking to a scientist.

Take the Junior Limnologist challenge and begin your investigation today!



WE ALL LIVE IN A WATERSHED

What is a watershed? A watershed is the area of land where water flows to the same waterbody (lake, river, stream, or ocean).

Multiple choice: Why is Lake Tahoe so clear?

- A. Small size of the watershed
- B. Granitic soil in the watershed is low in nutrients
- C. Wetlands around the lake filter dirty water
- D. Human efforts to protect the watershed
- ☒ E. All of the above.

Circle one:

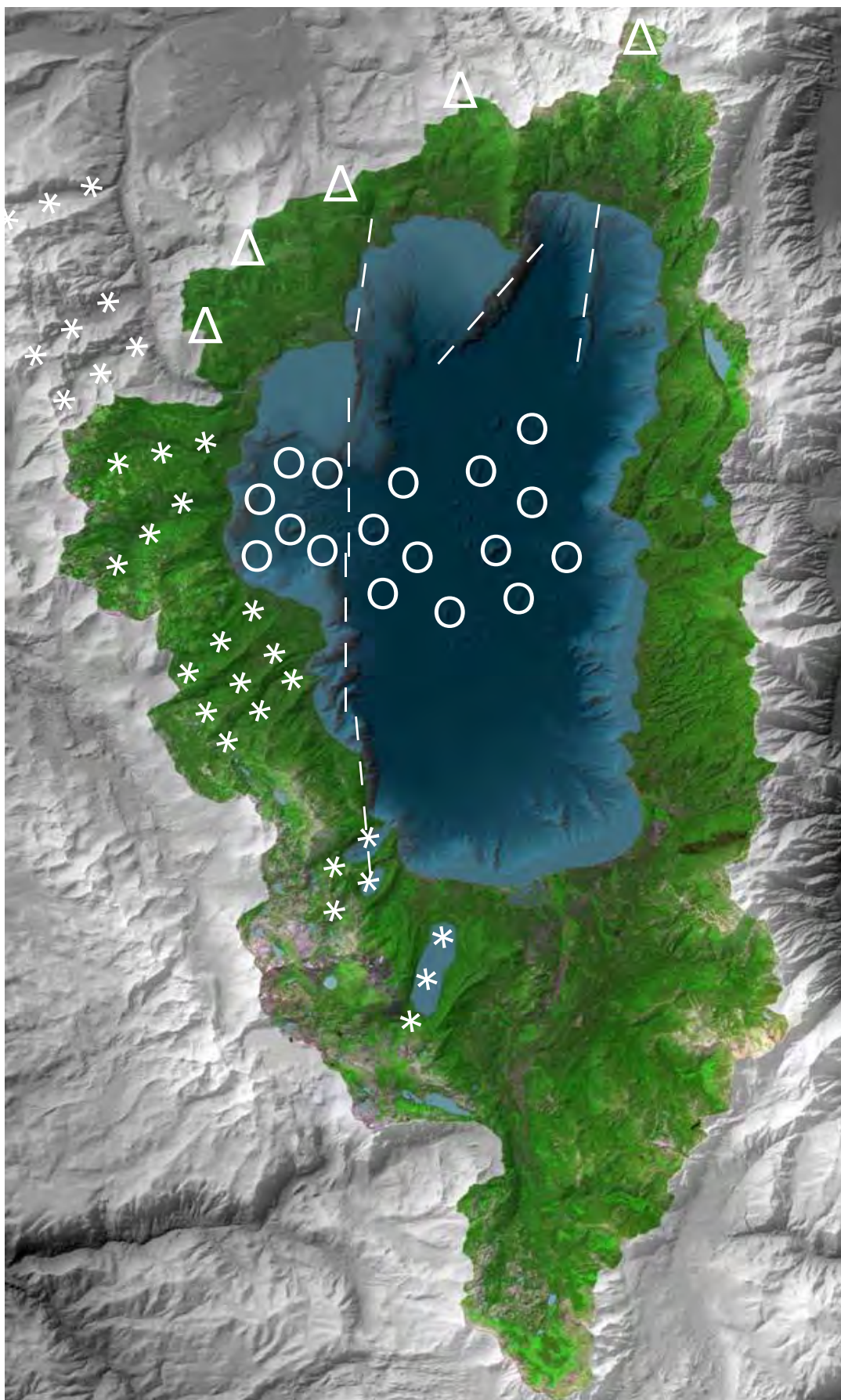
☒ True or False: Everyone lives in a watershed.

☒ True or False: Nearly one-third of all of the rain and snow that falls within the Lake Tahoe Watershed falls directly onto the lake without touching soil or sediment.



LAKE TAHOE WATERSHED MAP

Color the lake in blue and the lake's watershed in green.



LAKE TAHOE

Check out the large *Lake Tahoe Watershed Map* on the wall in the lobby. The Lake Tahoe Basin was formed by **faulting** and **volcanoes** on the north shore, and **glaciers** and a **landslide** on the west shore.

Mark the following features on the *Lake Tahoe Watershed Map* to the left using the symbols on the map key below:

— — — — Faults
(Can you name the three Tahoe faults?)

(1) **West Tahoe Fault**

(2) **Stateline Fault**

(3) **Incline Fault**

* * * * Glaciers

○ ○ ○ ○ Landslide

△ △ △ Volcanoes

What other observations can you make looking at the *Lake Tahoe Watershed Map*?

GEOLOGY WORD

Geologists study the rocks, minerals, fossils, landforms, and the layers of the Earth's surface.

Draw a line to connect the geology word to its definition.

Earthquake

Fault

Volcano

Glacier

Landslide

Tsunami

Erosion

Seismometer

MATCH

Geologists also study events that have changed and shaped the Earth over time.

The process of land being weathered or worn down by wind, water, or ice.

A large amount of earth, rock, and other material that breaks away and slides down a steep slope.

An instrument that records earthquake waves.

The shaking, rolling, or sudden movement of Earth's crust caused by a release of energy.

A line in the Earth's crust where earthquakes occur.

A large mass of ice moving slowly down a slope.

A mountain formed by molten rocks or magma erupting through the surface.

A large wave usually caused by an underwater earthquake or landslide.

TAHOE ROCKS!

Tahoe has two primary rock types. Try to find examples of them as you explore the science center or Lake Tahoe. Compare your observations to the descriptions below.

Color the *Rock Around Tahoe Map* on Page 9 to the right. Color volcanic rock red and color the granitic rock gray.

Volcanic



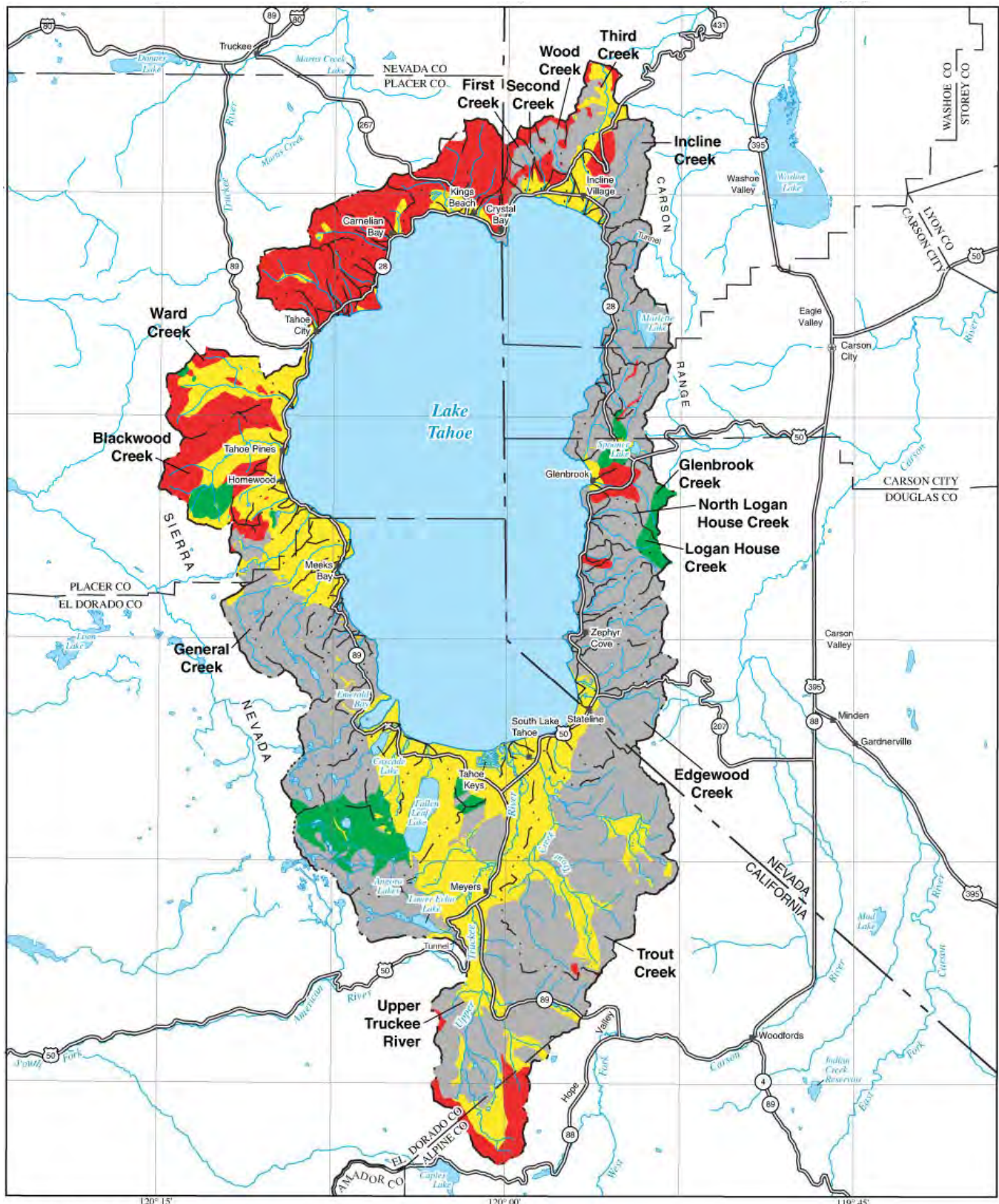
- May contain small holes
- Same color throughout entire rock
- Solid color of black, gray, or red
- Less dense (lighter)
- Example of extrusive igneous rock
- Cools above the Earth's surface

