GEOGRAPHY 8

READ THE READINGS AND ANSWER THE QUESTIONS ON THE QUESTION SHEETS

(USE YOUR OWN LINED PAPER)

1.) TRACKING - DIRT TIME

2.) UNDERWATER DAREDEVILS

AND THE BOOKLET

INCONVENIENT FACTS

1) INTRO - pg. 2

2) pgs. 3-5

3) pgs. 6-8
4) pgs. 9-11
5. pgs. 11-18
6.) pgs. 18-21
7.) pgs. 21-24
8.) pgs. 24-31

* USE LINED PAPER FOR ANSWERS

· DUE FIRST DAY BACK

sank to a whisper: "'Mr. Holmes, they were the footprints of a giant hound!'"

What got me to actually try tracking was the *Scout Field Book*. It described exploits of Scouting's founder, the British officer Sir Robert Baden-Powell. Standing in the African sand, he began speculating about tracks he identified as women's, heading toward the hills where an enemy encampment was thought to be located. What knocked me out was what he and his companion, a Zulu tracker, learned from a leaf they found about ten yards off the treeless track. Baden-Powell knew that the species grew in a village 15 miles back. The leaf was damp and smelled of the local beer, so he deduced the women were carrying the brew in leaf-stoppered pots. He knew they had passed in the early morning, before 5 A.M., when the winds had stopped. No leaf could have been blown off the track after that. And he deduced what time the men hidden in the hills would have received the beer, and that they would now be too muddled to notice him reconnoitering.

Stalking the wild Barbary ram

One leaf! I scoured my neighborhood for such telltale signs, but got discouraged. Luckily, I had not then read the memoirs of another Britisher, Sir Alfred Pease, a Kenyan big-game hunter who introduced Teddy Roosevelt to the thrill of tracking big cats and gunning them down. Pease praised Algerian trackers who had guided him to a wild Barbary ram by noticing a bush with one nibbled-off twig tip. But the most amazing tracker was a man called Ibrahim. Pease saw Ibrahim touch hoofprints in the desert sand with his big toe and pronounce whether the gazelle had passed a half-hour ago, or four hours ago, by whether the print had collected nighttime dew that crusted in the sun.

My toe will never match the IQ of Ibrahim's. But when Susan Morse invites me back to test my new skills, such as they are, I am gung ho. She has scheduled a "business trip" with one of Keeping Track's directors, Judy Bond, a professional natural resources mapper.

Bond will use a handheld satellite link (the Global Positioning System or GPS) to accurately line out a transect through a six-square-mile section of mountains Morse is studying. It is part of a 185-square-mile stretch—much of it wild—along the Green Mountains' northwestern flank. Morse's habitat studies have already convinced one town to preserve a wetlands corridor here. But she hopes Keeping Track's data will persuade the state and local governments to encourage private landowners to protect and preserve their holdings.

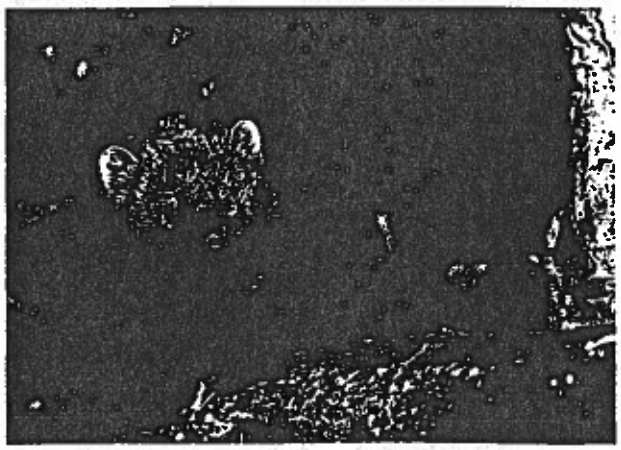
Meanwhile, today's hike will give Bond practice lining out transects using the GPS satellites. Her goal is to perfect the technique so that Keeping Track groups can present planning commissions with more precise habitat maps. Our last hike was in rain and mist. Today, sunlight sharpens everything, and blobs of snow melting from hemlock branches plop onto our heads. We have not gone far under this slaphappy bombardment when we "cut" our first track, which I get right: coyote. So far, my grade is an A.

We find another coyote track, and Morse asks me to say when it was made. But I have no idea. "It was between 8 and 10, last night," she says. "You can see it crossed this puddle of muddy water and left a wet track that froze. It got down to 28 degrees last night, but warmed up this morning, so the track froze before morning. And it has a light dusting of snow. It snowed heavily last night, but tapered off after 8 P.M., so the coyote must have walked by around then."

I miss the tiny tooth marks left in a tree by a squirrel after sap. A waddling raccoon track stumps me. My grade sinks even lower when I miss the claw marks left by a fisher climbing for berries. At the next clawed tree, I announce, "Fisher!" But it was a porcupine.

I won't be a dropout. Tracking is teaching me that landscapes where nothing seems to be going on are full of business, if you learn to read the memos and reports written in the mud. I plan to keep at it. In fact, as we hike, Morse keeping us on the transect, Bond tapping her satellite-link keys, and me desperately seeking tracks to get my grade up, I finger a talisman I put in my jacket pocket. It is a photocopy of Henry David Thoreau's journal entry for January 30, 1841, a tracker's credo.

"Here is the distinct trail of a fox stretching a quarter of a mile across the pond," Thoreau wrote. "I know which way a mind wended this morning, what horizon it faced, by the setting of these tracks; whether it moved slowly or rapidly, by the greater or less intervals . . . for the swiftest step leaves yet a lasting trace."



Member of weasel family, the fisher has rebounded in northern New England. Opposite: Morse says tracks are those of Mr. Softie, a fisher she released to the wild.

the bark and raked them upward, exposing inner bark in order, she theorizes, to ingest minerals found there.

We stop at a huge 200-year-old "witness tree," a hemlock preserved to mark a farm's boundaries. It is also a "baby-sitter tree," up which generations of mother bears have shooed cubs so the mothers could forage unencumbered. Morse shows us the cubs' scratch marks.

Under a hemlock sapling we find the snow strewn with small branches, nipped off by a browsing porcupine. Next door is a girdled beech. Morse announces: "There's a little story here." Gnawing its way around the beech, the porcupine reached the spot where the two trees grew close together. Enterprisingly, to get at every bit of the tasty beech bark, it wedged itself between the two trees. Morse shows us quill pricks in the hemlock.

We pass a five-story cliff she has dubbed the Bobcat Brownstones, where the cats hide from enemies, such as coyotes. We go on bobcat-track alert. Above a beaver pond, Morse abruptly points at a patch of mud. We see nothing, until a woman shouts, "Oh my God, you're right!" Now we see a perfect imprint, rounded, the four teardrop-shaped toes in an asymmetrical arc, the heel pad's leading edge with a characteristic indentation.

