

TPO 1~26 长难句汇总

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前言:

新托福阅读,说白了就是考察我们快速阅读理解各种类型句子的能力。因此,在准备阅读部分时候,尤其是刚开始阅读还有障碍的同学,需要着重锻炼自己阅读各类长难句的能力。此前,我们已经大致分析过 TPO 长难句的主要类型,以及分析方法,具体参看[这里](#)。

不过光靠这几句例句提高不了多少,所以寄托独家整理了 TPO1~26套全部阅读文章的长难句汇总,句子虽然不多,但都是每篇文章里面最为精华的长难复杂句。使用方法因人而异,想锻炼基础的话,可以精读这些句子,分析句子成分,理解句子;想练快速阅读的话,可以用这些句子训练自己快速抽取主干的能力。

另外,其实这些句子都很地道,完全可以用来训练我们的写作。读和写的练习如果能结合起来,那效果就更好了。

希望大家好好利用这份资源~取得理想的成绩! 考托路上,寄托与你同行!

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TPO 1

TPO1: Groundwater

1. The same thing happens **to this day**, though on a smaller scale, wherever a sediment-laden river or stream emerges from a mountain valley onto relatively flat land, dropping its load as the **current** slows: the water usually spreads out **fanwise**, depositing the sediment in the form of a smooth, **fan-shaped** slope.
2. Sediments are also dropped where a river slows on entering a lake or the sea, the deposited sediments are on a lake floor or the seafloor at first, but will be located inland at some future date, when the sea level falls or the land rises; such beds are sometimes thousands of meters thick.
3. In **lowland** country almost any spot on the ground may **overlie** what was once the bed of a river that has **since** become buried by soil; if they are now below the water's upper surface (the water table), the **gravels** and sands of the former riverbed, and its **sandbars**, will be **saturated** with **groundwater**.
4. This is because the gaps among the original **grains** are often not totally **plugged** with cementing chemicals; also, parts of the original grains may become **dissolved** by **percolating** groundwater, either while consolidation is taking place or at any time afterwards.
5. But note that **porosity** is not the same as permeability, which measures the ease with which water can flow through a material; this depends on the sizes of the individual **cavities** and the **crevices** linking them.
6. If the pores are large, the water in them will exist as drops too heavy for surface tension to hold, and it will drain away; but if the pores are small enough, the water in them will exist as thin films, too light to overcome the force of surface tension holding them in place; then the water will be firmly held.

TPO1: The Origins of Theater

1. But the myths that have grown up around the **rites** may continue as part of the group's oral tradition and may even come to be **acted out** under conditions divorced from these rites.
2. When this occurs, the first step has been taken toward theater as an **autonomous** activity, and **thereafter** entertainment and aesthetic values may gradually replace the former mystical and socially **efficacious** concerns.

3. For example, one sign of this condition is the appearance of the comic vision, since comedy requires sufficient detachment to view some deviations from social **norms** as ridiculous rather than as serious threats to the welfare of the entire group.

4. For example, some early societies ceased to consider certain rites essential to their well-being and abandoned them, nevertheless, they retained as parts of their oral tradition the myths that had grown up around the rites and admired them for their artistic qualities rather than for their religious usefulness.

TPO1: Timberline Vegetation on Mountains

1. This is particularly true for trees in the middle and upper latitudes, which tend to attain greater heights on ridges, whereas in the tropics the trees reach their greater heights in the valleys.

2. As the snow is deeper and lasts longer in the valleys, trees tend to attain greater heights on the ridges, even though they are more exposed to high-velocity winds and poor, thin soils there.

3. Some scientists have proposed that the presence of increasing levels of **ultraviolet** light with **elevation** may play a role, while browsing and grazing animals like the ibex may be another contributing factor.

4. Probably the most important environmental factor is temperature, for if the growing season is too short and temperatures are too low, tree shoots and buds cannot mature sufficiently to survive the winter months.

5. Immediately adjacent to the timberline, the **tundra** consists of a fairly complete cover of low-lying shrubs, herbs, and grasses, while higher up the number and diversity of species decrease until there is much bare ground with occasional **mosses** and **lichens** and some **prostrate cushion** plants.