Granitic



- Made up of 3 different minerals (mica, feldspar, and quartz)
- Speckled colors include black, pink, and white (sometimes looks like cookies and cream)
- More dense (heavy)
- Example of intrusive igneous rock
- Cools beneath the Earth's surface

ROCK AROUND TAHOE MAP



Base from U.S. Geological Survey digital data, 1:24,000 and 1:100,000, 1969-85
 Universal Transverse Mercator projection,
 Zone 10

EXPLANATION

- Metamorphic
- Granitic
- Volcanic
- Unconsolidated

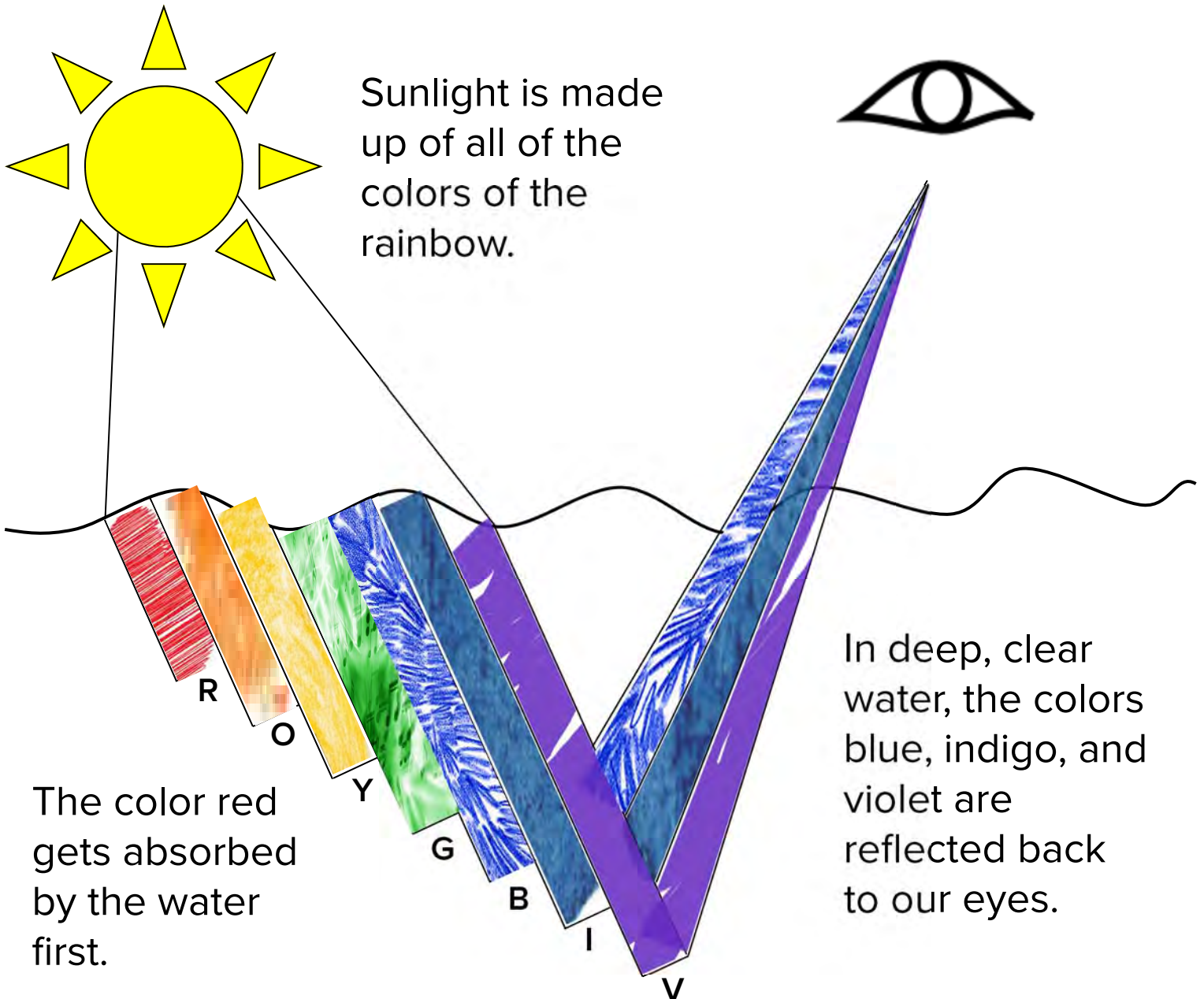
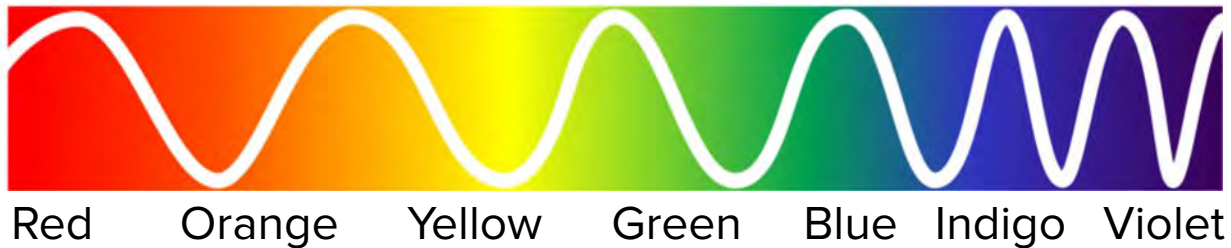
- Boundary of Lake Tahoe Basin
- Boundary of subbasin

0 5 10 KILOMETERS
 0 5 10 MILES

WHY IS TAHOE BLUE?

Since Lake Tahoe has very little sediment or algae, the water is very clear. This makes the lake appear blue to our eyes.

Color the diagram below!



MEASURING CLARITY

The clarity at Lake Tahoe is measured by lowering a 10-inch white disc, called a Secchi disc (pronounced sek-ee), into the water and measuring the depth to which it remains visible.



Secchi disc

Find the *Measuring Clarity* hands-on exhibit and try measuring clarity yourself using the mini Secchi discs.

- Which water sample has the best clarity? Lake Tahoe
- Which water sample has the worst clarity? Sediment or Algae & sediment

Name two things that can decrease the clarity of water.

- 1) Sediment
- 2) Algae (and the nutrients that cause it to grow)



Boat captain Brant Allen measuring Secchi depth on Lake Tahoe

TAHOE CLARITY

Now that you know that sediment and algae decrease clarity in the lake, decide which activities below might cause more sediment or algae to get into the lake.

Which of these activities help clarity? A C H I

Which of these activities harm clarity? B D E F G



A) Biking to school



B) Off-roading



C) Picking up dog poop



D) Fertilized lawn



E) Erosion



F) Littering



G) Car exhaust



H) Native plants



I) Beach clean ups

SECCHI DISK

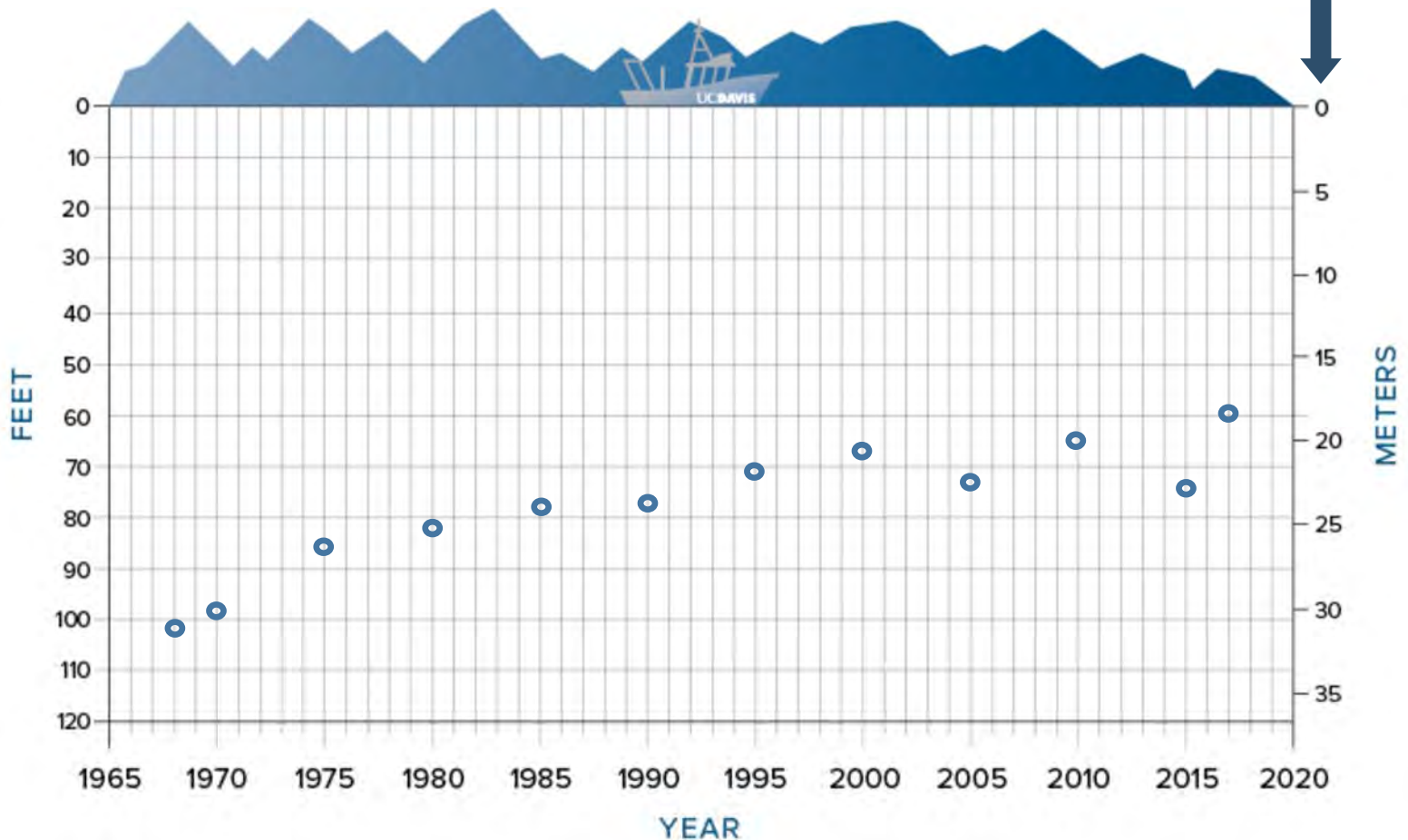
Look at the *Annual Average Secchi Depth* graph located on the *Research Vessel Exhibit*. Is the clarity of Lake Tahoe increasing or decreasing over time?