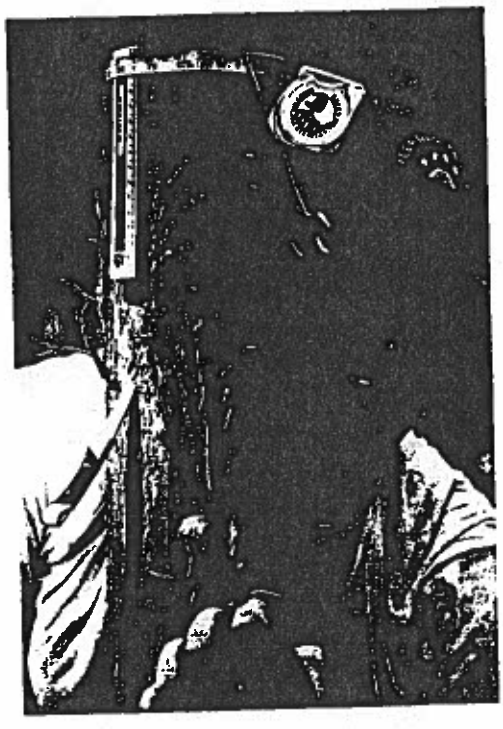
Topping another ridge, we find a mystery track. It amazes us: at this height, a web-footed water-loving otter. But Morse says otters think nothing of climbing mountains like this to reach the next valley's wetland.

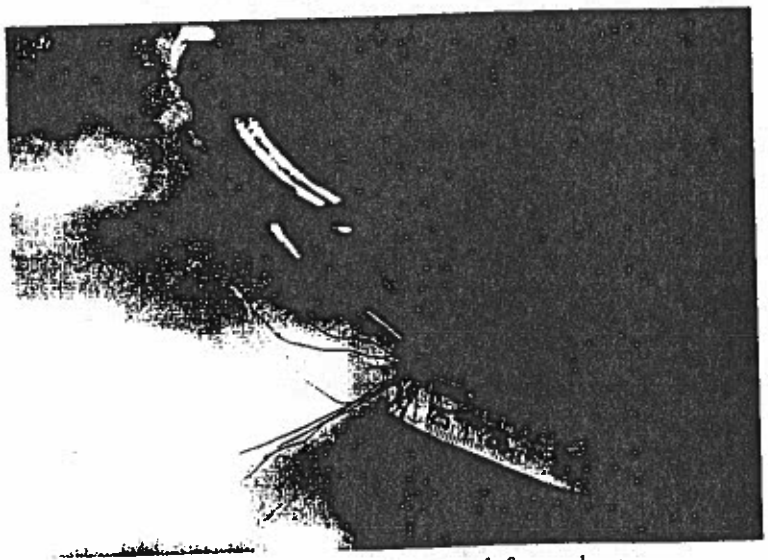
Our next stumper is a wild cherry tree with broken-off branches piled at its base. But there's an overt clue: one bear hair, snagged at the end of a jagged branch. "Hungry bear climbs to the top and gets so far out on a skinny branch that it breaks," Morse says. "The bear falls, snapping off limbs all the way down until it crashes on top of its pile of broken branches." Black bears are relentless in preparation for hibernation; adult bears may gain as much as 1½ pounds a day. This massive weight gain may require eating 25,000 calories a day for several months.

Hiking back down the mountain, Morse points out a final sign, broken-off branches stored, four stories up, in a towering beech. It is a "bear's nest": a bear has broken off branches laden with beechnuts and piled them in a crotch, convenient for munching.

So far, I think, we have learned how much we don't know. Standing beside my car before driving home, I ask Morse what it takes to become a tracker. "Dirt time," she answers. Tracking guidebooks help, she adds, but they can be confusing. Tracks change with the animal's gait and how hard it presses down its foot, splaying the toes. Tracks look different on crusty snow, soft snow, deep snow, slushy snow or snow-dusted ice, and in soft ground, dust, wet mud, drying mud, sand, wet sand. Tracks change with age; and tracks made in the open sun may not resemble tracks made in a cedar's shade.

I listen to all this glumly. Tracking turns out to be no snap course. Besides, my own urge to track comes mostly from books—probably my first encounter was Robinson Crusoe, discovering that footprint in the sand. But what really fired me up as a kid was Sherlock Holmes. In *The Hound of the Baskervilles*, for instance, Holmes must ponder the unfortunate Sir Charles Baskerville's footprints down his yew-lined walk, en route to his mysterious death. And, as the attending physician told Holmes, the walk had other tracks, too. Dr. Mortimer looked strangely at Holmes and his friend, Watson. His voice





Precision is essential to data collection: at left, a volunteer, demonstrating raking action, takes dimensions of a bear scrape; above, black bear hairs caught on a pole are demarcated.

This chart offers a guide for identifying prints from coyote to cottontail and representative trail patterns.

Arizona Game and Fish Department biologist known nationally for his cougar research. He agreed to teach her cougar tracking and to record tracks along transects. "It's low-tech because we don't do radio tracking or spotting from airplanes," Shaw tells me when I telephone. "I felt we needed ways to monitor these animals less intrusively, with less time and cost." With tracking, he says, "you can establish presence for the animal, and over time you can monitor population trends."

Morse joined Shaw and an expanding cadre of volunteers, from as far off as Germany, to survey cougar spoor along transects at Fort Huachuca, a sprawling Army base in southern Arizona. "It began as a joint project between the fort and the Arizona Game and Fish Department, but after I retired we kept at it," Shaw recalls. Fort Huachuca became Keeping Track's model, and Shaw applauds Morse's expansion of the work and seeding of groups nationwide. It needs to be done, he says, because funds for biological fieldwork are dwindling. "I think well-trained volunteers will be increasingly important—the alternative is no information at all."

Cougars in southern Arizona exemplify an animal needing Keeping Track's kind of help. They live on "sky islands," forested mountains thrust up from the desert. To maintain genetic diversity, Shaw explains, a species needs at least 500 breeding animals, and 500 cougars need about 10,000 square miles. "But that's only if the habitat is perfect," he says. "In the real world, it's more like these big cats need 30,000 square miles."

Morse has pondered this issue, too. "Corridors between those sky islands are essential," she says, "and if the valleys fill up with houses and highways, cutting off the cougars' routes between the mountains, they'll be gone." Morse now codirects the Fort Huachuca project on a volunteer basis and makes an annual pilgrimage there to train new volunteers and track big cats. She is also a consultant. Recently, for instance, she determined that a particular tract of Vermont mountainside did indeed serve as critical bear habitat. But since 1994, when she and fellow conservationists founded Keeping Track, most of her time has been devoted to training community volunteers.

Surviving in the freeway's shadow

When I first visited her, she had just returned from San Diego, called in by the Friends of Los Penasquitos Canyon Preserve. Houses line the 3,500-acre wildlife preserve's rim. Freeways roar overhead. Yet, the canyon is home to more than 175 species of birds, 500 species of plants, and even cougars and bobcats.

