Meeting 14 • 20 February 2014
Week 7: Rocks & soil, weather & water

Version: **2/20/14**

pictures of the week

Mt. Chimborazo, illustration from Humboldt's time

Humboldt's iconic engraving of Mt. Chimborazo

thought-bite of the week:

"...often during astronomic observations I almost dropped my instruments when I realized my face and hands were covered with these hairy bees. Our guides assured us that these bees only attacked when you annoyed them by picking them up by their legs. I did not try."

(Humboldt, "Personal Narrative", from *Jaguars and Electric Eels*, ed. & trans. Wilson, p. 17)

mini-text of the week (start):

"...the general phenomena of plant distribution..."

Humboldt, "Personal Narrative", from *Jaguars and Electric Eels*, ed. & trans. Wilson, pp. 14-16 (read more)

Topics for today (key to symbols)

- (05') This week's mini-text: Where have you yourself seen boundaries between plant zones or (much more difficult to note) animal zones? What might create those boundaries? Are they boundaries between species or something less definitie than that? If you're puzzled for an example, think about driving from PDX over/around Mt. Hood to Bend. (eph csffet; ivnbo sbdft?)

- (10') Followup on meeting 13 discussion of "data" and whether X is a "fact": 1) quantity / cost of data in 1800 and now; 2) differences in meaning among "data", "fact", "inference", "conclusion", "opinion", "hypothesis", "theory", "truth". To what extent to we take data, facts, etc. "on faith"? How do we decide what we believe/ accept? Where do you get your various data about the topics and issues that concern you? Where have you encountered wrong data in daily life? What examples can you give of other people innocently (or "innocently") finding and passingon (not generating) incorrect data?

- (10') Follow-up on "My Education" and prep for species descriptions / group projects:

  1) food for thought: How do you know where you learned X? How do you know that what you learned is really true? How/When did you learn how to learn? If you lost your curiosity and interest in learning, how and when did it happen?

  2) How many have talked this over with: friends? siblings? parents? former teachers? current teachers (other courses)? employers? your mentor (individually)? me (individually)?

  3) SINQing the Humboldt Canoe as material for discussion of curriculum: for math: age-appropriate activities; "spiral" syllabus; calculus?! AP?! Which other subject areas did we address / could be addressed? This is prep for larger discussion of species descriptions and group projects

- (05') More about educational standards and their parts in the course, and how that relates to the

• (05') More about educational standards and their parts in the course, and how that relates to the individual and group projects: a) Standards are regarded as a necessary part of creating curricula and competent learning activities in SCHOOL but NOT necessarily COLLEGE!) – so it may benefit you to learn about them as you evaluate your own education, especially now that you are in college. b) Educating the young(ish) learner about sustainable environmentalism, as you will explore with your species and descriptions and maybe your projects, requires systematic learning mapped onto standards (in a complete project, if not in your "proof of concept" versions)

• (15') Species descriptions, with work samples. Important: Don't write as though you yourself were the audience, as though you were writing a biology paper, or even as though I were the ultimate audience. Picture a distinct category of learner and work from there. Hallmarks / gauges of strong species descriptions / group projects: 1) Is it about you or about sustainable environmentalism and AvH? 2) Will your audience learn ABOUT or learn TO, or both? 3) Could a teacher use your activity a) as is; b) by adding something to it? 4) Does it contribute balance to a larger effort (or is it just another take on the penguin / squid)? 5) Could you confidently present it publicly? Example: PSU Student Research Symposium

Choose the Humboldt Penguin and the Humboldt Squid with caution, since so many people make them their easy choice and we've had too much of those "Bambi" creatures already and not enough attention to other Humboldt-named species, especially plants. If you go with the penguin and the squid, your project will be judged by particularly strict standards. But the penguin and squid can be used in group projects. So can the species descriptions, but they can't substitute for the main content (example: creating the template and several examples for a booklet or similar resource that collects the Humboldt-named species into one handy reference tool, for example for a Humboldt-named school to keep in its main office for kids, parents and visitors)

• (15') The problem of courses that are only 10 weeks long. Group project guidelines/ specifications and second look at ideas for group projects: which skills do thethe projects need / which skills map onto which ideas? Examples of group projects from last year's Humboldt SINQ. Concept of Big IDEA for Major Project, rather than finished, packaged product. Reasons: a) never enough time; b) we're contemplating another SINQ (summer, maybe) and even a Humboldt Capstone. This course's group projects could be handed off (anonymously) to your successors for further development. Into the projects we'll integrate the species descriptions and the foundation for learning materials of use to Humboldt-named schools, or just about any school. You learn best when you have to teach what you've learned. To be an educated, committed citizen is both to learn and to teach.

Organizing principles: AmAze me (Amaze me with the idea, amAze me with the presentation) - but if I tell you what will amaze me, it won't.