Fill in the missing data below and the completed data to plot the Secchi depths on the graph:

Year	Depth (ft)	Depth (m)
1968	102	31
1970	99	30
1975	86	26
1980	81	25
1985	79	24
1990	77	24

Year	Depth (ft)	Depth (m)
1995	71	22
2000	67	21
2005	72	22
2010	64	20
2015	73	22
2017	60	18

Note: Secchi depths are plotted with the zero line (water surface) at the top of the graph.

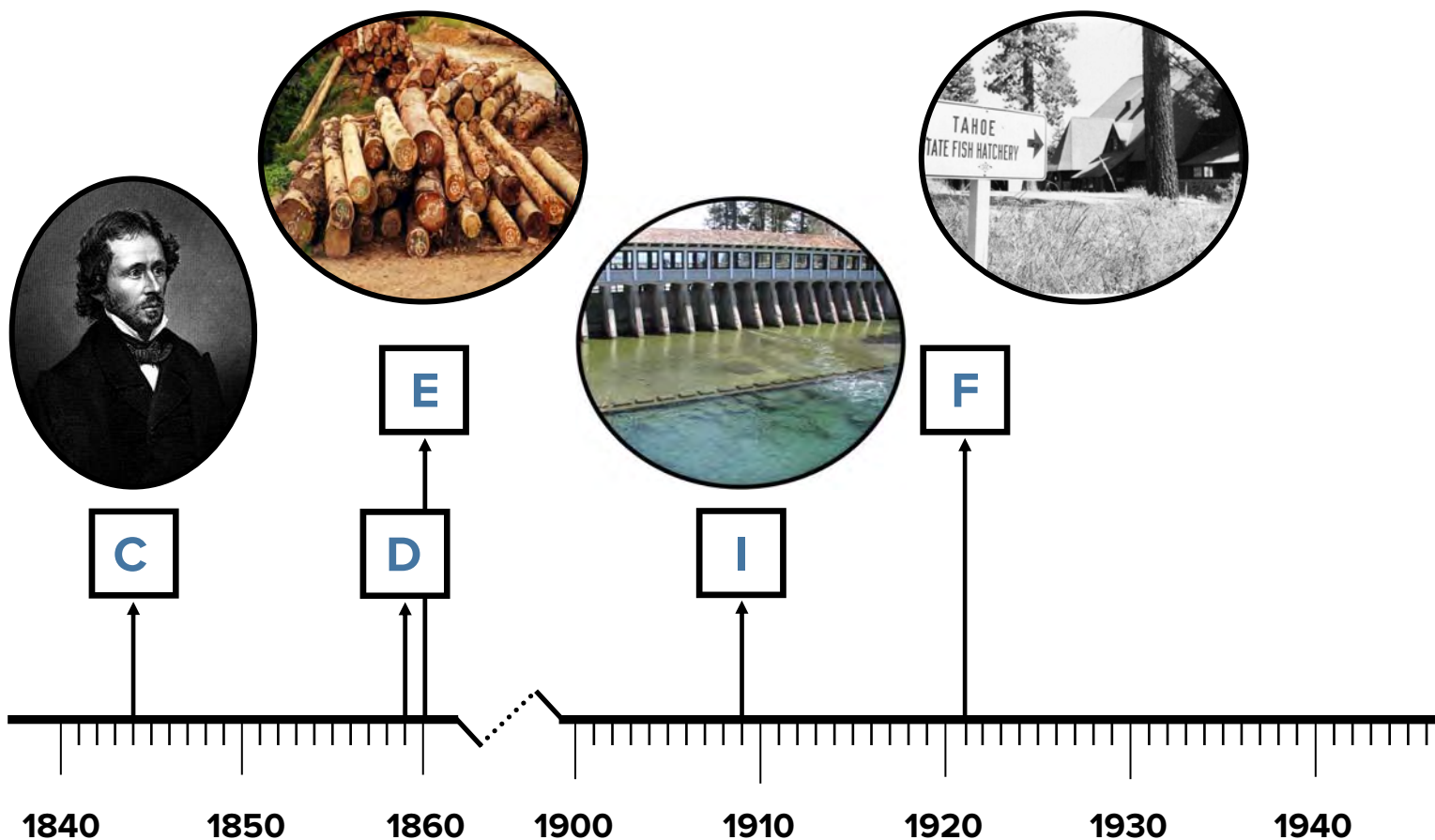


LAKE

Lake Tahoe has a rich and diverse human history, beginning with the Washoe Tribe. The Washoe people inhabited the Lake Tahoe region sustainably for over 6,000 years.

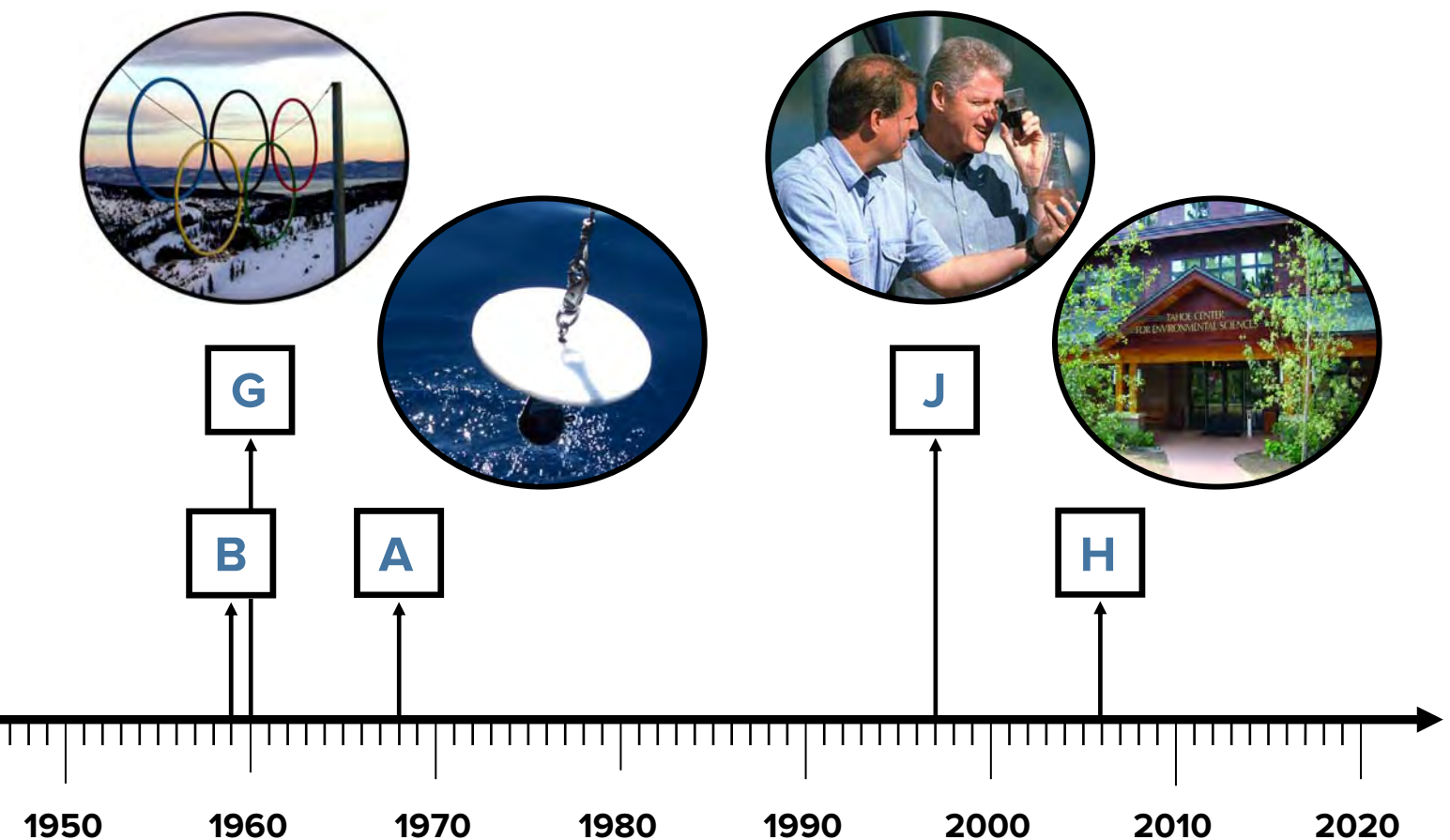
Label the following events at Lake Tahoe from the past on timeline below.

