MOVIE GUIDE

MOVIES NUMBER **2013-15**

The FUTURES Channel®

Voyage of the Ventana PARTS 3,4 & 5

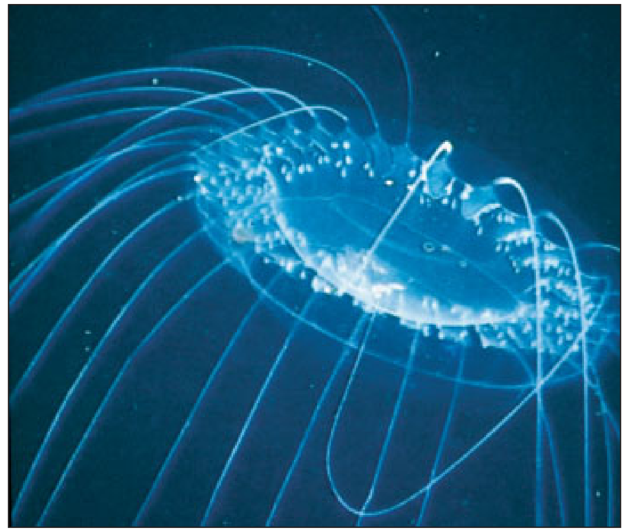
The Movies:

Part 3: Making a mission succeed with the undersea vehicle Ventana requires careful planning and preparation. *(Movie length: 5:27)*

Part 4: Journey to the bottom of the Monterey Bay on a mission of science with the pilot of the Ventana. *(Movie length: 5:21)*

Part 5: Some of the answers to how the Earth's atmosphere works may lie at the bottom of the ocean. As the Ventana completes its mission, ocean scientists are one step closer to those answers. *(Movie length: 4:52)*

Featured: James McFarlane, Chief ROV Pilot, Monterey Bay Aquarium Research Institute; Mary Silver, oceanographer.



Background:

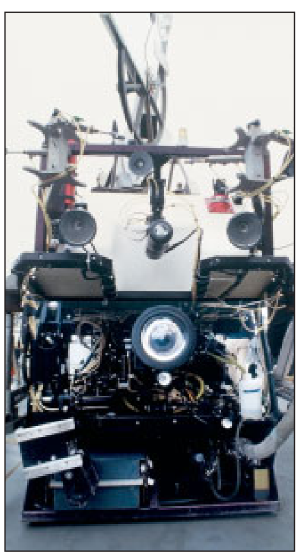
It can seem to us as though the Earth is and will be as it always has been: constant and steady in its course and seasonal patterns. Yet we now know that our planet is in fact an extremely dynamic system, with complex interactions among the land, atmosphere and ocean. And we know that the activities of humankind have grown to a scale that is beginning to impinge directly on those interactions.

Science and technology have brought us to this point, and science and technology are the tools that we are using to better understand the Earth and our relationship to it. Nowhere is this more true than in our ongoing exploration of the Earth's oceans.

Curriculum Connections:

Measurement: Rate (1)

If the Ventana travels to a depth of 700 meters at a rate of 6 meters per minute, how long will it take to reach that depth?



Geometry: Circles (2)

To know *Ventana's* exact position, you need to know the depth of the Ventana and its horizontal distance from the ship. You also need to know which direction it is from the ship. This is called the *bearing,* and it is stated in degrees, with 0˚ being directly north, 90˚ directly east, 180˚ directly south, and 270˚ directly west.

Draw a circle with the ship at the center and label the circle with N, S, E, and W. Then show where these bearings are: 15˚, 300˚, 140˚, 250˚, 60˚.

Percents

3

This table shows the approximate composition of Earth's atmosphere in trillions of tons of material (1 trillion = 1,000,000,000,000):

Nitrogen	4,627
Oxygen	1,246
Carbon dioxide	2
Water vapor and other	58
Total	5,933

a) What percent (by weight) of the atmosphere is carbon dioxide (to the nearest thousandth of a percent)?

b) Suppose we added 1 trillion tons of carbon dioxide to the atmosphere. The amounts of the other gases stay the same. What would the new percent for carbon dioxide be? How does the new percent compare to the old percent?