TPO 2

TPO2: Desert Formation

1. The extreme seriousness of **desertification** results from the vast areas of land and the tremendous numbers of people affected, as well as from the great difficulty of reversing or even slowing the process.

2. In areas where considerable soil still remains, though, a **rigorously** enforced program of land protection and cover-crop planting may make it possible to reverse the present deterioration of the surface.

TPO2: The Origins of Cetaceans

1. However, unlike the cases of sea otters and pinnipeds (seals, sea lions, and walruses, whose limbs are functional both on land and at sea), it is not easy to envision what the first whales looked like.

2. The structure of the backbone shows, however, that *Ambulocetus* swam like modern whales by moving the **rear** portion of its body up and down, even though a fluke was missing.

TPO2: Early Cinema

1. Exhibitors, however, wanted to maximize their profits, which they could do more readily by projecting a handful of films to hundreds of customers at a time (rather than one at a time) and by charging 25 to 50 cents admission.

2. But the movies differed significantly from these other forms of entertainment, which depended on either live performance or (in the case of the slide-and-lantern shows) the active involvement of a **master of ceremonies** who assembled the final program.

3. Even though early exhibitors shaped their film programs by mixing films and other entertainments together in whichever way they thought would be most attractive to audiences or by accompanying them with lectures, their creative control remained limited.

4. What audiences came to see was the technological **marvel** of the movies; the lifelike reproduction of the commonplace motion of trains, of waves striking the shore, and of people walking in the street; and the magic made possible by trick photography and the manipulation of the camera.

5. With the **advent** of projection, the viewer's relationship with the image was no longer private, as it had been with earlier **peepshow** devices such as the Kinetoscope and the Mutoscope, which was a similar machine that reproduced motion by means of successive images on individual photographic cards instead of on **strips** of **celluloid**.

TPO 3

TPO3: Architecture

1. In order for the structure to achieve the size and strength necessary to meet its purpose, architecture employs methods of support that, because they are based on physical laws, have changed little since people first discovered them—even while building materials have changed dramatically.
2. The arch was used by the early cultures of the Mediterranean area chiefly for underground **drains**, but it was the Romans who first developed and used the arch extensively in aboveground structures.

TPO3: Depletion of the Ogallala Aquifer

1. Estimates indicate that the **aquifer** contains enough water to fill Lake Huron, but unfortunately, under the **semiarid** climatic conditions that presently exist in the region, rates of addition to the aquifer are minimal, amounting to about half a centimeter a year.
2. This unprecedented development of a finite groundwater resource with an almost negligible natural recharge rate—that is, virtually no natural water source to replenish the water supply—has caused water tables in the region to fall drastically.
3. The incentive of the farmers who wish to conserve water is reduced by their knowledge that many of their neighbors are profiting by using great amounts of water, and in the process are drawing down the entire region's water supplies.
4. Unfortunately, the cost of water obtained through any of these schemes would increase pumping costs at least **tenfold**, making the cost of irrigated agricultural products from the region uncompetitive on the national and international markets.
5. Whatever the final answer to the water crisis may be, it is evident that within the High Plains, irrigation water will never again be the abundant, inexpensive resource it was during the agricultural boom years of the mid-twentieth century.

TPO3: The Long-Term Stability of Ecosystems

1. Many ecologists now think that the relative long-term stability of **climax communities** comes not from diversity but from the “patchiness” of the environment, an environment that varies from place to place supports more kinds of organisms than an environment that is uniform.

TPO 4

TPO4: Cave Art in Europe

1. The researchers Peter Ucko and Andree Rosenfeld identified three principal locations of paintings in the caves of western Europe: (1) in obviously inhabited rock shelters and cave entrances; (2) in galleries immediately off the inhabited areas of caves; and (3) in the inner reaches of caves, whose difficulty of access has been interpreted by some as a sign that **magical**-religious activities were performed there.
2. Perhaps, like many contemporary peoples, Upper Paleolithic men and women believed that the drawing of a human image could cause death or injury, and if that were indeed their belief, it might explain why human figures are rarely **depicted** in cave art.
3. Consistent with this idea, according to the investigators, is the fact that the art of the cultural period that followed the Upper Paleolithic also seems to reflect how people got their food.