- A. UC Davis measures Lake Tahoe clarity at 102.4 feet (1968)
- B. Construction of Tahoe Keys destroys largest wetland in Tahoe basin (1959)
- C. American explorer John Fremont glimpses Lake Tahoe (1844)



HISTORY

- D. Discovery of silver in Nevada (1859)
- E. Clear-cut logging of the Tahoe Basin provides lumber to build the silver mines (1860)
- F. Tahoe City Fish Hatchery built (1921)
- G. Squaw Valley USA hosts Winter Olympics resulting in increased development (1960)
- H. Tahoe Science Center opens (2006)
- I. Truckee River Dam built to store the top 6.1 feet of water on lake surface (1909)
- J. President Clinton and Vice President Gore visit Lake Tahoe and sign the Lake Tahoe Restoration Act (1997)



RESEARCH IN ACTION

Find the *Research In Action Photo Wall* to see many of the different fields of science conducted at Lake Tahoe.

Write the field of science next to its definition.

<u>Climatology</u>	The study of climates including the causes and long term effects of variation.
<u>Geology</u>	The study of the Earth, the rocks it is made of, and the changes the Earth goes through.
<u>Meteorology</u>	The study of the atmosphere and the effects on our weather.
<u>Biology</u>	The study of living organisms, including their structure, function, growth, origin, evolution, and distribution.
<u>Hydrology</u>	The study of the distribution of water on the Earth's surface and in the atmosphere.
<u>Ecology</u>	The study of distribution and abundance of living organisms and the interactions between organisms and their environment.
<u>Limnology</u>	The study of fresh water bodies, such as lakes and ponds.
<u>Physics</u>	The study of matter, energy, motion and force.
<u>Chemistry</u>	The study of the composition, properties, and reaction of matter.

WORD BANK:	Biology	Ecology	Limnology
	Chemistry	Geology	Meteorology
	Climatology	Hydrology	Physics

INTERVIEW A SCIENTIST

Scientists help answer questions we have about the world.
Interview a scientist to learn more about their job.

1) What field of science are they in?

Answers vary

2) Why did they choose this field of science?

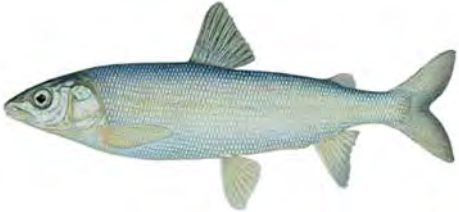
3) What do they enjoy most about their work?

4) What are their concerns or hopes for the future?

LAKE TAHOE NATIVE FISH

Lake Tahoe originally had seven native fish.

Unscramble their names. (Hint: Find the *Species of Lake Tahoe's Aquatic Food Web* poster in the *Lab Exhibit*.)



naoMutni fhheiswti

Mountain whitefish



oahtanLn cathruatot rtuto

Lahontan cutthroat trout



IcekedSp eacd

Speckled dace



haLontna sdreide

Lahontan redside



iTu uhbc

Tui chub



Toaeh kuscre

Tahoe sucker

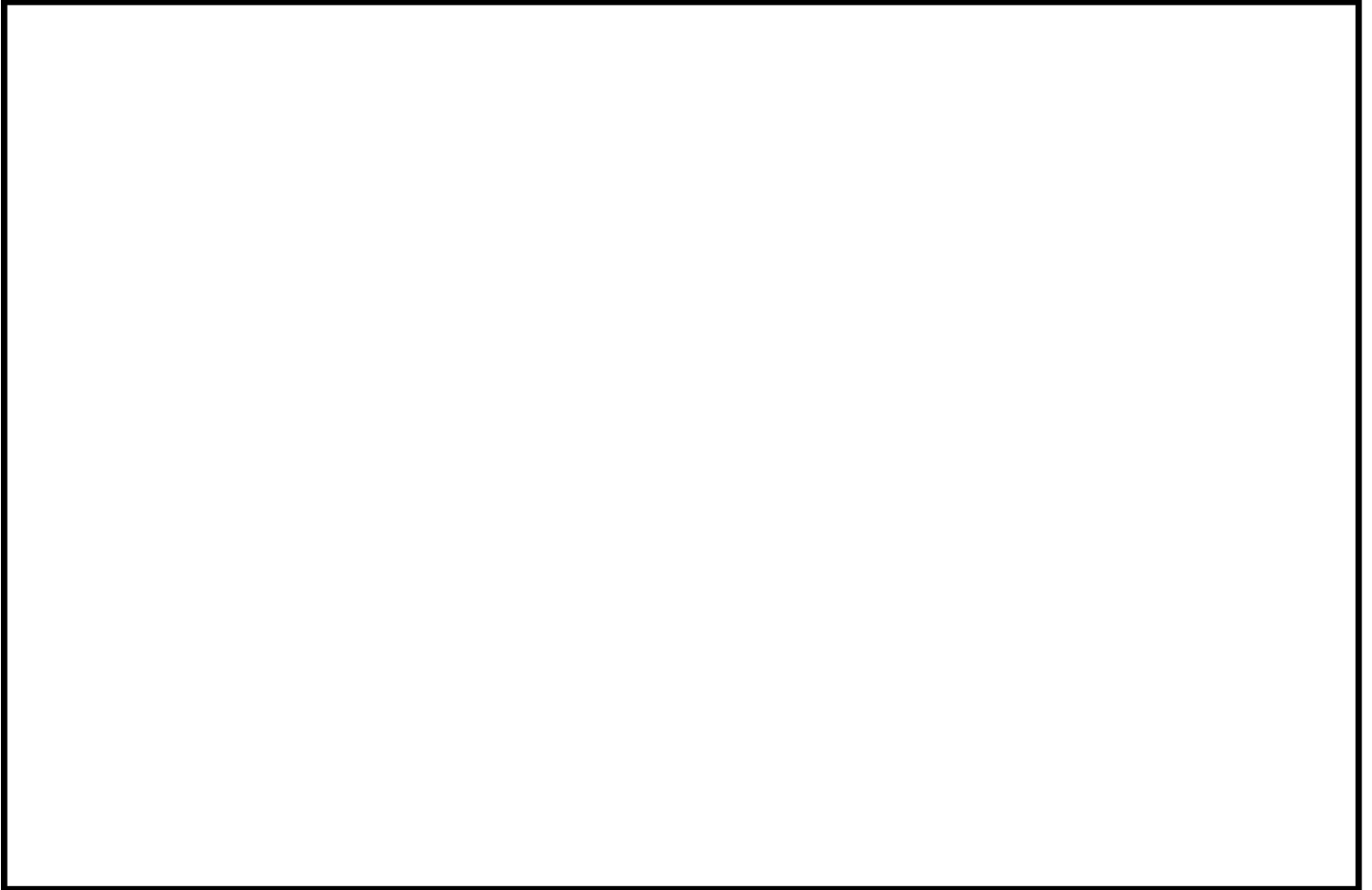


tPauei nsclpui

Pauite sculpin

SOMETHING FISHY!

Find the aquariums and choose a fish to draw.



What fish **species** did you choose? Answers vary

Is your fish **native** or **non-native**? _____

What do you think this fish **eats**? _____

How many **fins** does it have? _____

Label the **mouth**, **eyes**, **gills**, **tail** and **fins** on your drawing!

LAKE TAHOE NATIVE ZOOPLANKTON

Lake Tahoe has four native zooplankton. Zooplankton are tiny organisms that live in the lake and eat algae.

Unscramble their names using the *Species of Lake Tahoe's Aquatic Food Web* poster in the *Lab Exhibit*.



tpuasDiom

Diaptomus



anhaipD

Daphnia



Bmnoasi

Bosmina



hriuEsapc

Epischura

I NOTICE, I WONDER, IT REMINDS ME OF...

Observe the picture below of a non-native Mysis shrimp. You can learn more about the introduction of Mysis shrimp and their effect on Lake Tahoe's food web during the tour!



Scientists make observations, ask questions, and make connections as part of the scientific process. **Be a scientist and explore Mysis shrimp by finishing these sentences:**

I notice...

Answers vary: big eyes, antennae, tail, legs, segmented

I wonder...

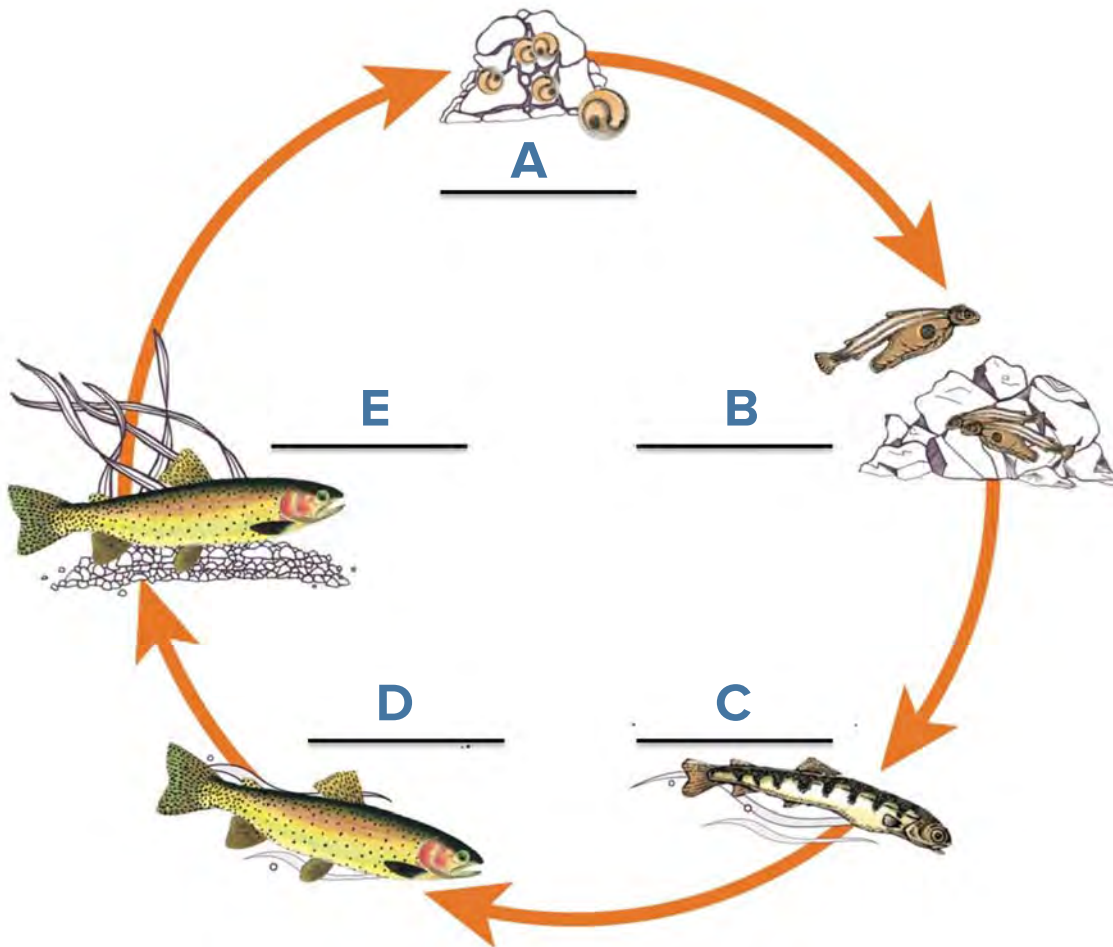
Answers vary: What species? How big is it? What does it eat?