"We already had trackers among our members," says Mike Kelly, the organization's president. "But we flew Sue Morse out to help us get on a more scientific footing, like how do we design good transects?" Morse also decided the volunteers needed more skills identifying scat and other nontrack signs. And now, in the wake of her visit, the group has laid out transects and picked key animals—coyote, long-tailed weasel, gray fox, badger, mule deer, cougar and bobcat. Bobcats in San Diego may sound surprising, but Morse found their tracks even under the dozen-plus freeway lanes where Interstates 5 and 805 merge.

In Vermont, following Morse up the mountain in the rain, we find no sign of bobcat. But, as she predicted, tracks are just part of the story. We find, for instance, a tree with two parallel gouges, like the numeral 11. A moose, Morse observes, has dug its lower incisors into

story about Keeping Track, and she invited me to visit. She lives a half-hour from Vermont's largest city, Burlington, where developments slowly spread across the meadows like weeds. To get to her house, I drove along a maze of byways and old cow paths, then past a horse farm onto a bumpy dirt road through pastures and spruce jungles, and finally—with the Green Mountains' western flank rising ahead—onto a rutted lane under maples that dead-ended at Morse's cabin.

"I just got back from setting up a Keeping Track program in San Diego, and it's taken me three days to decompress from the population density," she says.

She grew up outside of Philadelphia, where she was a kind of "wild child." She spent hours prowling forests along Wissahickon Creek, and on her grandfather's 2,000-acre farm in the Pennsylvania countryside. Her family had been landscapers for generations.

Her cabin's walls are lined with books, both literature and natural history, interspersed with her vivid photographs of cougars, lynx and bobcats. On display in one corner are molds of animal tracks and sets of rubber reproductions of animal feet.

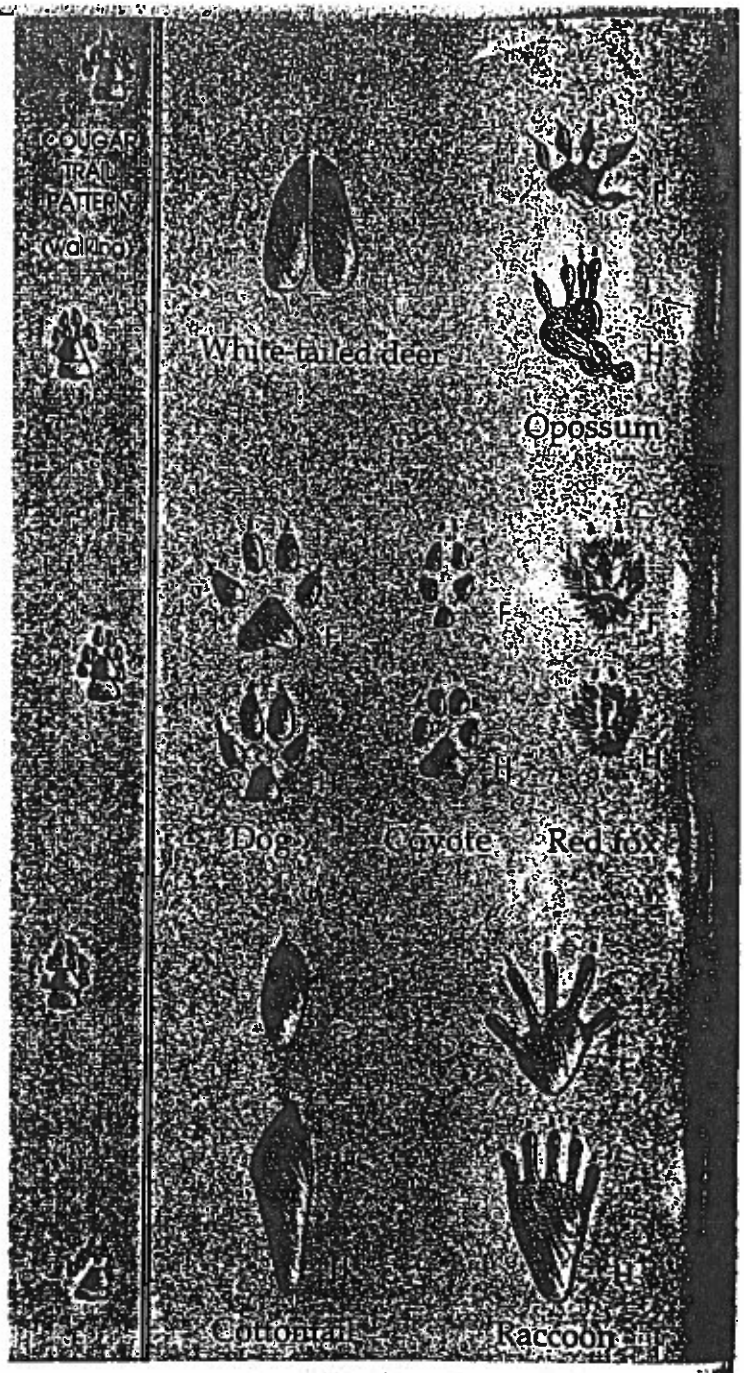
Since childhood, a love for the wild

Her fascination with wild things began before she was old enough to remember. As a child, she shoveled snow and chopped wood to earn money to travel in the Western deserts with friends of her family. Recognizing the girl's passionate interests, her naturalist grandfather gave her rock specimens for Christmas and encouraged her love for wild animals and their habitats. Another family friend got her started tracking.

She majored in forestry at Pennsylvania State University. But there seemed to be, at that time, little connection between the discipline's dry underpinnings—calculus, statistics and chemistry—and exploring and saving the habitat she loved. And so she drifted into the university's literary life, probably the only student forester publishing poems in journals.

After her sophomore year, Morse transferred to the University of Vermont, where she majored in English. She liked Thoreau, Frost and Faulkner. "But by my senior year I had fallen head over heels in love with Shakespeare," she says. In graduate school it was Shakespeare she studied. But she never left the outdoors, and ultimately, the outdoors, as a career choice, won out over literature. Partly it was because, just after moving to Vermont in 1969, Morse had a tracking epiphany.

One dead-of-winter dawn, she hiked along a ridge above her house. Snow melted in a January thaw had refrozen, with a dusting of star-like snow crystals. She found the tracks of a bobcat. She seemed to actually "see" the cat, where it crouched behind a spruce, then advanced and crouched again.



Whether you live in the city, near the woods, or at a canyon's edge, you may find tracks in your backyard.