Examples - stop me if I'm invading your idea - of hypothetical projects: "Humboldt and Electricity"; "Humboldt and Presidents"; "Humboldt and Indigenous Cultures / Peoples /'Races'"; "Humboldt - You've Read the Novel, Now Go to the Play / See the Movie"; "Humboldt-Themed Student-Created Businesses (coffee, chocolate, Humboldt-branded articles made from Humboldt-related materials)

• (10') Examples of lesson plans that can guide species descriptions and some group projects: Enchanted Learning - but one of many sources of learning activities, especially for younger learners. Here's their "Explorers" page about Humboldt. Here's their section about "astronomy:Earth", with activities that could be inspiration for learning activities for Humboldt-named schools. Here is "ThirteenEd Online", about lesson plans (example: math). For the Bigger Picture about principles, stakeholders, etc., see PSU/Oregon "STEM+German" grant-funded project.

• (05') grants, jobs, résumé lines through PSU Institute for Sustainable Solutions; grants and conferences elsewhere; see earlier handouts for examples of internships

• (0') If time (or you can do on your own): Check your progress (other than by your current grades and the midterm) – and explore the related issues of standards, assessment and grading by exploring this self-evaluation guide for the middle of the term; this applies to your recent writing assignment, to your performance in the course, and to your larger roles as citizen and (possibly) parent.

• On the horizon:

Soon: A last quantification activity: precise measurement of altitude / distance (demo, then do in groups). Thought questions: Are all angles and degrees created equal? Why use a barometer to measure altitude when the theodolites and trig tables are there? Margins for error in Humboldt's time and our own: latitude, longitude, altitude, temperature; news flash: PSU Building World's Biggest Barometer!!

Soon: topographical mapping and iso-dimensions

Looking further ahead (projects, etc.): presentation (continuation) about educational standards and their parts in the course: 1) Improving your learnign by helping others to learn - This is preparation for assignments about species description and group projects.

looking ahead: presentation of project ideas (just the ideas, not finished projects) in week ••

Later: what it's like to read Darwin; the iconic graphic of Chimborazo; Upcoming: presentation about society back then (and any time before 1800 or so), to help understand how H related to people of other classes / races (teaser: When was it that someone's ears first popped with a change in altitude?)

advice about "educated citizen" reading, with a short sample

disturbed by that immeasurable force which has burst asunder the solid pavement of the globe.

They were looking at an angular unconformity that stimulated Playfair to further reflect that 'the mind seemed to grow giddy by looking so far into the abyss of time'. It was Hutton's exploration and explanation of the rocks that generated these famous words. And it was Hutton who was instrumental in unshackling our view of Earth history from biblical constraints.

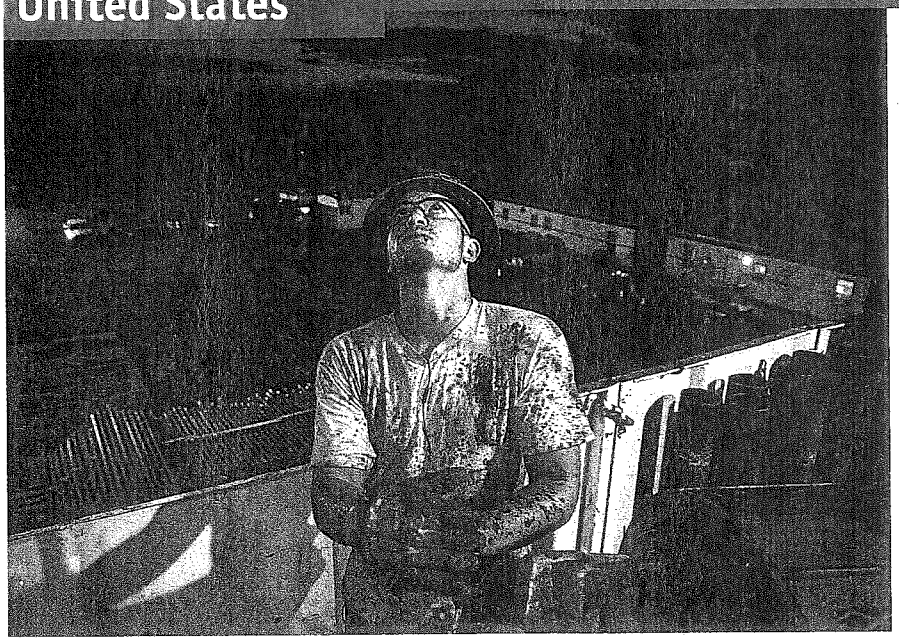
By the time Powell encountered the same phenomenon in the depths of the Canyon, the received wisdom of the time suggested that such an unconformity implied that the Precambrian strata were first folded by immense compressive tectonic pressures. The large-scale compression also elevated the rock strata to form landscapes that were subject to long-term weathering and erosion. Over many millions of years, the rocks were worn away and reduced to form new sedimentary debris. This in turn was carried away by wind and water and dumped in the encroaching ocean, which lay not too far away to the west. The hills and valleys of the landscape were gradually reduced to sea level and eventually the sea returned and lay down a new succession of marine deposits. However, we now know that there are important differences in the developing story.