It reminds me of...

Answers vary: a shrimp or other crustacean

LAHONTAN CUTTHROAT TROUT (LCT) LIFE CYCLE

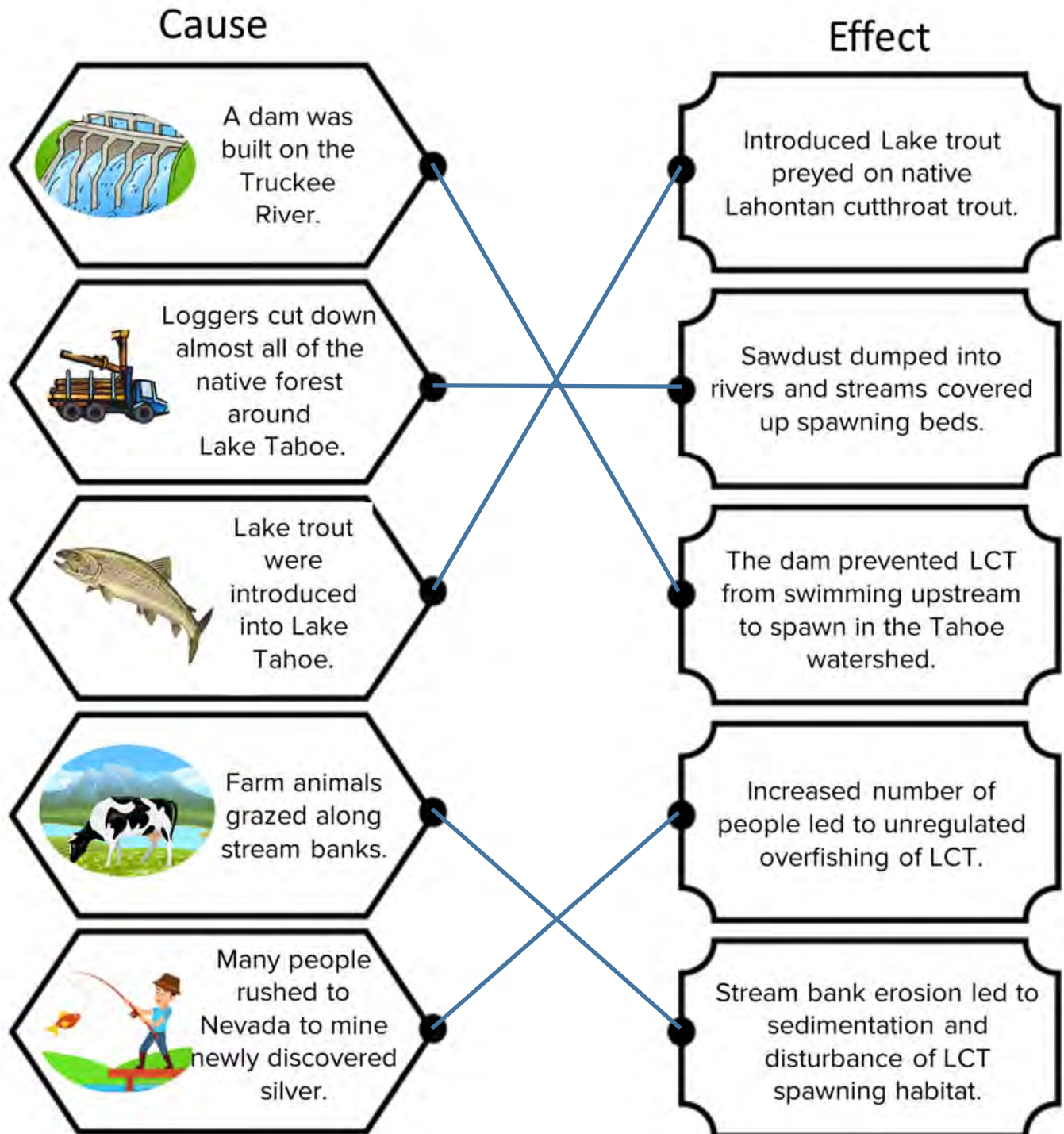
Use the letters below to label the Lahontan cutthroat trout (LCT) life cycle.



- A. **Eggs**—LCT eggs develop in gravel nests called redds.
- B. **Alevins**—After hatching, LCT live in the gravel and get nutrients from their attached yolk sac.
- C. **Fry**—LCT swim up from the gravel, becoming fingerlings when they reach about three inches in length.
- D. **Mature lake form**—LCT migrate downstream to lakes where they live until they spawn.
- E. **Spawning**—LCT return to the streams or rivers where they were born to make their nests and lay their eggs.

WHERE DID LAHONTAN CUTTHROAT TROUT GO?

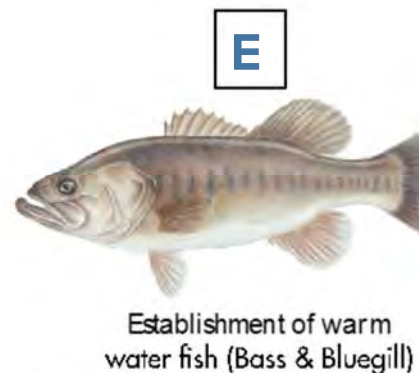
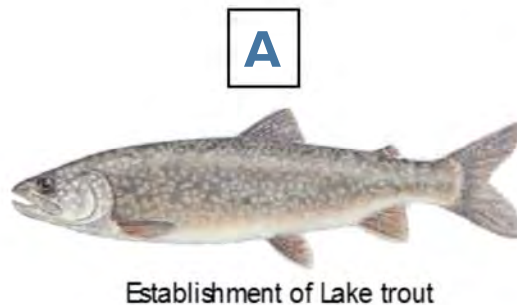
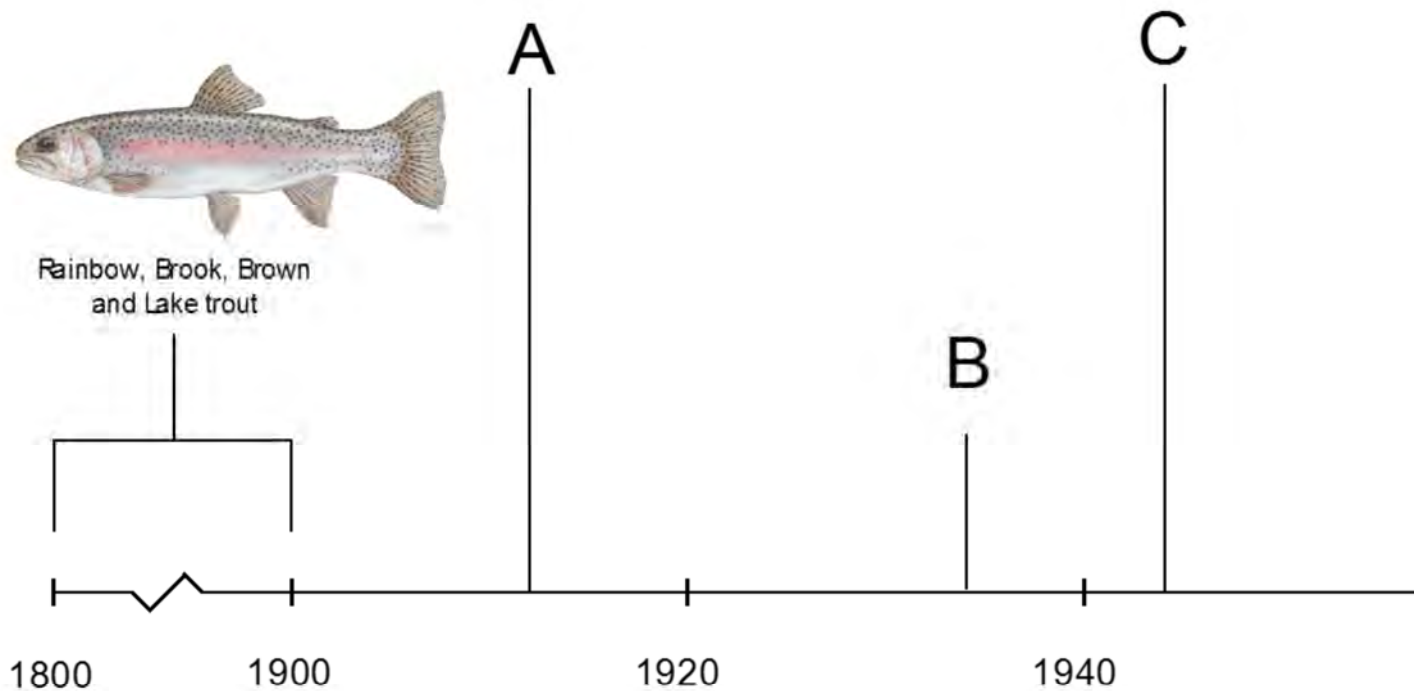
Determine why Lahontan cutthroat trout (LCT) disappeared from Lake Tahoe by **drawing a line to match each cause with its effect.**