TPO4: Deer Populations of the Puget Sound

1. Wildlife zoologist Helmut Buechner(1953), in reviewing the nature of biotic changes in Washington through recorded time, says that "since the early 1940s, the state has had more deer than at any other time in its history, the winter population fluctuating around approximately 320,000 deer (mule and black-tailed deer), which will **yield** about 65,000 of either sex and any age annually for an indefinite period."
2. In addition to finding an increase of suitable browse, like huckleberry and vine maple, Arthur Einarsen, longtime game biologist in the Pacific Northwest, found quality of browse in the open areas to be substantially more nutritive.

TPO 4: Petroleum Resource

1. Continued sedimentation—the process of deposits' settling on the sea bottom—buries the organic matter and **subjects it to** higher temperatures and pressures, which convert the organic matter to oil and gas.

TPO 5

TPO5: Minerals and Plants

1. Mineral deficiencies can often be detected by specific **symptoms** such as **chlorosis** (loss of **chlorophyll** resulting in yellow or white leaf tissue), **necrosis** (isolated dead patches), **anthocyanin** formation (development of deep red pigmentation of leaves or **stem**), **stunted** growth, and development of woody tissue in an **herbaceous** plant.
2. Only recently have investigators considered using these plants to clean up soil and waste sites that have been **contaminated** by toxic levels of heavy metals—an environmentally friendly approach known as **phytoremediation**.
3. For examples, in field trials, the plant **alpine** pennycress removed zinc and cadmium from soils near a zinc smelter, and Indian **mustard**, native to Pakistan and India, has been effective in reducing levels of **selenium** salts by 50 percent in contaminated soils.

TPO5: The Origin of the Pacific Island People

1. Contrary to these theorists, the overwhelming evidence of physical anthropology, linguistics, and archaeology shows that the Pacific islanders came from Southeast Asia and were skilled enough as navigators to sail against the prevailing winds and currents.
2. The basic cultural requirements for the successful colonization of the Pacific islands include the appropriate boat-building, sailing, and navigation skills to get to the islands in the first place, domesticated plants and gardening skills suited to often marginal conditions, and a varied inventory of fishing implements and techniques.
3. Contrary to the arguments of some that much of the Pacific was settled by Polynesians accidentally **marooned** after being lost and **adrift**, it seems reasonable that this **feat** was accomplished by deliberate colonization **expeditions** that set out fully stocked with food and domesticated plants and animals.
4. As Patrick Kirch, an American **anthropologist**, points out, rather than being brought by **rafting** South Americans, sweet potatoes might just have easily been brought back by returning Polynesian navigators who could have reached the west coast of South America.

TPO5: The Cambrian Explosion

1. The **geologic timescale** is marked by significant geologic and biological events, including the origin of Earth about 4.6 billion years ago, the origin of life about 3.5 billion years ago, the origin of eukaryotic life-forms (living things that have cells with true nuclei)

about 1.5 billion years ago, and the origin of animals about 0.6 billion years ago.

2. At one time, the animals present in these fossil beds were assigned to various modern animal groups, but most paleontologists now agree that all Tommotian fossils represent unique body forms that arose in the early Cambrian period and disappeared before the end of the period, leaving no descendants in modern animal groups.

3. These fossil beds provide evidence of about 32 modern animal groups, plus about 20 other animal body forms that are so different from any modern animals that they cannot be assigned to any one of the modern groups.

TPO 6

TPO6: Powering the Industrial Revolution

Only the last of these was suited at all to the continuous operating of machines, and although waterpower **abounded** in Lancashire and Scotland and ran grain **mills** as well as **textile** mills, it had one great disadvantage: streams flowed where nature intended them to, and water-driven factories had to be located on their banks whether or not the location was desirable for other reasons.

2. Early in the eighteenth century, a pump had come into use in which expanding steam raised a **piston** in a **cylinder**, and atmospheric pressure brought it down again when the steam **condensed** inside the cylinder to form a **vacuum**.

3. This “atmospheric engine,” invented by Thomas Savery and vastly improved by his partner, Thomas Newcomen, embodied revolutionary principles, but it was so slow and wasteful of fuel that it could not be employed outside the coal mines for which it had been designed.