Baron Friedrich Wilhelm Heinrich Alexander von Humboldt, 1769–1859, a pioneer German polymath and geographer. Humboldt travelled to South America with his lifelong companion Aimé Bonpland. His journal influenced Charles Darwin and Humboldt authored the multivolume *Kosmos*, 1845 *et Seq.*

Jefferson's geopolitical 'savvy' and palaeontological interests led to his further sponsorship of the Meriwether Lewis and William Clark 1804–6 exploration of the American West. Part of their remit was to collect any fossil bones they might come across and to investigate whether any mammoths were living in the remote wooded and forested territories west of the Missouri. In addition, they were to check up on persistent rumours that there were Welsh-speaking, white-skinned people known as the Madocians living in the far west. They were supposed to be descendants of the Welsh Prince Madoc who, it was claimed, discovered America in 1170. Jefferson was disappointed on both counts, but in 1807 William Clark did recover some 300 fossil bones from Big Bone Lick. We now know that they included the remains of both mammoth and mastodon along with extinct species of bison, deer and oxen. They were shipped down the Mississippi and in 1803 installed in Jefferson's 'mammoth room'.

Meriwether Lewis, 1774–1809, American soldier and explorer, led an unsuccessful expedition up the Missouri (1792), private secretary to President Jefferson (1801) and joined with William Clark to explore west of the Mississippi (1804–6) and made the first overland journey to the Pacific coast. Governor of Louisiana from 1806.

Cotton Mather, 1663–1728, a Harvard-trained American protestant mystic involved with the Salem witch trials. Mather also founded Yale with a grant from a London merchant, Elihu Harvard. He pioneered innoculation against smallpox in America and became a Fellow of the Royal Society in 1713.



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The economics of shale oil

Saudi America

MIDLAND, TEXAS

The benefits of shale oil are bigger than many Americans realise. Policy has yet to catch up

DENNIS LITHGOW is an oil man, but sees himself as a manufacturer. His factory is a vast expanse of brushland in west Texas. His assembly line is hundreds of brightly painted oil pumps spaced out like a city grid, interspersed with identical clusters of tanks for storage and separation. Through the windscreen of his truck he points out two massive drilling rigs on the horizon and a third about to be erected. Less than 90 days after they punch through the earth, oil will start to flow.

What if they're dry? "We don't drill dry holes here," says Mr Lithgow, an executive for Pioneer Natural Resources, a Texan oil firm. In the conventional oil business, the riskiest thing is finding the stuff. The "tight oil" business, by contrast, is about deposits people have known about for decades but previously could not extract economically.

Pioneer's ranch sits at the centre of the Permian Basin, a prehistoric sea that, along with Eagle Ford in south Texas and North Dakota's Bakken, are the biggest sources of tight oil, a broad category for the dense rocks, such as shale, that usually sit beneath the reservoirs that contain conventional oil. Since 2008 tight-oil production in America has soared from 600,000 to 3.5m barrels per day (see chart 1). Thanks to tight oil and natural gas from shale, fossil fuels are contributing ever more to economic growth: 0.3 points last year alone, according to J.P. Morgan, and 0.1 to 0.2 a year to the end of 2020, according to the Peterson Institute, a think-tank. Upscale furniture stores and luxury-car dealerships have sprung up in Midland since the boom began. Mr Lithgow has truck drivers who earn $80,000 a year. Local oil-service firms have been known to hire fast-food workers on the spot. In all, the unconventional-energy boom will create up to 1.7m new jobs by 2020, predicts McKinsey, a consultancy.

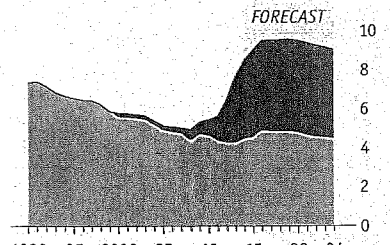
And that is only part of the story. Another benefit of tight oil is that it is much more responsive to world prices. Some economists think this could turn America into a swing producer, helping to moderate the booms and busts of the global market.

Pioneer is rapidly boosting production. But Scott Sheffield, the company's boss, worries that in a few years he will run out of customers; America has prohibited the export of crude oil since the 1970s. At $100 a barrel, the price of West Texas Intermediate (the most popular benchmark for American oil) is comfortably above the break-even cost of tight oil. But the prospect of a glut has futures pricing it at $20 less in 2018. "There will be a lot less oil-drilling when you take $20 out of everybody's margin," says Mr Sheffield.

