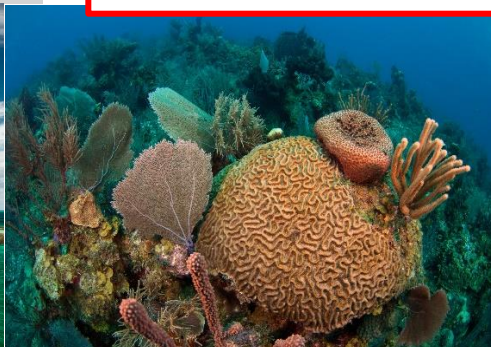


# HEAT

Unit 20 Dr. John P. Cise, Professor of Physics, Austin Com. College, Austin Tx. [jpcise@austincc.edu](mailto:jpcise@austincc.edu)

& New York Times, July 9, 2017 by John Bruno

## My Depressing Summers in Belize



**INTRODUCTION:** The specific heat of soil(land) is just 0.2 cal./gm. C°. But, water specific heat is 1 cal./gm. C°. Take mass of total earth as m. Since earth land is 30 % of earth: mass of land = 0.3 m, water mass = 0.70 m.

**QUESTIONS:** (a) If temperature of earth's land increases 1 C° find heat(Q) gained by earth's land?, (b) If temperature of earth's oceans increases 1 C° find heat(Q) gained by earth's oceans?(continued below)

Entrance to the famous Great Blue Hole, part of the Belize Barrier Reef Reserve System. The Belize Barrier Reef Observing bleached coral on Australia's Great Barrier Reef

When summer arrives, my friends and family inevitably roll their eyes when I tell them I'm packing for my fieldwork in the Caribbean. They picture a book and a white-sand beach. I do get a tan. But it's no vacation. I study ocean ecosystems. The work is chronically underfunded, so food and housing is basic or worse. I've walked away from the type of purely basic academic science I was trained to do **to focus on trying to understand and slow the rapid changes underway in ocean ecosystems**. My team has been working on determining whether protection from fishing and pollution in well-policed marine reserves can moderate or reverse the loss of Caribbean corals, the small invertebrate animals that build up reefs over thousands of years. Since 2009 we've been annually surveying 16 reefs across the Belizean Barrier Reef, half of which are inside a protected reserve. We typically survey two reefs a day, filming the seafloor with video cameras and counting and identifying every fish in 100-foot-long bands. Unfortunately, **we've found local conservation is ineffective in stopping coral loss**. Dozens of other studies around the world have reported the same finding. **The most striking example is probably mass bleaching and coral mortality on Australia's Great Barrier Reef in 2016 and again this year. This well-protected reef, relatively isolated from human activities, is nevertheless susceptible to global warming**. I was a co-author of [a paper](#) last year that found (to my surprise) that the world's most isolated reefs were no healthier than those adjacent to coastal cities. Even the most remote marine ecosystems in the **Central Pacific and the North Atlantic and around Antarctica are being radically altered as oceans warm and become more acidic**. The **Caribbean has warmed by about two degrees Fahrenheit during my lifetime**. Carbon dioxide and other greenhouse gases act as a sort of blanket around the earth, trapping heat that would otherwise be lost to space. **Incredibly,((( 94 percent of this extra heat is going into the oceans,))) and it's not just coral reefs that are being affected**. By the time I graduated from high school, most of that coral splendor was gone. A disease linked to ocean warming wiped out about 99 percent of elkhorn coral colonies across the entire Caribbean — literally hundreds of millions of corals disappeared in a matter of months.

**QUESTIONS(CON.):** In questions (a) & (b) find amount of heat(Q) gained by land and oceans in terms of m. (c) Find total heat gained by land + oceans in terms of m?, (d) With a 1 C° temperature increase find % of heat Gained in oceans and land? **HINTS:**  $Q = c m \Delta t$ , **COMMENT:** Goal: Showing oceans gain most of the heat.

**ANSWERS:** (a)  $\Delta Q_{\text{LAND}} = 0.06 m$  calories, (b)  $\Delta Q_{\text{OCEANS}} = 0.7 m$  calories, (c)  $\Delta Q_{\text{TOTAL}} = 0.76 m$  calories (d) % gain by oceans =  $(\Delta Q_{\text{OCEANS}}/\Delta Q_{\text{TOTAL}}) 100 = 92 \%$ , % gain by land =  $(\Delta Q_{\text{LAND}}/\Delta Q_{\text{TOTAL}}) 100 = 8\%$