She came to the tracks of a snowshoe hare nibbling twigs beside an old logging skid road. She saw the bobcat's final crouch behind a stand of spruce. She saw where its paws kneaded the snow. Then came the spring. She found hare fur on the snow, and drops of blood. "And then the track of the kitty dragging the hare off," she says. She found the spot where the bobcat ate the hare, leaving only fur and churned snow and part of the colon, feet and skull. Deciphering tracks turned out to be like interpreting a literary passage. Morse decided to become Thoreauvian, a self-directed biospheric scholar. Tracks would be her text.

In the 1980s, she telephoned Harley Shaw, then an

AME_____ (40pts.) TRACKING:DIRT TIME

ANSWERS ON A SEPARATE SHEET OF LINED PAPER.

1.)DEFINE:DECOMPRESS-

2)WHERE DID THE "WILD CHILD" GROW UP?

3)HOW DID THE WILD CHILD EARN MONEY TO TRAVEL TO THE WESTERN DESERT?

4)HOW DID HER GRANDFATHER ENCOURAGE HER INTERESTS?

5)WITH WHOM DID SHE FALL IN LOVE IN HER SENIOR YEAR?

6)WHAT HAPPENED IN VERMONT IN 1969?

7)DEFINE: EPIPHANY-

8)WHAT ANIMALS PARTICIPATED IN HER EPIPHANY?

9)WHAT ARE "SKY ISLANDS"?

10)WHY MUST AN ANIMAL SPECIES HAVE AT LEAST 500 BREEDING ANIMALS?

11)WHAT COULD PREVENT THE COURGARS FROM TRAVELING FROM ONE SKY ISLAND TO ANOTHER?

12)IN WHAT SURPRISING PLACES WERE BOBCATS FOUND?

13)WHAT ELSE OTHER THAN TRACKS ARE PROOF OF AN ANIMALS PRESENCE?

14)WHAT WAS THE "WITNESS TREE"?

15)WHAT IS THE STORY BEHIND THE PILE OF BROKEN OFF BRANCHES?

16)WHAT DOES IT TAKE TO BECOME A TRACKER?

17)WHAT CONDITIONS CAN CHANGE THE APPEARANCE OF TRACKS?

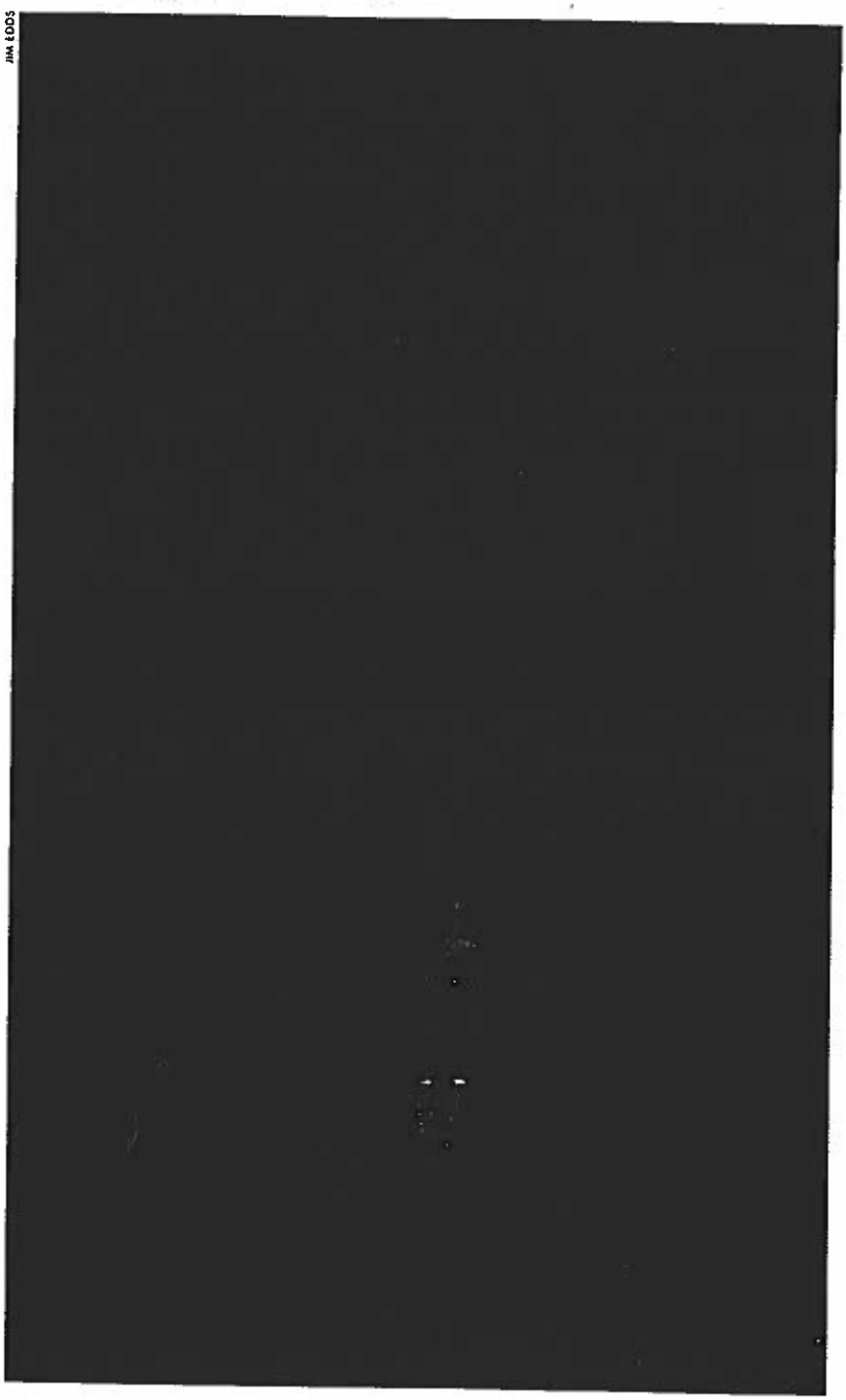
18)WHY WAS SIR ROBERT BADEN-POWELL NOT CONCERNED ABOUT BEING SEEN RECONNOITERING?

19)HOW DID IBRAHIM TRACK GAZELLES IN THE SAND?

20)WHAT IS THE TRACKER'S CREDO?

Underwater Daredevils

Divers compete to see who can go deepest on just one breath—and who can survive the yet-more-perilous ascent to air



JIM EDDS

Mehgan Heaney-Grier on the way to a record 155-foot breath-hold dive

ONE mile off the coast of Mi Alejandro Ravelo, a small shaven man, perches quie the edge of a floating white platfor neoprene-clad torso swaying witho sistance to the ocean's uneven rhyth His submerged feet sport three-foot-lo fins. A heavy-duty clip clamps his no trils closed.