Until the early 1970s, America was the world's largest oil producer and the Texas Railroad Commission stabilised world prices by dictating how much the state's producers could pump. When Arab states slapped an oil embargo on Israel's Western allies after the six-day war in 1967, Texas cushioned the blow by allowing a massive production boost.

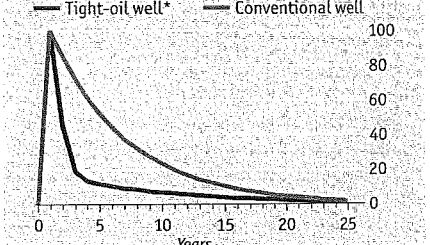
But rising consumption and declining production eroded the state's spare capacity, and in March 1972 Texas called for flat-out production. "This is a damn historic occasion and a sad occasion," the Texas Railroad Commission's chairman declared. When Arab producers imposed another embargo the next year, prices rocketed. America had lost the role of world price arbiter to OPEC, a cartel dominated by des- ▸▸

The shale gale 1
Barrels per day, m
United States
Crude oil production
of which: tight oil*



Source: International Energy Agency *Including shale

Quick hit v slow burn 2
Typical production curves of different kinds of oil well
Peak production=100%



Source: International Energy Agency *Including shale

potic regimes. American politicians tried desperately to curb consumption (for example, by lowering speed limits) and to conserve supplies (by banning crude-oil exports in 1975).

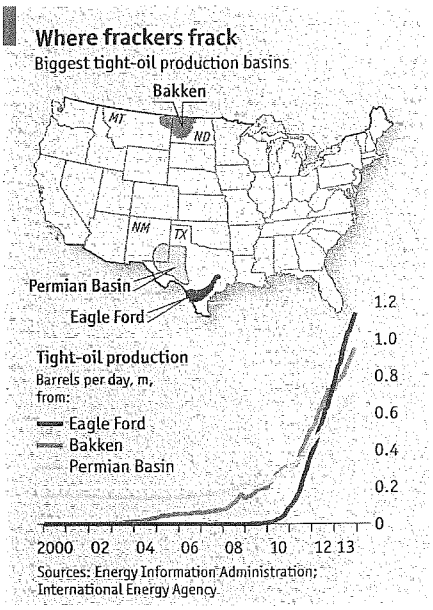
American production declined steadily from a peak of 9.6m barrels a day in 1970 to under 5m in 2008. About then, independent producers began adapting the new technologies of hydraulic fracturing ("fracking") and horizontal drilling, first used to tap shale gas, to oil. Total American production has since risen to 7.4m barrels a day, and the Energy Information Administration, a federal monitor, reckons it will return to its 1970 record by 2019. The International Energy Agency is more bullish; it reckons that by 2020 America will have displaced Saudi Arabia as the world's biggest producer, pumping 11.6m barrels a day.

Besides directly creating new jobs and income, the fossil-fuels boom could help growth by reducing America's vulnerability to oil-price swings, in two ways. First, as production rises and imports shrink, more of the cash that leaves consumers' pockets when the oil price rises will return to American rather than foreign producers. David Woo of Bank of America/Merrill Lynch notes that America's petroleum deficit has narrowed to 1.7% of GDP while Europe's has widened to nearly 4%, which seems to have made both the dollar and the economy less sensitive to oil prices.

The second channel lies in the economics of shale. Oil flows relatively easily through the porous rocks that make up a conventional reservoir, so a conventional well can tap a large area. As a result, the volume of oil pumped each day declines slowly, on average at 6% per year. By contrast, oil flows much more sluggishly through impermeable tight rock. A well will tap a much smaller area and production declines quite rapidly, typically by 30% a year for the first few years (see chart 2 on previous page). Maintaining a field's production levels means constant drilling. The International Energy Agency reckons maintaining production at 1m barrels per day in the Bakken requires 2,500 new wells a year; a large conventional field in southern Iraq needs just 60.

This all means that when oil prices rise, producers can quickly drill more holes and ramp up supply. When prices fall, they simply stop drilling, and production soon declines. In early 2009, after prices collapsed with the global financial crisis, Pioneer shut down all its drilling in the Permian Basin. Within six months, output in the affected areas dropped by 13%.

Bob McNally of Rapidan Group, an industry consultant, predicts that America could be "force-marched" back to the stabilising role it played in the 1960s, this time responding to the market's invisible hand rather than government diktat. Will that work in practice? It may already have done so. Since 2008, the Peterson Institute notes, turmoil in Sudan, sanctions on Iran and declining North Sea output have taken a lot of oil off the market. Without America, which accounted for half of the growth in global output over that period, Persian Gulf producers might not have been able to make up for the loss. Prices could have risen sharply, hurting consumers everywhere. Yet they did not.