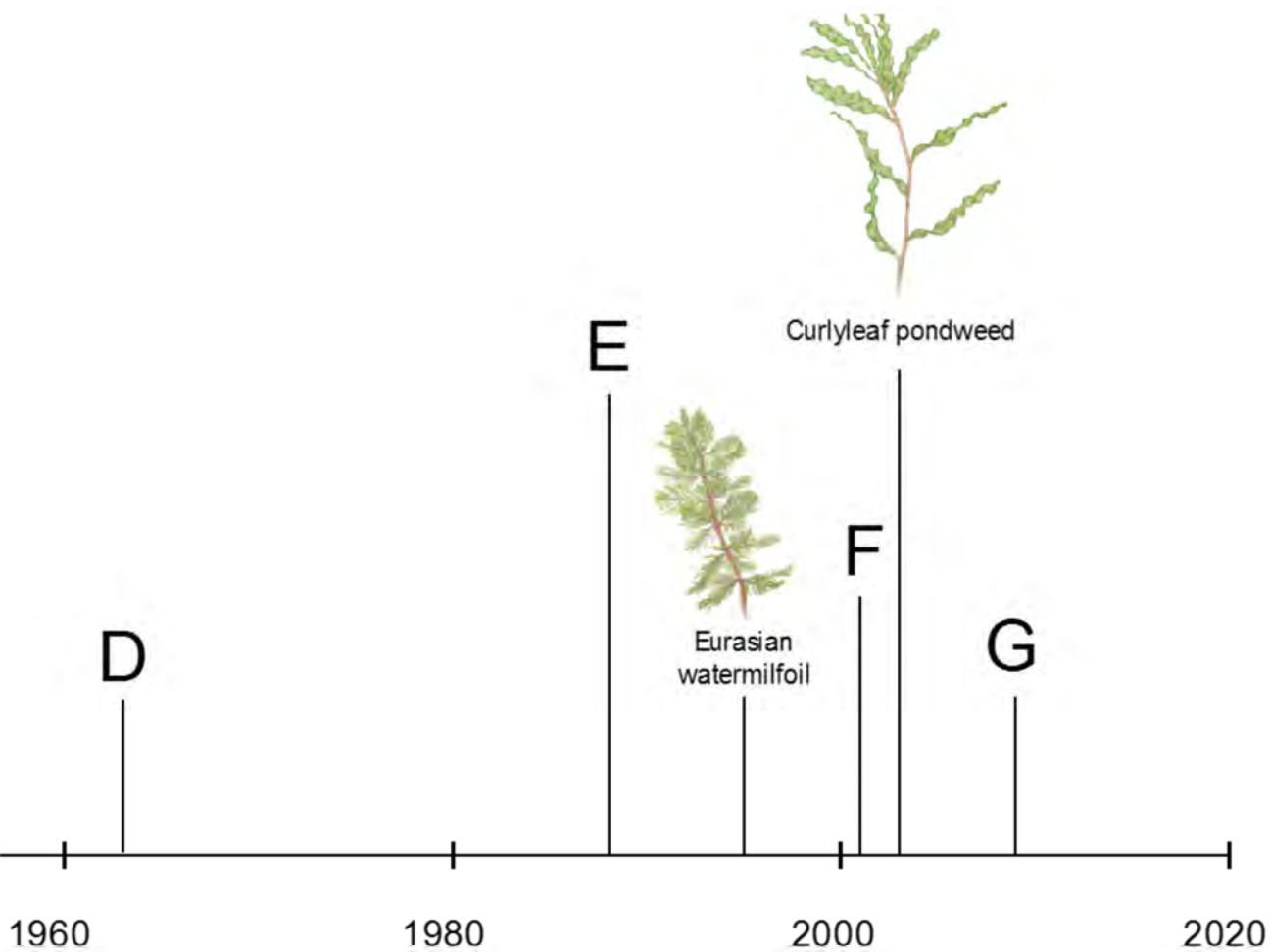
NON-NATIVE SPECIES

Many non-native species have been introduced to Lake Tahoe. Go to the *Laboratory Exhibit* and find the *Lake Tahoe Species Introduction* poster to the right of the aquarium on the counter.

Match each letter on the timeline with the species below.



IN LAKE TAHOE



G



Goldfish

C



Kokanee salmon

D

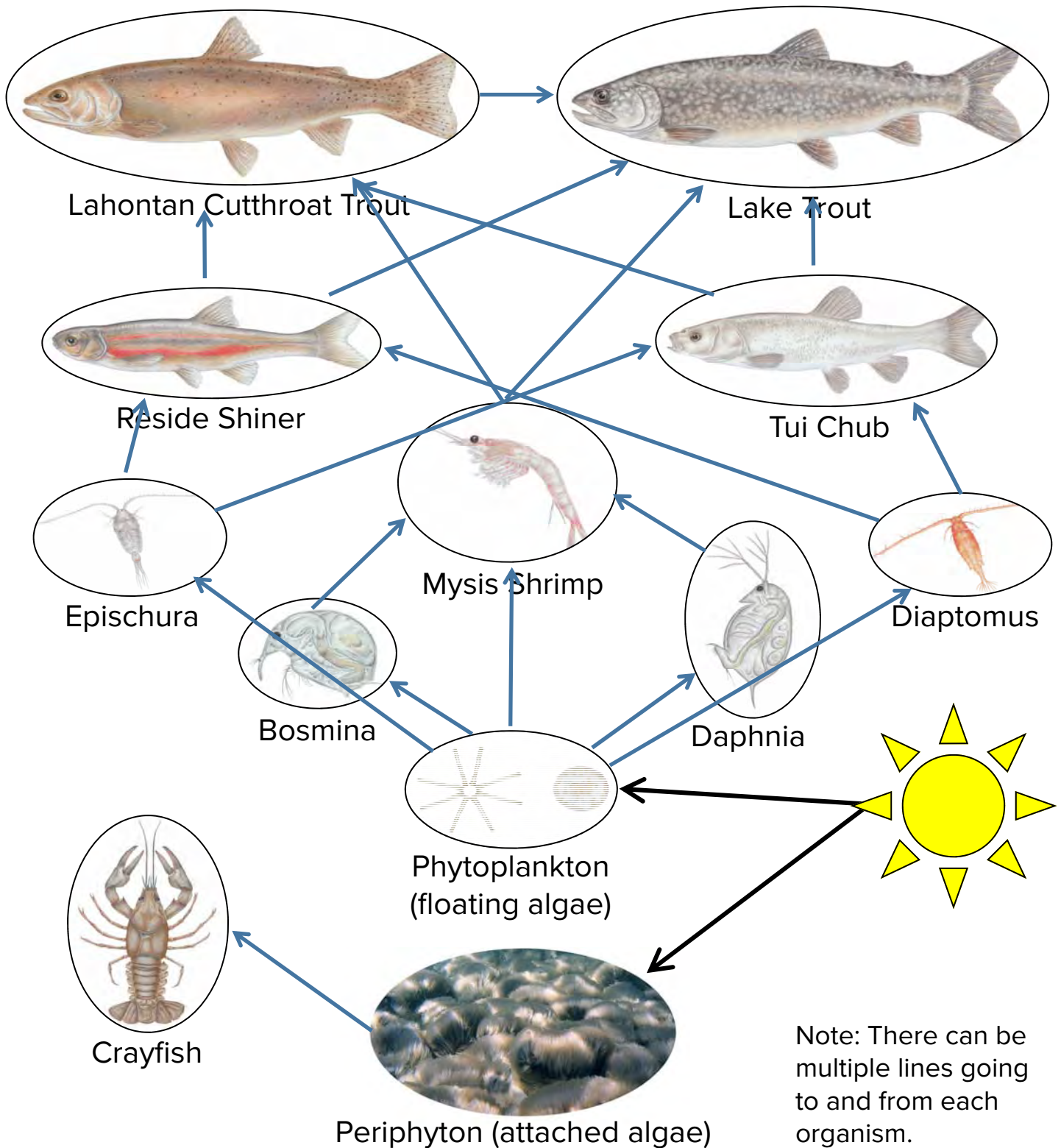


Mysis shrimp

STUDYING THE FOOD WEB

Energy flows from one organism to another through what they eat, with plants (algae) getting energy from the sun.

Draw lines showing energy flow between organisms.