4. Another generation passed before inventors succeeded in combining these **ingredients**, by putting the engine on wheels and the wheels on the rails, so as to provide a machine to take the place of the horse.

TPO6: William Smith

1. In 1815 he published the first modern geological map, “A Map of the Strata of England and Wales with a Part of Scotland,” a map so **meticulously** researched that it can still be used today.

2. But as more and more **accumulations** of **strata** were cataloged in more and more places, it became clear that the sequences of rocks sometimes differed from region to region and that no rock type was ever going to become a reliable time marker throughout the world.
3. Not only could Smith identify rock strata by the fossils they contained, he could also see a pattern emerging: certain fossils always appear in more ancient sediments, while others begin to be seen as the strata become more recent.
4. Limestone may be found in the Cambrian or—300 million years later—in the Jurassic strata, but a trilobite—the ubiquitous marine **arthropod** that had its birth in the Cambrian—will never be found in Jurassic strata, nor a dinosaur in the Cambrian.

TPO6: Infantile Amnesia

1. Demonstrations of infants' and **toddlers'** long-term memory have involved their repeating motor activities that they had seen or done earlier, such as reaching in the dark for objects, putting a bottle in a **doll's** mouth, or pulling apart two pieces of a toy.
2. Whether people can remember an event depends **critically** on the fit between the way in which they earlier encoded the information and the way in which they later attempt to retrieve it.
3. General knowledge of categories of events such as a birthday party or a visit to the doctor's office helps older individuals encode their experiences, but again, infants and toddlers are unlikely to encode many experiences within such knowledge structures.

TPO 7

TPO7: The Geologic History of the Mediterranean

1. Were they salt **domes** such as are common along the United States Gulf Coast, and if so, why should there have been so much solid **crystalline** salt **beneath** the floor of the Mediterranean?

TPO7: Ancient Rome and Greece

1. Like the stone of Roman wall, which were held together both by the **regularity** of the design and by that **peculiarly** powerful Roman cement, so the various parts of the Roman **realm** were bonded into a massive, **monolithic** entity by physical, organizational, and

psychological controls.

2. Of course, the contrast is not quite so **stark**: in Alexander the Great the Greeks had found the greatest territorial **conqueror** of all time; and the Romans, once they moved outside Italy, did not fail to learn the lessons of sea power.

3. In all probability it was the fertile plain of Latium, where the Latins who founded Rome originated, that created the habits and skills of landed settlement, landed property, landed economy, landed administration, and a land-based society.

4. In turn, a deep attachment to the land, and to the stability which **rural** life **engenders**, fostered the Roman virtues: **gravitas**, a sense of responsibility, *peitas*, a sense of devotion to family and country, and *iustitia*, a sense of the **natural order**.

TPO7: Agriculture, Iron, and the Bantu Peoples

1. Most of Africa presents a **curious** case in which societies moved directly from a technology of stone to iron without passing through the intermediate stage of copper or **bronze metallurgy**, although some early copper-working sites have been found in West Africa.

2. Unlike in the Americas, where metallurgy was a very late and limited development, Africans had iron from a relatively early date, developing **ingenious furnaces** to produce the high heat needed for production and to control the amount of air that reached the carbon and iron ore necessary for making iron.

3. Why and how these people spread out into central and southern Africa remains a mystery, but archaeologists believe that their iron weapons allowed them to conquer their hunting-gathering opponents, who still used stone implements.

TPO 8

TPO8: The Rise of Teotihuacan

1. Among the main factors are Teotihuacán's geographic location on a natural trade route to the south and east of the Valley of Mexico, the **obsidian** resources in the Teotihuacán Valley itself, and the valley's potential for **extensive irrigation**.

2. The exact role of other factors is much more difficult to pinpoint—for instance, Teotihuacán's religious significance as a **shrine**, the historical situation in and around the

Valley of Mexico toward the end of the first millennium B.C., the ingenuity and foresightedness of Teotihuacán's elite, and, finally, the impact of natural disasters, such as the volcanic eruptions of the late first millennium B.C.

3. The hard volcanic stone was a resource that had been in great demand for many years, at least since the rise of the Olmecs (a people who flourished between 1200 and 400 B.C.), and it apparently had a secure market.