Oil firms try not to over-react to short-term price fluctuations, of course. Capital, equipment and labour all cost money, so they try to ramp up production only in response to what they think will be long-term shifts in the oil price.

The ban on crude-oil exports hurts producers and makes it harder for America to become a swing supplier. Light, sweet (ie, low-sulphur) West Texas Intermediate already trades at a discount of $8 to Brent, its global peer. That is due mostly to transport and storage bottlenecks in America, but increasingly the export ban makes a difference. In recent decades American refiners have reconfigured themselves to handle the heavier, sour oil imported from Mexico, Venezuela and Canada's tar sands, leaving them with less capacity for refining tight oil, which is light and sweet.

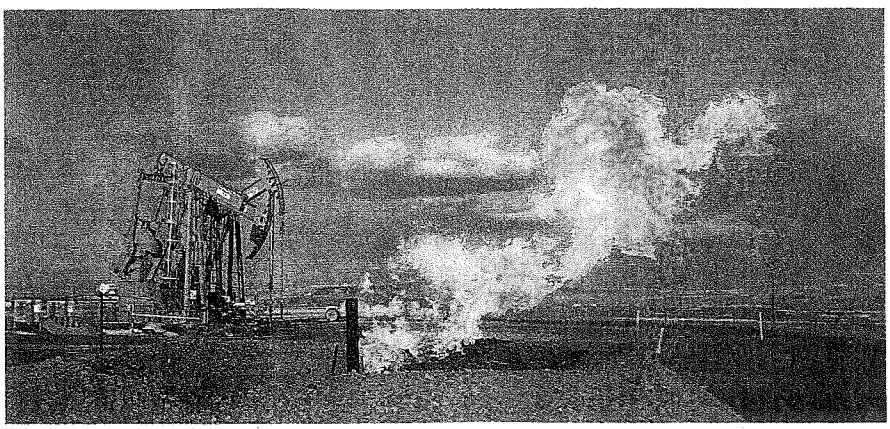
The oil price at which shale producers break even ranges from $60 in the Bakken to $80 in Eagle Ford, reckons Michael Cohen of Barclays, a bank. If exports yielded an extra $1 to $1.30 a barrel, he estimates that might raise total output by as much as 200,000 barrels per year.

If the ban were lifted, crude-oil exports could start more or less straight away. The necessary pipes and tankers are mostly there already. But the political debate is only in its infancy. By law the president can allow exports he considers in the national interest. Barack Obama has yet to express a view on the ban. Legislators from non-oil-producing states are wary. "For me the litmus test is how middle-class families will be affected," says Ron Wyden, the Democratic chairman of the Senate energy and natural resources committee.

The main beneficiaries of the ban are the refiners. They buy light, sweet American crude for less than the global price, turn it into petrol and then sell that at the global price. Exports of refined petroleum products are not banned, and have, unsurprisingly, soared.

Defenders of the ban (including, naturally, some refiners) claim that if America exported more oil, Saudi Arabia would reduce its own output. Prices to American consumers would not fall, they say, and might even rise. Historical evidence says otherwise, however. When Congress allowed Alaska to export crude oil in 1995, its west-coast customers did not pay any more for petrol, diesel or jet fuel.

Oil producers would obviously benefit from lifting the ban. So might other Americans, in less obvious ways. A global oil market that fully included America would be more stable, more diversified and less dependent on OPEC or Russia. The geopolitical dividends could be hefty. As Pioneer's Mr Sheffield notes, "It's hard to believe we're asking the Japanese to stop taking Iranian crude, but we won't ship them any crude ourselves." ■



Frackin' the Bakken

which seeks steadily and benignly to eradicate all differences between the individuals who compose it? If we want to have *men* again in our theatres and our films and our novels—not to speak of in our classrooms, our business offices and our homes—we must first have a society which encourages each of its members to have a distinct identity.

BERNARD DE VOTO (1897-1955)

Born in Ogden, Utah, of Mormon-Italian descent, Bernard De Voto received his bachelor's degree from Harvard College, where he later became a teacher of English. A prolific writer, he was known for such novels as *The Crooked Mile* (1924), and *The Chariot of Fire* (1926), for his articles in such periodicals as *The Saturday Review* and *Harper's* (for which he edited "The Easy Chair" column for twenty years), and for *The Course of Empire* (1952), which Henry Steele Commager called "the best book written about the West since Webb's *Great Plains*." In 1948, he won the Pulitzer Prize for History with *Across the Wide Missouri* (1947). The following selection, typical of his vigorous and stimulating style, is taken from a remarkable collection of miscellany called *The Hour* (1951).