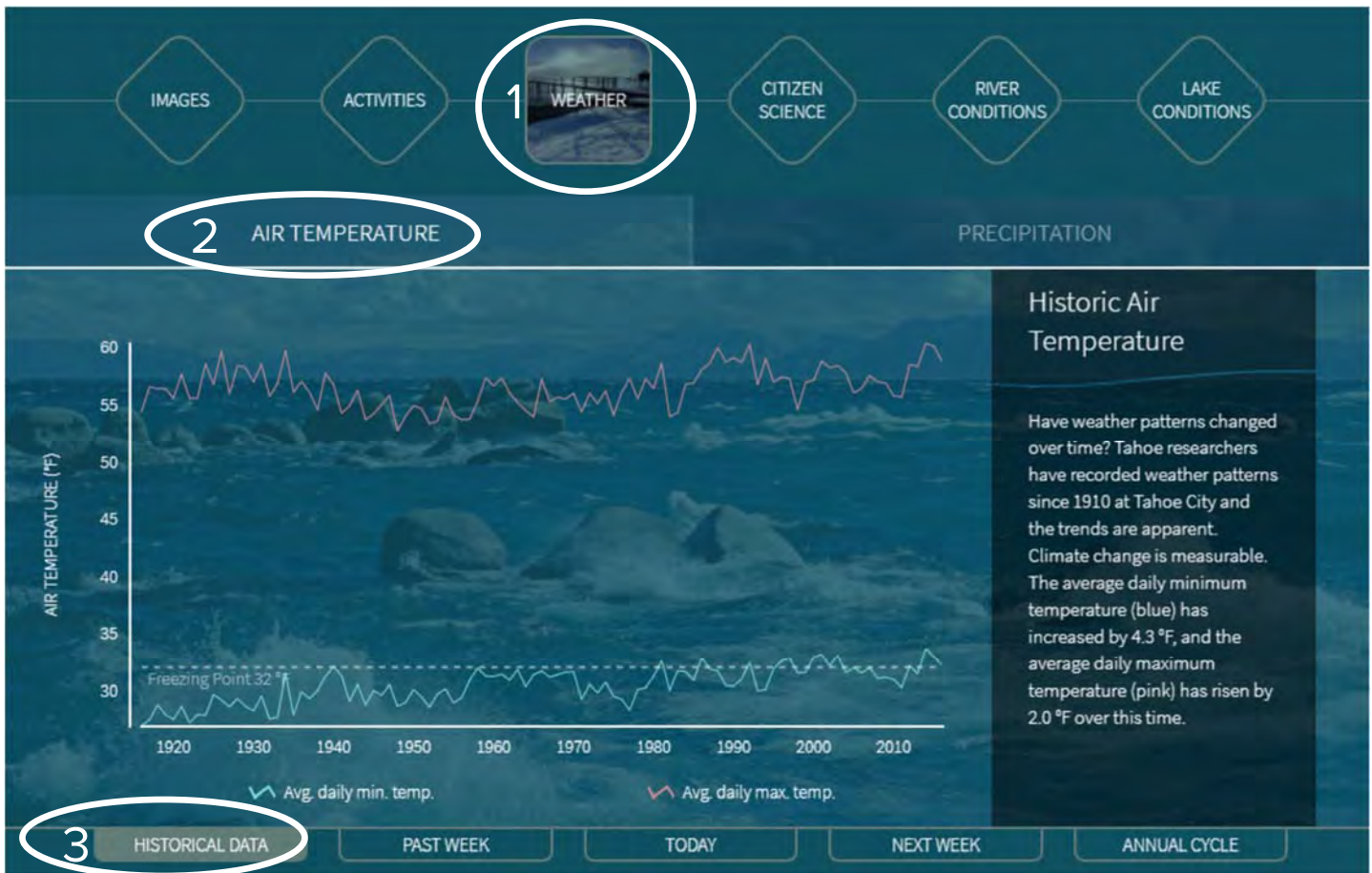
LAKE TAHOE IN DEPTH TOUCHSCREEN

Find the *Lake Tahoe in Depth Touchscreens* and explore the images, activities, weather, citizen science, river conditions, and lake conditions.

Get creative! Draw your favorite place, season, or activity at Lake Tahoe.

A large, empty rectangular box with a black border, intended for a drawing activity. It occupies the lower half of the page.

THINGS ARE HEATING UP



Find the *Lake Tahoe in Depth Touchscreens*. Follow the directions below:

1. Click on the *Weather* button
2. Click on the *Historical Data* tab at the bottom
3. Click on the *Air Temperature* tab

Look at the *Historic Air Temperature* showing the average air temperature at Lake Tahoe since 1911. **Are temperatures increasing or decreasing over time? Circle the correct answer.**

You can also find the *Lake Conditions—Water Temperature* data on this exhibit to see how the lake's water temperature is changing.

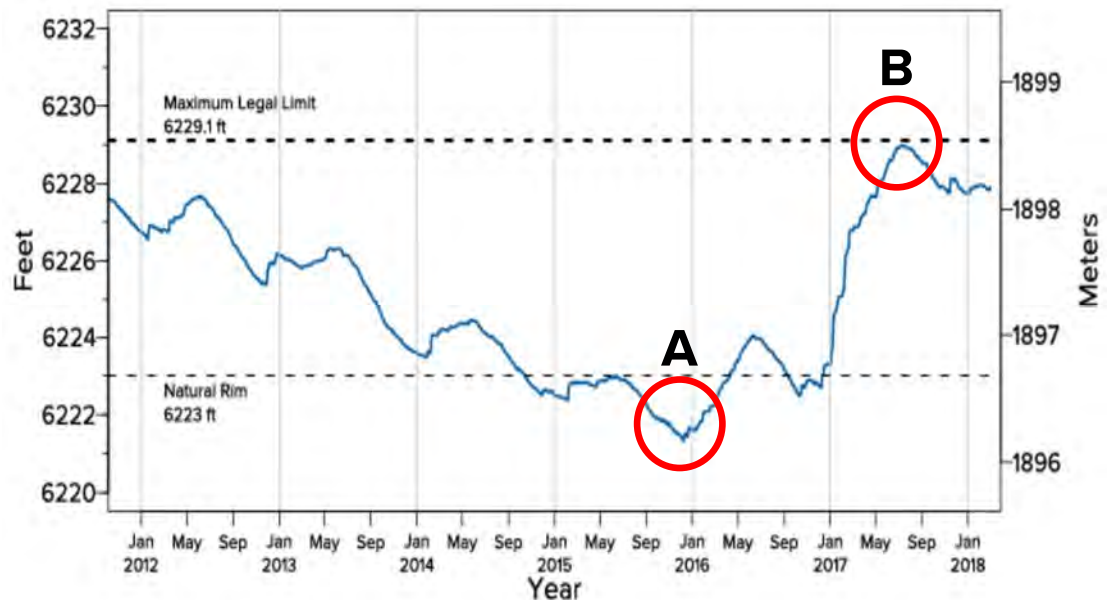
LAKE LEVEL

Lake Level Data

At the touchscreen exhibit:

1. Click on the *Lake Conditions* tab.
2. Click on the *Lake Level* tab.
3. Click on the *Historical* tab at the bottom.

Note: It may take a minute to load more than 100 years of data!



The surface level of the lake varies over time and by season. The dam in Tahoe City holds back the top 6.1 feet of water above the lake's natural rim, providing water storage. If the water level is below the natural rim, no water flows out into the Truckee River.

Compare the two pictures below showing the Tahoe City dam at different times. **Which picture matches the circled data on the graph above?**



B



A

HEALTHY FOREST POP QUIZ

Circle the descriptions you think are healthy for our forests.



A) Bark beetles build galleries and slowly weaken trees.



F) Clearcutting causes increased erosion.



B) Sustainable selective logging allow forest to grow.



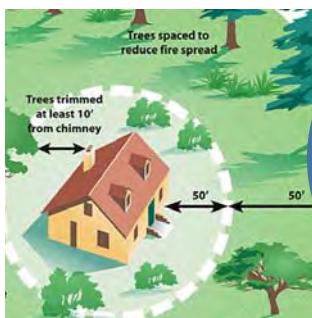
G) Prescribed burns reduce undergrowth.



C) Mistletoe extracts water and nutrients from its host.



H) Blister rust is an airborne tree infection with 90% mortality.



D) Defensible space around a home helps protect it from approaching fire.



I) Wildfires grow bigger with more undergrowth.



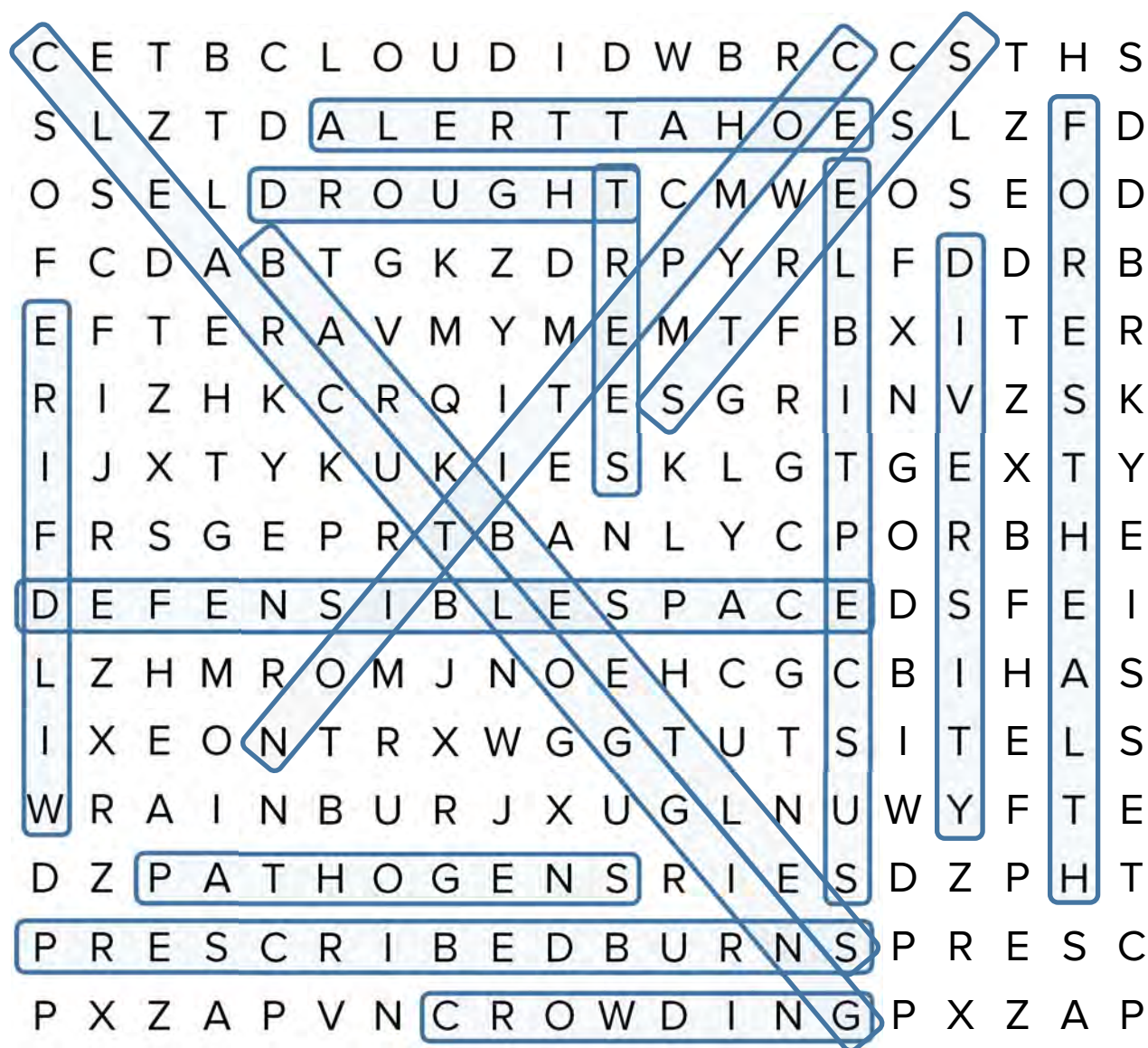
E) Trees are spaced far apart which reduces competition.