Ravelo's breathing is slow and deep. His eyes are shut. By calming his mind he will, he hopes, slow his body and quell its thirst for oxygen as he attempts to reclaim his place as the world's deepest breath-holding diver, unaided by breathing equipment—a title that the Italian Umberto Pelizzari took in 1992. In his category of breath-hold, or "free," diving, called constant-weight, Pelizzari descended 236 feet on a single breath of air. Ravelo aims to descend ten feet farther, looking for a "confirmation tag" attached to a blood-red guide rope that has already been laid deep beneath the platform. If he grabs the tag, the time he took to reach it—probably about a minute—will not be the most impressive part of his oxygenless excursion: he set a world record in 1993 by holding his breath for six minutes and forty-one seconds while lying motionless at the bottom of a hotel pool. The true feat is the tremendous exertion required to return to the surface. With his arms extended above him in a hydrodynamic Superman pose, Ravelo must kick against gravity the equivalent of nineteen stories back to air.

Around Ravelo's platform the faces of six scuba divers—white ovals emerging from dark wet suits—bob on the Atlantic's steely swells, waiting for Ravelo's move. Stationed at ten-meter intervals, the divers, who will later be joined by breath-hold divers, are ready to serve as links in Ravelo's underwater lifeline. If he passes out, no one of the safety divers can rush him to the surface: they will be anchored to their assigned depths by the perils of the bends, which threaten divers who breathe compressed air and ascend too rapidly. Instead they

will pass his unconscious body back to the surface like a baton.

Spectator boats drift away; their engines must not taint the air. Momentarily lapsing from his trance, Ravelo signals to his manager, Rudi Castineyra, among the scuba divers. Castineyra extends his arm into the air and gives a thumbs-down sign—diver-speak not for "bad" but for "descend." Air hisses out of their buoyancy vests as the divers sink like paratroopers into the clouds. Ravelo's black form remains alone under the gray sky as he prepares his underwater pas seul.

In 1992, in Cuba, Ravelo set the world record for constant-weight free diving at 230 feet—the record Pelizzari broke only a few months later in Italy, where free divers are celebrated as fervently as bullfighters are in Spain. When Ravelo tried to regain his title in 1993, Cuban security officials refused him a boat, fearing that he would sail for America. Their refusal drove him to flee to Miami.

Ravelo's upper body grows larger and then smaller: his ribs are bowing outward from the pressure of his lungs as he breathes deeply, stretching their capacity for a gigantic last gasp. He makes the *puh-puh-puh* sounds of a bicycle pump as he swallows air into his digestive system, like a child wanting to burp. This may save Ravelo's life: on the way back up he will belch the gaseous discharge into his lungs. His twenty minutes of breathing techniques complete, a tingling in his fingertips tells him that his body is fully oxygenated. He blows off carbon dioxide with four hard exhales and gasps once. The water accepts him silently.

With a flutter of powerful fin kicks Ravelo propels himself downward. At fifty feet the increasing water pressure compresses the air-filled cavities in his body to a density sufficient for him to sink without effort. He stops kicking, and the force of gravity slices him through the water like an arrow surging toward its target.

by Colin Beavan

RINO Gamba, of the Confédération Mondiale des Activités Subaquatiques (CMAS), has been verifying free-diving records, including Ravelo's, since 1967. "They aren't trying to beat nature," he says of the divers. "They have a deep love of the sea. You cannot understand the strength of their passion."

Gamba points out that human beings have long braved the sea unaided by gadgets. In 1913, thirty years before Jacques Yves Cousteau and Emil Gagnan perfected the self-contained underwater breathing apparatus (SCUBA), a Greek sponge diver, Stotti Geroghios, dove 200 feet without so much as fins and tied a line to the lost anchor of an Italian battleship. Archaeological digs have unearthed widespread evidence of breath-hold diving in seaside cultures. Mother of pearl, for example, harvested from the deep, adorns carved ornaments that date from 3200 B.C. in Thebes and 4500 B.C. in Mesopotamia. Today in Japan female divers known as amas scavenge the ocean floor for pearls and coral at depths of as much as 145 feet for up to three hours a day, returning to the surface as many as ninety times for air. Scuba divers at those depths for this duration would suffer decompression sickness. The ama practice of whistling before a plunge seemed only a custom until scientists discovered that whistling increases air pressure in the lungs, forcing blood out and leaving more volume for the next breath.

Rural peoples of the Mediterranean and the Caribbean buy the daily catch of local spearfishers who hold their breath as they dive. Ravelo himself, before becoming the youngest-ever member of the Cuban national spearfishing team, helped his father support the family by spearfishing. With his spear gun attached by rope to a buoy on the surface, he searched beneath underwater rocks and in caves for groupers, which can be as large as 140 pounds. Once the fish was speared, a buddy at the surface gathered in the line while Ravelo, fresh air in his lungs, returned to untangle the line from rocks or sometimes to fight his catch hand to fin. Today spearfishing has become a sport for thousands around the world. At international championships judges tally points for each fish caught and for their weights; the record for a bluefin tuna caught with a spear gun stands at 398 pounds.

Free diving is not without risk. In the European countries of the Mediterranean alone about fifty-five free divers die each year, many from "shallow-water blackout." With increasing depth, pressure compresses the chest, giving divers the false sensation that their lungs are full. But during ascent pressure drops rapidly and gas in the lungs expands, which can lead to a lack of blood-oxygen and loss of consciousness, often just before divers reach the surface. Pre-dive hyperventilation, as practiced by Ravelo and others, can also put divers at risk by lowering carbon dioxide levels so much that they do not feel the need to breathe soon enough. Mehgan Heaney-Grier, a nineteen-year-old model who established the U.S. women's constant-weight free-diving record at 155 feet, and who accompanied her friend Ravelo to observe his most recent attempt to break a record, explains the danger all free divers face: "You override your brain's message telling you when to breathe. You're running on your reserve tank and there's no warning before you hit empty."

Most free divers neither hunt for fish nor seek to set records. They simply prefer to venture underwater unencumbered by pounds of scuba equipment. "Breath-holders often see things scuba divers don't," says Tec Clark, the assistant director of the YMCA's national scuba program (a U.S. federation of CMAS), based in Norcross, Georgia, which supported Ravelo's attempt as part of its plans to promote free diving more widely. "The aquatic environment accepts you more as a free diver. You get to see fish that might otherwise shy away from bubbles and the noise of scuba mechanisms." Heaney-Grier agrees. She tells stories of riding the backs of twenty-five-foot whale sharks and giant sea turtles on a single breath of air.

THE quest to make the world's deepest dive unaided by breathing equipment began in earnest about thirty years ago, when Enzo Maiorca, an Italian, and Jacques Mayol, a Frenchman born in Shanghai, separately developed methods using heavy weights to speed their descent. As they plummeted five feet per second, they grabbed their noses and blew like crazy, racing against time to equalize the mounting pressure that could otherwise burst an eardrum.