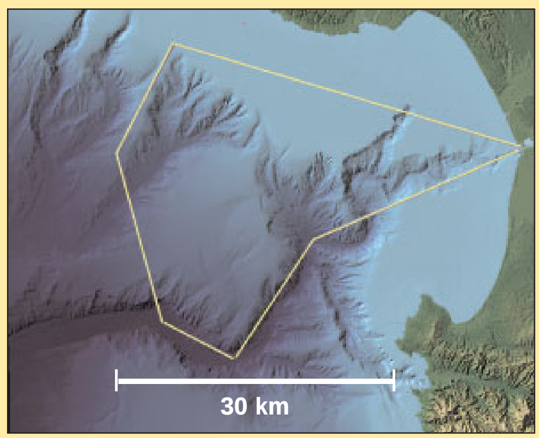
c) What if 50% of the carbon dioxide that we added in question b were absorbed by the ocean? What would the new percent of carbon dioxide in the atmosphere be?

Ratios, Measurement (length), Geometry (angles)

4

The map at right shows a planned route for a future mission for the *Point Lobos.* Find the length of each leg of the route, and the angle between each leg and the adjacent legs.

If the ship begins the first leg of its journey at a bearing of 295°, what is the bearing of each subsequent leg?



Algebra (expressions)

5

When the *Ventana* is suspended off to the side of the *Point Lobos*, just before being lowered into the water, it shifts the position of the center of gravity of the ship away from the center and towards the side of the ship that the *Ventana* is on. The amount of shift is given by this expression:

$$\frac{\text{weight of Ventana x distance from center of ship to Ventana}}{\text{weight of ship + weight of Ventana}}$$

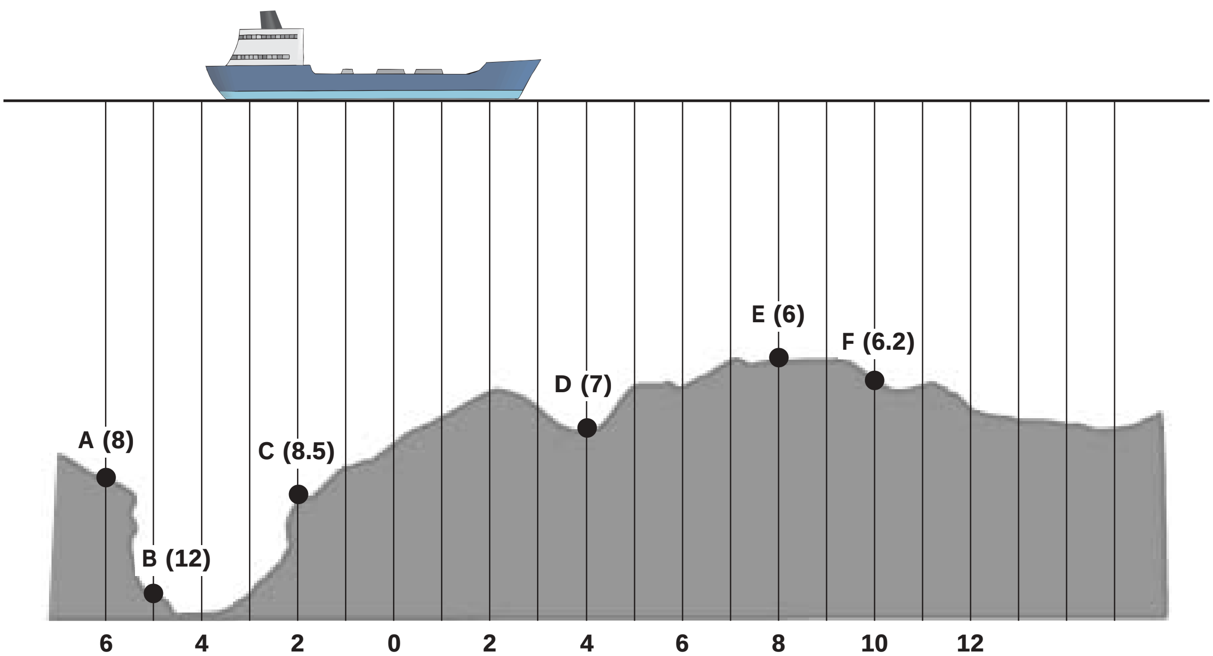
Suppose that the *Point Lobos* weighs 800,000 pounds, the *Ventana* weighs 5,000 pounds, and the *Ventana* is suspended at a distance of 20 meters from the *Point Lobos*. By how much does the center of gravity shift?