J) Drought affects availability of water for trees.

FOREST WORD SEARCH

Words can be forward, backward, up, down, or diagonal.



Alert Tahoe

Bark beetles

Clearcut logging

Competition

Crowding

Defensible space

Diversity

Drought

Forest health

Pathogens

Prescribed burns

Stress

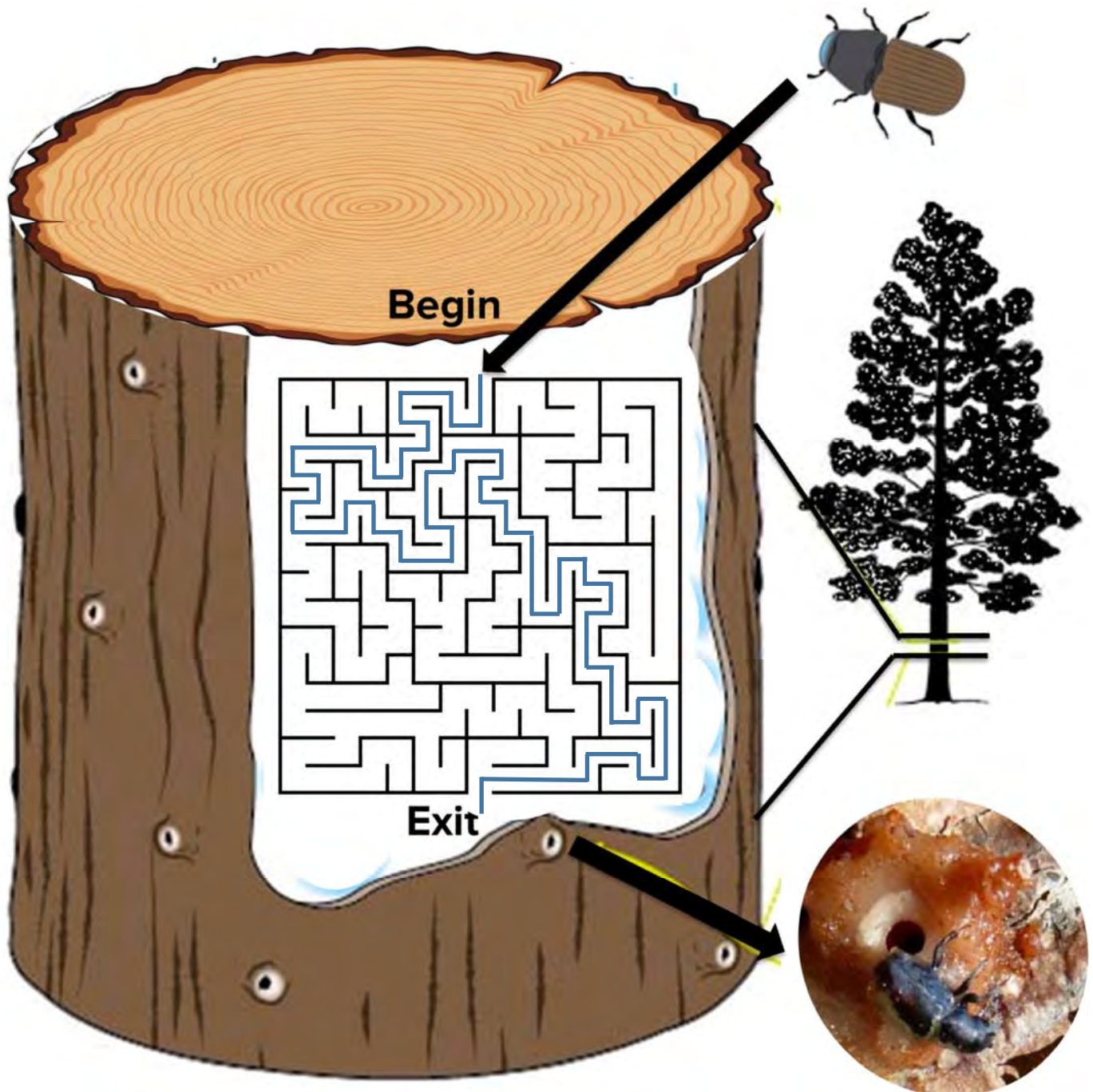
Susceptible

Trees

Wildfire

FOR TREES SAKE

Bark beetles live underneath the bark of trees and dig tunnels with their jaws. The markings they leave behind are called galleries. Bark beetles make it hard for the tree to transport water and nutrients, so the tree's defense is to push out the beetles with sap. **Help the tree by locating the bark beetle in the maze and chasing it out to the exit.**



TAKE CARE TAHOE

At a young age we are taught to take care of the things we love. The same thing goes for the places we love. With just a little more effort, we can all help take care of Lake Tahoe. Find the *Take Care Tahoe* exhibit to learn about stewardship actions you can do to keep Tahoe beautiful for everyone.

To learn more, visit the Take Care Tahoe website at <http://takecaretahoe.org>



**Find the Take Care Bear,
take a selfie with the
purple bear, and tag
@UCD_TERC**

HEALTHY OR

Circle all of the icons that are healthy activities.



UNHEALTHY?

Find the magnets of these activities at the *Green Building* Exhibit.



CITIZEN SCIENCE APP

Citizen scientists can monitor their surrounding environment. They can help researchers at Lake Tahoe by taking a few minutes to enter what they see at Lake Tahoe—whether it's an algal bloom, cloudy water, or litter on the beach.



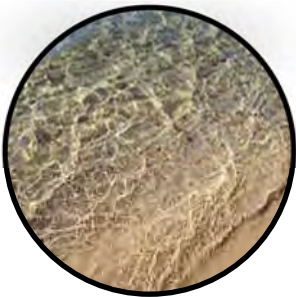
Follow the steps below and make 3 observations using the Citizen Science Tahoe app:

- Step 1: Download the Citizen Science Tahoe app at CitizenScienceTahoe.org
- Step 2: Go to the beach
- Step 3: Use the app to make observations: algae, water color, local species, beach litter.
- Step 4: That's it! It's that easy. Thanks for being a Citizen Scientist!

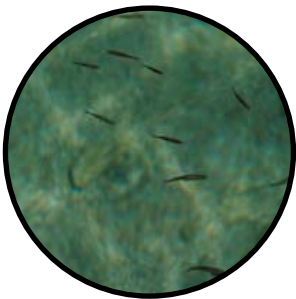
BE A CITIZEN SCIENTIST!



Algae: Do you see algae? Understanding the location and timing of algae growth can help us better control it.



Water quality: How does the water look today? Pollutants and other harmful materials can negatively affect the color and clarity of the water.



Local species: What plants or animals do you see? Lake Tahoe is home to many aquatic and terrestrial species.



Beach conditions: Do you see any litter? Litter on the beach and strange odors can indicate a problem that needs investigation.



Stories in the snow: In the winter, students can collect visual data of snow crystals to better understand the region's climate.

BECOMING A JUNIOR LIMNOLOGIST

Through this challenge you have learned about the science behind taking care of Lake Tahoe. The same values can be applied to lakes around the world. Become an official Junior Limnologist by reading and signing our pledge.

Junior Limnologist Pledge

I, _____, promise to take preventive actions to conserve and protect the environment by:

- ☐ Following the 4 R's: Refuse, Reduce, Reuse, Recycle
- ☐ Picking up my trash
- ☐ Drink Tahoe Tap (reduce single use plastic)
- ☐ Participating in Citizen Science
- ☐ Respecting the plants and animals in the watershed
- ☐ Following the laws that protect the environment
- ☐ Being an advocate for the environment

Sign here

CONGRATULATIONS!

You have completed the questions and activities needed to become a Junior Limnologist.

Bring your completed book back to the UC Davis Tahoe Science Center in Incline Village, Nevada, to check your answers and receive a prize. Or find the answers online at <https://tahoe.ucdavis.edu/junior-limnologist>.

Certificate of Completion

This certifies that

Name

has completed the Junior Limnologist challenge at the UC Davis Tahoe Science Center and has pledged to protect the lakes of the world.

Docent signature

Date

THANK YOU FOR VISITING THE TAHOE SCIENCE CENTER

UC Davis Tahoe Science Center

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(775) 881-7560

tercinfo@ucdavis.edu

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UCDAVIS

**Tahoe Environmental
Research Center**



**Tahoe Water
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Association**

Protect the Source

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