WHISKEY IS FOR PATRIOTS

WHISKEY has been the drink of patriots ever since freedom from her mountain-height unfurled her banner to the air. The American people achieved nationality and Old Monongahely in the same generation, which should surprise no one, since nations flower swiftly once their genius has budded. Take the Irish. They were a breed of half-naked cave dwellers sunk in ignorance and sin and somewhat given to contentiousness. Then the gentle St. Patrick appeared among them. He taught them to make usquebaugh and at once they became the most cultured people in the world.

Or take the Indians. They were a genial people on whom we inflicted repulsive cruelties. (For instance, after the French had educated them to brandy we corrupted their taste with rum.) Yet a philosopher may wonder whether they had it in them to rise to cultural distinction. They evoke both pity and dismay: north of Mexico they never learned to make a fermented beverage, still less a distilled one. That they had ingenuity is not to be denied and one of their achievements is a marvel: they took a couple of wild grasses and bred them up to corn. But what did they do with corn? Century succeeded century and, content to regard it as a mere food, they could not meet the challenge on

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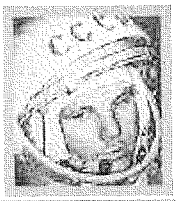
Zoom Explorers

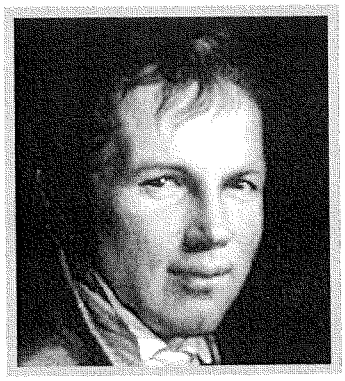


A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Africa	Antarctica	Arctic	Australia	Canada	Mexico	North America	South America	Space	Undersea	Women

1300's and Earlier	1400's	Early 1500's	Late 1500's	1600's	1700's	1800's	1900's	Glossary of Exploration Terms

Baron Alexander von Humboldt: Explorer and Naturalist



Baron Alexander von Humboldt (September 14, 1769-May 6, 1859) was a Prussian naturalist and explorer who explored much of Central and South America. Humboldt and his friend, the French medical doctor/botanist Aime-Jacques-Alexandre Goujoud Bonpland (1773-1858), explored the coast of Venezuela, the Amazon and Orinoco Rivers, and much of Peru, Ecuador, Colombia and Mexico (1799-1805).

On their many expeditions, Humboldt and Bonpland collected plant, animal, and mineral specimens, studied electricity (including discovering the first animal that produced electricity, *Electrophorus electricus*, the electric eel), did extensive mapping

of northern South America, climbed mountains (and set altitude records), observed astronomical phenomena, and performed many scientific observations. The scientist Carlos Montufar (who later became a revolutionary in Ecuador) acconpanied them on part of the trip.

The Humboldt Current

Humboldt discovered what is now called the Humboldt Current off the west coast of South America, while he was investigating why the interior of Peru was so dry. It is a cold ocean current that runs along much of the western coast of South America, and is also known as the Peru Current.

Other Discoveries and Firsts

Humboldt was the first European to witness native South Americans preparing curare arrow poison from a vine. He was also the first person to recognize the need to preserve the cinchona plant (its bark contains quinine, which is used to cure malaria, and it was terribly over-harvested at the time). Humboldt was the first person to make accurate drawings of Inca ruins in South America (he visited the ruins at Canar, Peru). Humboldt and Bonpland discovered and mapped the Casiquiare Canal, the only natural canal in the world that connects two major rivers (the Orinoco River and the Negro River, a tributary of the Amazon). Humboldt was also the first person to discover the importance of guano (the dried droppings from fish-eating birds); it is an excellent fertilizer.

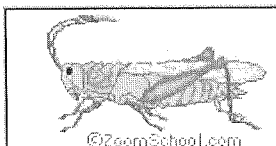
In the USA

After their South American expeditions, Humboldt and Bonpland visited the USA and were guests of President Thomas Jefferson in Washington, D.C., for three months in 1804 (their visit happened just after Jefferson had sent Lewis and Clark to explore the western US).

Late in Life

At the age of 60, Humboldt traveled to the Ural mountains in Siberia and to Central Asia to study the weather. He wrote extensively of his travels and discoveries. One of his books, *A Personal Narrative* inspired a young Charles Darwin. His last work was his multi-volume book, *Kosmos*, which tried to unify all of science. Humboldt died at age 90 (leaving Kosmos unfinished), and is buried in Tegel, Germany. Many landmarks in the Americas, including a current, a river, a mountain range, a reservoir, a salt marsh, parks, many counties and towns are named for Humboldt. On the moon, the Mare Humboldtianum (Humboldt's Sea) was named for Humboldt.