One method, which survives to this day, involves no swimming at all and is known as "no-limits" free diving. Divers hold on to a weighted, rope-guided sled. Delivered by this aquatic luge to the prescribed depth, they detach themselves from the sled and pull a pin that releases compressed air from a cylinder into a balloon, which they grab to buoy themselves back to the surface in a storm of bubbles. In an intermediate kind of free diving, "variable-weight" divers hasten their descent with a sinker of no more than a third of their body weight, which they shed before ascending unaided. In Ravelo's "constant-weight" type of free diving, he completes the round trip without assistance.

In the late sixties Mayol and Maiorca achieved depths approaching 240 feet. Physiologists, groups of whom curiously follow free divers, cautioned them against going deeper. The limit, they said, would be not breath-holding capacity but water pressure, which below 325 feet, they calculated, would collapse the chest like an empty soda can—an effect known as thoracic squeeze.

But Mayol was convinced otherwise. During his studies of the diving behavior and anatomy of dolphins at the Seaquarium, near Key Biscayne, Florida, he witnessed autopsies that revealed no obvious anatomical structure preventing thoracic squeeze. The lungs and thorax were essentially the same in a dolphin as in a human being, yet dolphins survived great depths. Mayol was sure that whatever protected them would also protect people. Testing himself in waters from the Mediterranean to the frigid lakes of the Andes, and helped by a group of scientists, Mayol sought to understand what happens to the human body underwater. In a typical experiment, Mayol descended to 150 feet and held his breath for nearly four minutes with a cardiac catheter inserted in his chest. When in 1976 he defied warnings and, helped by a sled, went to 328 feet, scientists confirmed the existence of "blood shift" in humans.

We share this mechanism to prevent crushing—a throwback to our evolutionary aquatic heritage—with dolphins, seals, and other diving mammals. In response to pressure, the body constricts the blood vessels on the periphery, forcing blood from the extremities into the chest cavity. The thoracic cavity becomes not like an empty soda can but like a full one, blood being incompressible.

Blood shift protected Francisco "Pipin" Ferreras, another native of Cuba who now lives in Florida, when in 1990 he broke Mayol's record for no-limits free diving by going to 367 feet. In 1991 Umberto Pelizzari, Ravelo's nemesis in constant-weight free diving, broke the no-limits record by going to 387 feet.

These records tempt divers to believe that there is no limit to the depths a diver can withstand, but scientists still say otherwise. They worry now not about the crushing of the chest but about cardiac arrhythmias, which they have observed during Ferreras's dives. Claes Lundgren, the director of the Center for Research and Education in Special Environments at the State University of New York at Buffalo medical school, has observed that blood shift causes the heart to swell. Lundgren is also concerned that mounting blood pressure will eventually burst the capillary walls inside the lungs. The potential looms for an unromantic death by cardiac arrest or by drowning in lungs full of blood. "No one seems concerned," he says. "But they will be when somebody finds out what the absolute limit is in a very unpleasant way."

On a platform, Alejandro Ravelo hyperventilates as he prepares to dive

Even without these dangers, the hazards of no-limits diving are drastic. Ferreras, in his most recent world-record attempt, off Cabo San Lucas, at the southern tip of Mexico's Baja Peninsula, successfully descended to and returned from 436 feet. But he had to abort a first attempt, because he drifted into shallow water. Effectively blind without a mask, he raced toward a rocky bottom. Safety divers had to get him off the sled to avoid a crash. Only a few weeks earlier one of Ferreras's safety scuba divers had been found floating dead on the surface. During a training dive he may have had convulsions and therefore returned too quickly to the surface; internal gases, expanding as water pressure decreased, caused the arteries in his organs to explode.

Because of the dangers, dive organizations refuse to sanction no-limits diving. In 1970 CMAS stopped ratifying records, saying that no-limits diving was not a sport but a brand of "applied experimentation," meaning experiments involving people. Many aficionados of free diving are unimpressed with Ferreras and his ilk. Constant-weight has much more finesse, they say. Jacques Mayol's son, Jean-Jacques, who now teaches free diving in Miami, says of no-limits diving, "It's turned into a circus. Anybody who can clear his ears and hold his breath for two minutes can set a no-limits record. It doesn't take a whole lot of skill to hang on to something. But constant-weight I truly admire. They train until every little cell knows how to hold its breath."

WHEN Ravelo stops kicking at fifty feet, he orders his body to sleep for the rest of the ride. Down is the easy part. Everything is on his side. His body is saturated with fresh oxygen and depleted of carbon dioxide—it is an excess of the latter, not a shortage of the former, that causes the craving to breathe.

Somewhere in the primordial part of his mind the pressure and cold water trigger orders to conserve the oxygen supply in his bloodstream. His spleen shrinks substantially, raising the level of oxygen-enriched hemoglobin. Because blood shift takes blood from the limbs, the burning of oxygen is much reduced —only the brain and vital organs are drawing it. Receptor cells around Ravelo's lips cue the slowing of his heart by as much as 50 percent—a phenomenon, known as diving bradycardia, that sometimes allows near-drowning victims to be revitalized forty minutes after sinking into icy water.

Certainly the human body has ways to survive this sort of maneuver—as free divers argue when they are criticized for going where they do not belong. If we are not meant to descend into deep water, they ask, why are our bodies adapted to it?

Yet Ravelo's maneuver remains risky. The blood shift has reduced oxygen circulating to Ravelo's legs, which must power his return to the surface. Muscular exertion without oxygen is common; the muscles of a champion running a hundred-yard dash operate anaerobically, taking chemical energy from stores within themselves. But Ravelo's anaerobic strength may run out before he hits the surface.

The stopwatch ticks off the hundred and twentieth second: the entire dive is expected to last no more than 135 seconds. Two breath-hold safety divers descend to monitor Ravelo during the last, most dangerous, forty feet to the surface. This is the nether region between conquest and death, where the success shimmering at the surface can yet be snatched away by shallow-water blackout. The two breath-hold divers, unencumbered by equipment or considerations of decompression, can rush Ravelo to the surface if his body goes limp.

They have been below for thirty seconds; the stopwatch has ticked fifteen times since Ravelo was due on the surface—an eternity in a realm where contingencies are planned to the second. Their finned forms shoot around like huge, nervous baitfish. They know that the current, blown up by recent windstorms, has caught Ravelo off guard. Only later, when the scuba divers return to the surface, will they learn the full extent of the drama. Ravelo achieved his depth but drifted sixty feet from the guide rope. Disoriented, struggling against the current, he grabbed at a video-camera light instead of the reflector to which his confirmation tag was fixed. "When he realized his mistake," his manager said afterward, "he tried to go deeper, thinking he had farther to go." Another twenty seconds was lost while he wrestled with the cameraman. "I thought he would take my spare air supply and breathe," his manager continued, "but he went for the tag and started his ascent."

By the time the divers spot Ravelo, his legs are powerless. Sinking, he desperately claws for the surface with his arms. Then he goes limp.