If a center of gravity shift of up to 20 centimeters is acceptable, what is the greatest allowable distance from the center of the ship to the *Ventana*?

To: Mission Planning Staff
From: Chief ROV Pilot
Subject: Planning a Mission

We are planning a mission to unexplored areas of Monterey Bay. We need to plan our mission carefully to make sure that we can reach our collection sites without damaging *Ventana.*

Look at this diagram of the dive area where we plan to position the *Point Lobos*. Points A through F represent possible collection sites. Use the scale at the bottom of the diagram to figure out the *horizontal distance* from each point to the location of the ship. The numbers in parentheses are the *depths* for points A through F. All units are “hundreds of meters”.



1. With the *Point Lobos* at the position shown in the sketch, how much cable will we have to use to reach points A, B, and C?
2. We have 1,300 meters of umbilical cable. Will we be able to reach points E and F from the indicated position of the *Point Lobos*?
3. Because of the canyon, I’m a little worried about reaching point B. Maybe we should position the Point Lobos directly above Point B so that *Ventana’s* cable won’t catch on the edge of the canyon. If we choose that position, will we still be able to reach points E and F?
4. Our second dive area is over a flat area of the ocean floor with a water depth of 800 meters. Using the full length of the available cable increases the risk of snagging or breaking the cable. If we use only 1,000 meters of cable to increase safety, how much of the sea floor will we be able to investigate?
5. Suppose we position the ship over a different flat area of the ocean floor with a water depth of 900 meters. In that case, what area of the floor could we investigate with 1,000 meters of cable?

Teaching Guidelines: Planning a Mission
Math Topic: Geometry (triangles, circles)

Procedure: Students should work individually or in teams of two to complete the assignment. You may wish to work out the first part of question 1 with the entire class.

Keep in mind the fact that units are "hundreds of meters".

Answers:

1. *Point A:* 1000 m ($6^2 + 8^2 = 100$; the square root of 100 = 10; 10 hundreds = 1,000). Point B: 1,300 m ($5^2 + 12^2 = 169$; the square root of 169 = 13; 13 hundreds = 1,300). Point C: 873 m ($8.5^2 + 2^2 = 76.25$; the square root of 76.25 = 8.73; 8.73 hundreds = 873).

2. *Point E:* Yes. ($6^2 + 8^2 = 100$; the square root of 100 = 10; 10 hundreds = 1,000 meters, which is less than the 1,300 meters of the cable). *Point F:* Yes. ($6.2^2 + 10^2 = 138.44$; the square root of 138.44 = 11.77; 11.77 hundreds = 1,177 meters, which is less than the cable length)

3. *Point E:* No. The new position of *Point Lobos* is 500 meters farther horizontally from point E, for a total horizontal distance of 1,300 meters. The length of cable required is 1,432 meters, which is more than the 1,300 meters of cable available ($13^2 + 6^2 = 205$; the square root of 205 = 14.32; 14.32 hundreds = 1,432).

   Point F: No. Point F is farther than point E; if the cable won't reach point E it won't reach point F.

   The question is designed to encourage students to think about a problem in light of previous knowledge before attempting to solve it computationally.

4. Step 1: determine what horizontal distance can be achieved at 800 meters. Using the unit "hundreds of meters," you get $10^2 = 8^2 + b^2$, or $100 = 64 + b^2$. Students can solve this equation by trial and error, algebraically, or by reference to the solutions in question 1. Whichever route, $b = 6$, which gives a distance of 600 meters.

   Step 2 requires the realization that the *Ventana* will be able to explore a circular area of the ocean floor whose radius is the horizontal distance computed in Step 1. (You may wish to have students draw a diagram to help them to see the connection.) The value of this area is pr^2 = p600^2 = 1,130,400 square meters (to the nearest unit).

5. Using the approach from answer 4 gives a horizontal distance of 436 meters, and an area of 596,901 square meters (to the nearest unit).

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Life Under the Ocean, #2004	A marine biologist studies the jellyfish-like animals living at 3,000 feet, where it is cold, dark and quiet.

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