Our subscribers' grade-level estimate for this page: 3rd - 4th



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Biomes - Habitats

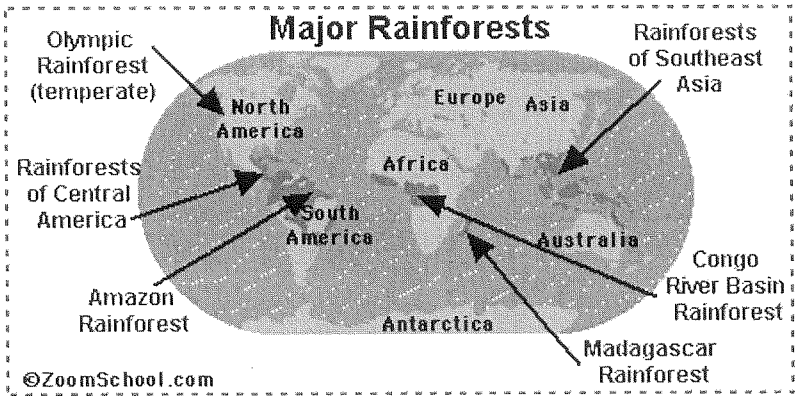
Biomes Calendar
A calendar to print, color, and read.

Arctic	Desert	Chaparral or Scrub		Taiga = Coniferous Forests	Grassland		Tropical Rainforest	Pond	Ocean			
Antarctic	Tundra	Cave	City	Temperate Deciduous Forest	Savanna	Prairie	Freshwater Marsh	Swamp	Intertidal Zone	Coral Reef	Sunlit (Euphotic) Zone	Twilight (Disphotic) Zone

A Sampling of Tropical Rainforest Animals

Rainforests are very dense, warm, wet forests. They are havens for millions of plants and animals. Rainforests are extremely important in the ecology of the Earth. The plants of the rainforest generate much of the Earth's oxygen. These plants are also very important to people in other ways; many are used in new drugs that fight disease and illness.

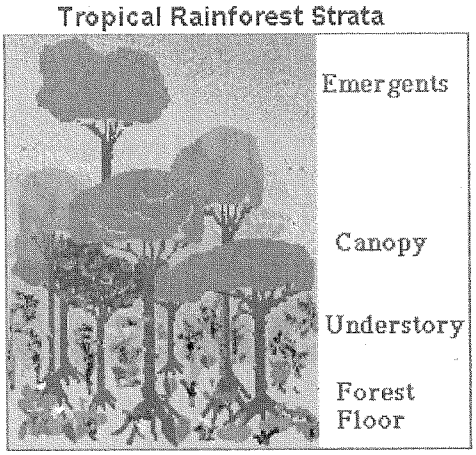
Where are Rainforests? Tropical rainforests are located in a band around the equator, mostly in the area between the Tropic of Cancer (23.5° N latitude) and the Tropic of Capricorn (23.5° S latitude). This 3,000 mile (4800 km) wide band is called the "tropics." Tropical rainforests are found in South America, West Africa, Australia, southern India, and Southeast Asia. **Go to a rainforest map printout to color**.



Strata of the Rainforest

Different animals and plants live in different parts of the rainforest. Scientists divide the rainforest into strata (zones) based on the living environment. Starting at the top, the strata are:

- **EMERGENTS**: Giant trees that are much higher than the average canopy height. It houses many birds and insects.
- **CANOPY**: The upper parts of the trees. This leafy environment is full of life in a tropical rainforest and includes: insects, birds, reptiles, mammals, and more.
- **UNDERSTORY**: A dark, cool environment under the leaves but over the ground.
- **FOREST FLOOR**: Teeming with animal life, especially insects. The largest animals in the rainforest generally live here.



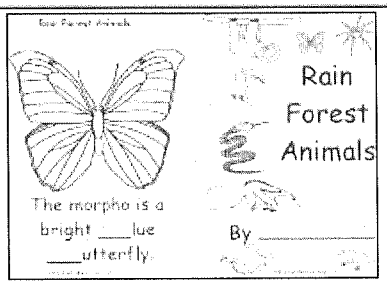
Animals that Live in Rainforests: Ridiculously huge numbers of animals live in rainforests, including microscopic animals, invertebrates (like insects and worms), fish, reptiles, amphibians, birds, and mammals. The different rainforests of the world support different populations of animals. A few animals from each rainforest are listed below:

- **South America** -
  - insects (morpho butterfly, Julia butterfly, Monarch butterfly, and millions of other insects)
  - mammals (jaguar, ocelot, didelphid opossums, sloth, howler monkey, spider monkey, capybara, many bats, marmosets, procyonids, peccaries)
  - birds (quetzal, macaw, tinamous, curassows, hoatzins, hummingbirds, eagles, ovenbirds, antbirds, flycatchers, puffbirds, toucans, jacamars, tanagers, tapirs, troupials, honeycreepers, cardinal grosbeaks, xenops)
  - reptiles (anaconda, caiman, iguanas, lizards, microteiid lizards, boas, and coral snakes), amphibians (poison arrow frog, etc.)
  - fish (electric eel, piranha), and millions of other animals.
- **Australia** -
  - mammals (tree kangaroo, rat kangaroo, yellow-footed Antechinus, Giant White-tailed Uromys, opossums, bandicoot, echidna, duck-billed platypus, sugar glider, red legged pademelon)

- birds (cassowary, brolga, emerald dove, orange-footed scrubfowl, Australian brush-turkey, sarus crane, gray goshawk, wompoo fruit dove, topknot pigeon, Australian king parrot, laughing kookaburra, lesser sooty owl, fernwren, barred cuckoo-shrike, golden whistler, etc.)
- reptiles (frilled lizard, carpet python, Green Tree Snake, Spotted Tree Monitor, Eastern Water Dragon, Boyd's Forest Dragon, Northern Leaf Tailed Gecko)
- insects (Ulysses butterfly, Zodiac Moth, Union Jack butterfly, Regent skipper, Birdwing Butterfly)
- amphibians (Giant Tree frog, Striped marsh frog, Northern Barred frog, Dainty Green Tree frog), and millions of other animals.

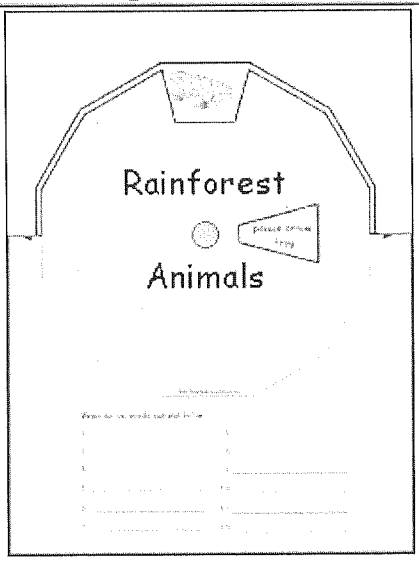
- **Southeast Asia** -
  - mammals (tarsiers, orangutans, Siamangs, gibbons, colobine monkeys, tigers, tree shrews, binturong, moonrats, most flying foxes, colugos, bamboo rats, Oriental dormice)
  - birds (tree swifts, leafbirds, fairy bluebirds, fantails, whistlers, flowerpeckers, wood swallows)
  - insects (Queen Alexandra's Birdwing butterfly, Goliath Birdwing butterfly, Saturn Butterfly), and millions of other animals.
- **West Africa** -
  - mammals (antelopes, bonobo, chimpanzee, gorilla, Mandrill, scaly-tailed squirrels, otter shrews, duikers, okapi, hippopotamus, Cercopithecus monkeys, bushbabies, pygmy hippo, duiker)
  - birds (Congo peafowl, African Gray Parrot) and millions of other animals.

Click on an animal or other rainforest topic for a printout or information on that animal:



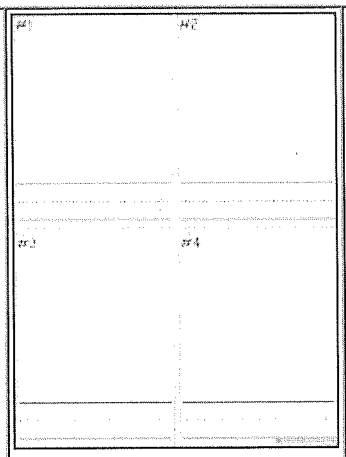
Rain Forest Animals Book

A short book about rain forest animals to print (for early readers), with letters to fill in. There are pages on the morpho butterfly, toucan, anaconda, sloth, howler monkey, kinkajou, tarantula, piranha, capybara, poison arrow frog, and giant anteater.



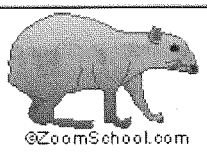
Rainforest Animals Word Wheel

Make a Rainforest Animals word wheel using this 2-page print-out; it consists of a base page together with a wheel that spins around. When you spin the wheel, 12 rainforest animals appear, one at a time: poison arrow frog, anaconda, piranha, howler monkey, capybara, sloth, giant anteater, jaguar, kinkajou, morpho butterfly, toucan, and tarantula. The student then writes down the word wheel



Draw Four Things You Would See in a Rain Forest

Draw four things you would see in a rain forest. Below each item, write its name.



AGOUTI

The agouti is a large, short-tailed rodent from rainforests in the Americas.