Two minutes and forty-three seconds. The safety divers burst to the surface with Ravelo's motionless form between them. "Breathe!" they shout. "Breathe!" With all their might they slap their friend's face. His limp floating body is as blue and dark as the ocean. The speedboat roars over and a medic has an oxygen mask over Ravelo's face before his fins are out of the water. No one cares that the record attempt has failed.

Bobbing in another swell, Mehgan Heaney-Grier looks at something in her hands. It is the confirmation tag, which she found floating on the surface.

A FEW days after he returns from the hospital, Ravelo sits comfortably in a friend's living room, planning the next attempt. He is not intimidated by the blackout he suffered: he "pinked up" right after the mask was put on his face; the blood he vomited was only seepage from burst capillaries in his sinuses. He's had that before. "What we've learned," he says through his manager, who interprets, "is that we have to be where the seas are calm. We may go to the Caribbean or the Mediterranean. A record of this nature can be attempted only in perfect conditions."

Nor is Ravelo discouraged. He claims that Mayol has aborted many of his dives in panic, and so has Ferreras. He must go forward. Now, he feels, he has an advantage: he reached the depth.

But has he not learned something about tempting fate? Is he not worried that he has gone too far?

Ravelo shrugs. "Even the fish were uncomfortable in the sea that day," he says. Then, more thoughtfully, in his rapid-fire Spanish, he tells of the most painful time of his life. It was in 1994, when he was interred for a year at Guantanamo, the U.S. military base on the island of Cuba, where refugees were processed before they could come to America. "Every day I could see the sea but I could not go to it." He craved the sensations of a deep dive. The ocean has become, after all, his second home.

NAME_____ (50pts.) HOOK:UNDERWATER DAREDEVILS

ANSWERS ON A SEPARATE SHEET OF LINED PAPER.

1)WHAT ARE ON THE DIVER'S SUBMERGED FEET?

2)WHAT DOES THE DIVER HOPE TO ACCOMPLISH BY CALMING HIS MIND?

3)WHAT IS A BREATH-HOLDING DIVER?

4)HOW FAR DID PELIZZARI DECEND ON A SINGLE BREATH OF AIR?

5)HOW LONG WILL IT TAKE RAVELO TO REACH HIS GOAL OF 246 FEET?

6)WHAT RECORD DID RAVELO SET IN 1993?

7)WHAT IS THE HARD PART OF THE DIVE? WHY?

8)WHY CAN'T THE SAFTY DIVERS (INDIVIDUALLY)RESCUE BREATH HOLD DIVERS?

9)HOW CAN THE SAFETY DIVERS RESCUE RAVELO?

10)HOW DOES HE KNOW THAT HIS BODY IS FULLY OXYGENATED?

11)WHAT HAPPENS AT 50 FEET?

12)FOR WHAT DOES THE ANACRONYM SCUBA STAND?

13)WHAT ARE "AMAS"?

14)WHAT IS THE RECORD SIZE CATCH FOR SPEAR FISHING?

15)WHAT IS "NO LIMITS" FREE DIVING?

16)WHAT IS "VARIABLE WEIGHT" FREE DIVING?

17)WHAT IS THE THORACIC SQUEEZE?

18)WHAT IS THE "NO LIMITS" FREE DIVING RECORD?

19)WHAT TYPE OF FREE DIVING IS ADMIRED THE MOST? WHY?

20)WHAT CAUSES THE CRAVING TO BREATHE?

21)HOW DO FREEDIVERS RESPOND TO THE CRITICISM THAT THEY'RE GOING WHERE THEY DON'T BELONG?

22)WHAT IS THE MOST DANGEROUS PART OF THE DIVE?

23)WHAT DANGER LURKS AT FORTY FEET?

24)HOW DO THEY GET RAVELO TO BREATHE?

25)WHAT IS RAVELO'S SECOND HOME?

"LET BOTH SIDES BE FREELY HEARD."

INCONVIENT FACTS INTRO - pgs 1,2 (20pts)

Answer w/ complete sentences.

1.) WHAT IS THE AIM OF PRACTICAL POLITICS?

2.) DEFINE: AN APOCALYPSE IS...

3.) WHAT IS THE "LOOMING ENVIRONMENTAL APOCALYPSE?

TOLD 4.) WHAT IS THE CAUSE OF ANY CLIMATE CHANGE? WHAT ISN'T

TOLD 5.) DEFINE: AN ASSERTION IS...

TOLD 6.) WHAT IS "SETTLED SCIENCE"? OR WHY IS SCIENCE SETTLED?

7.) WHAT TRANSITION OCCURRED IN THE MID-2000s?

8.) WHY HAVEN'T THE INCONVENIENT FACTS BEEN PUBLICIZED?

9.) WHAT IS THE PURPOSE OF THIS BOOK?

10.) WHAT IS THE GREAT TRAGEDY OF SCIENCE?

INCONVIENT FACTS GLOBAL WARMING — (20pts.)
THE BASICS pg 3-5

Answer w/ complete sentences.

1.) DEFINE: RADIATION MEANS...

2.) WHAT IS THE "GOLDILOCKS EFFECT"?

3.) WHAT IS THE ATMOSPHERIC COMPOSITION OF VENUS? EARTH? MARS? WHAT IS THIS COMPARISON NAMED?

4.) WHAT AGENT OF GREENHOUSE WARMING DOES THE MEDIA FOCUS UPON?

5.) WHAT IS THE MOST SIGNIFICANT GREENHOUSE GAS OF ALL?

6.) WHAT PERCENTAGE DOES WATER VAPOR CONTRIBUTE TO GLOBAL WARMING? CARBON DIOXIDE? METHANE? OTHER?

NOODLE OR NOTES 7.) DEFINE: QUANTIFY MEANS TO ASSIGN NUMERICAL VALUE...

8.) WHY IS NEW MEXICO SO COOL IN THE EVENING, AND HOUSTON SO HOT?

9.) COMPLETION: THERE IS NO AGREEMENT, HOWEVER,...

10.) WHAT DOES WARMING ALLOW?

INCONVIENT FACTS GREENHOUSE GASES—OUR SECURITY BLANKET pgs 6-8 (20pts)

1.) WHAT IS INCONVENIENT FACT #1?

2.) WHY ARE CLIMATE PREDICTIONS BASED ON WATER VAPOR PERCENTAGES IN THE ATMOSPHERE AN INEXACT SCIENCE?

3.) WHAT IS INCONVENIENT FACT #2?

4.) WHAT FACT UNDERMINES THE THEORY OF FUTURE CATASTROPHIC CLIMATE CHANGE?

5.) WHAT IS A THEORY?
NOODLE OR NOTES WHAT IS A FACT?

6.) WHAT CO_2 FACTS ARE AGREED UPON BY "ALL" SCIENTISTS?

7.) WHAT CO_2 FACTS ARE NOT AGREED UPON BY ALL SCIENTIST:

8.) WHAT ARE THE 3 PRIMARY, CARBON-BASED SOURCES OF ENERGY?

9.) WHAT QUESTIONS ARE RAISED BY ATTEMPTS TO REDUCE OUR RELIANCE ON CO_2?

10.) COMPLETION: WE SHALL SEE THAT...

INCONVIENT FACTS CO_2 — THE FOOD OF PLANTS pgs 9-11 (20 pts)

ANSWER

NOODLE OR NOTES

1.) WHAT IS PHOTOSYNTHESIS?

2.) WHAT IS INCONVENIENT FACT #3?

3.) WHAT PERCENTAGE OF THE ATMOSPHERE IS NITROGEN? OXYGEN? TRACE GASES?

4.) WHAT PERCENTAGE OF TRACE GASES ARE ARGON? CARBON DIOXIDE? OTHER GASES?

5.) WHAT IS THE "LINE OF DEATH"?

6.) WHAT HUMAN ACTIVITIES ARE THE LARGEST CONTRIBUTORS TO CO_2 LEVELS IN THE ATMOSPHERE?

7.) WHAT PERCENTAGE OF MAN-MADE CO_2 EMISSIONS IS COAL? OIL? NATURAL GAS? CEMENT? GAS FLARING?

8.) WHATS THE GOOD NEWS ABOUT NATURAL GAS?

9.) WHAT PERCENTAG OF GLOBAL CO_2 EMISSIONS IS F/ CHINA? THE U.S.A.? THE E.U.? INDIA? RUSSIA? JAPAN? 190 NATIONS?

NOODLE OR NOTES

10.) DEFINE: QUANTIFY MEANS TO ASSIGN...

INCONVIENT FACTS THE FOOD OF PLANTS pgs 11 - 18 (20pts

Answer w/ complete sentences.

1.) WHAT IS THE PRIMARY CAUSE OF THE 40% INCREASE IN CO_2 CONCENTRATIONS IN THE ATMOSPHERE SINCE 1750?

2.) WHAT MAKES THE MEASUREMENT OF ANCIENT GASES POSSIBLE?

3.) WHAT IS INCONVENIENT FACT #4?

4.) WHAT GLOBAL TRAGEDY WAS NARROWLY AVOIDED AT THE END OF THE LAST ICE AGE?

5.) ~~WHAT~~ HOW WAS THE COMBUSTION OF FOSSIL FUELS HELP TO AVERT A CO_2-RELATED CLIMATE APOCALPSE?

6.) WHAT IS INCONVENIENT FACT # 5?

Noodle or Notes

7.) DEFINE: DATA MEANS...
PROPAGANDA IS...

8.) WHAT IS INCONVENIENT FACT #6?

9.) COMPLETION: "IT SHOULD BE OBVIOUS TO IMPARTIAL OBSERVERS...

10.) WHY IS THE IDEA OF A "TIPPING POINT" NOT SCIENCE, BUT PROPAGANDA?

INCONVIENT FACTS THE FOOD OF PLANTS pgs 18-21 (26pts.)

Answer w/ complete sentences.

1.) WHAT DOES Fig. 1-13 ILLUSTRATE ABOUT CO_2 LEVELS?

2.) WHAT DID DE SAUSSURE DISCOVER ABOUT CO_2 AND PLANT GROWTH?

INSIDE OF NOTES 3.) WHAT IS MEANT BY "PEER REVIEWED STUDIES"?

4.) HOW DOES INCREASED CO_2 LEVELS HELP PLANTS?

5.) WHAT IS INCONVENIENT FACT #7?

6.) WHAT IS INCONVENIENT FACT #8?

7.) WHAT IS "CO_2 FERTILIZATION"?

8.) HOW DOES CO_2 FERTILIZATION HELP FORESTS? CROP YIELDS? WATER LOSS? PLANTS TO FIGHT INSECT PREDATORS?

9.) WHAT IMPACT WOULD THE DOUBLING OF CO_2 HAVE ON CARROTS? SUGAR BEET? APPLES? POTATOES?

10.) WHAT IS INCONVENIENT FACT #9?

11.) WHAT IS THE MAJOR CAUSE OF WATER LOSS IN PLANTS?

12.) HOW WOULD MORE CO_2 CORRECT THE WATER LOSS IN PLANTS?

13.) COMPLETION: "FOR NOW, LET US NOTE THAT DECREASES...

INCONVENIENT FACTS : THE FOOD OF PLANTS pgs 21-24 (20 pts)
Answer w/ complete sentences. "TEMP. - A QUESTION OF DEGREE"

1.) WHY IS CO_2 CALLED THE MIRACLE MOLECULE?

NOODLE QR NOTES

2.) DEFINE: A MOLECULE IS...

3.) WHAT IS MEANT BY THE PHRASE, "H.L. MENCKENS HOBGOBLINS OF ALARM"?

4.) HOW DO GOVERNMENTS PLAN TO CURTAIL THE USE OF FOSSIL FUELS?

5.) COMPLETION: "THE POLICIES THEMSELVES ARE...

6.)7.) EXPLAIN THE VISUAL ON PAGE 22.

8.) IDENTIFY THE GREATEST MASS DELUSION IN THE HISTORY OF THE WORLD.

9.) WHAT IS THE FALACY OF THE ARGUEMENT THAT THE WARMING OF RECENT DECADES IS UNUSUAL AND UNPRECEDENTED?

10.) WHEN DID MODERN WARMING BEGIN? WHY DOES THIS INCONVENIENT FACT HURT MAN-MADE GLOBAL WARMING POINT OF VIEW?

INCONVENIENT FACTS TEMP: A QUESTION OF DEGREE pgs 24-31 (20 pts)

Answer w/ complete sentences.

1.) EXPLAIN THE "HOCKEY STICK".

NOODLE OR NOTES

2.) WHAT IS PEER REVIEW?

3.) WHY IS TREE-RING DATA A POOR SOURCE OF INFORMATION FOR TEMPERATURE RECONSTRUCTION?

4.) WHAT SCIENCE "NO-NOs" DID MANN USE TO CONTRUCT HIS CHARTS?

5.) IDENTIFY THE THREE WAYS TO MEASURE ATMOSPHERIC TEMPERATURE DIRECTLY USING INSTRUMENTS?

6.) WHAT IS THE STRENGTH AND WEAKNESS SATELLITES? WEATHER BALLOONS? THERMOMETERS?

7.) ~~WHAT~~ HOW DOES THE TEMPERATURE DATA BETWEEN 1945 TO 1979 AND 1998-TO 2015 HURT THE MAN-MADE GLOBAL WARMING ARGUMENT?

8.) WHAT IS INCONVENIENT FACT # 10?

9.) WHY WAS GLOBAL WARMING CHANGED TO CLIMATE CHANGE

10.) WHAT DID GEOLOGISTS TEACH IN THE 1970's?