TPO8: Extinction of the Dinosaurs

1. Critics also point out that the shallow seaways had retreated from and advanced on the continents numerous times during the Mesozoic, so why did the dinosaurs survive the climatic changes associated with the earlier fluctuations but not with this one?

2. Scientists felt that they could get an idea of how long the extinctions took by determining how long it took to deposit this one centimeter of clay and they thought they could determine the time it took to deposit the clay by determining the amount of the element iridium (Ir) it contained.

3. Their calculations show that the impact kicked up a dust cloud that cut off sunlight for several months, inhibiting photosynthesis in plants; decreased surface temperatures on continents to below freezing; caused extreme episodes of acid rain; and significantly raised long-term global temperatures through the greenhouse effect.

TPO8: Running water on Mars

1. The onrushing water arising from these flash floods likely also formed the odd teardrop-shaped “islands” (resembling the miniature versions seen in the wet sand of our beaches at low tide) that have been found on the plains close to the ends of the outflow channels.

2. Judging from the width and depth of the channels, the flow rates must have been truly enormous—perhaps as much as a hundred times greater than the 105 tons per second carried by the great Amazon river.

3. A 2003 Mars Global Surveyor image shows what mission specialists think may be a delta—a fan-shaped network of channels and sediments where a river once flowed into a larger body of water, in this case a lake filling a crater in the southern highlands.

4. But detractors maintain that the terraces could also have been created by geological activity, perhaps related to the geologic forces that depressed the Northern Hemisphere far below the level of the south, in which case they have nothing whatever to do with Martian water.

5. Furthermore, Mars Global Surveyor data released in 2003 seem to indicate that the Martian surface contains too few **carbonate** rock layers—layers containing compounds of carbon and oxygen—that should have been formed in abundance in an ancient ocean.
6. Aside from some small-scale gullies (channels) found since 2000, which are inconclusive, astronomers have no direct evidence for liquid water anywhere on the surface of Mars today, and the amount of water **vapor** in the Martian atmosphere is tiny.

TPO 9

TPO9: Colonizing the Americas via the Northwest Coast

1. Fladmark's hypothesis received additional support from the fact that the greatest diversity in native American languages occurs along the west coast of the Americas, suggesting that this region has been settled the longest.
2. The **coastal** hypothesis has gained increasing support in recent years because the remains of large land animals, such as **caribou** and brown bears, have been found in southeastern Alaska dating between 10,000 and 12,500 years ago.
3. The most recent geologic evidence indicates that it may have been possible for people to colonize **ice-free** regions along the continental **shelf** that were still exposed by the lower sea level between 13,000 and 14,000 years ago.

TPO9: Reflection in Teaching

1. This was justified by the view that **reflective practice** could help teachers to feel more intellectually involved in their role and work in teaching and enable them to **cope with** the **paucity** of scientific fact and the uncertainty of knowledge in the **discipline** of teaching.
2. They were concerned that many would be **"drawn to"** these new, refreshing" conceptions of teaching only to find that the **void** between the abstractions and the realities of teacher reflection is too great to bridge.
3. The researchers estimate that the initial training of the teachers to view events objectively took between 20 and 30 hours, with the same number of hours again being required to practice the skills of reflection.

TPO9: The Arrival of Plant Life in Hawaii

1. It is significant that the earliest living things that built communities on these islands are examples of **symbiosis**, a phenomenon that depends upon the close cooperation of two or more forms of life and a principle that is very important in island communities.
2. Lichens helped to speed the **decomposition** of the hard rock surfaces, preparing a soft bed of soil that was abundantly supplied with minerals that had been carried in the molten rock from the **bowels** of Earth.
3. These plants propagate by producing **spores**—tiny fertilized cells that contain all the instructions for making a new plant—but the spore are unprotected by any outer coating and carry no supply of nutrient.
4. Remarkably **resistant to** the **vicissitudes** of ocean travel, they can survive prolonged **immersion** in saltwater when they come to rest on warm beaches and the conditions are favorable, the seed coats soften.

TPO 10

TPO10: Chinese Pottery

1. **Whitewares** produced in Hebei and Henan **provinces** from the seventh to the tenth centuries evolved into the highly prized **porcelains** of the Song dynasty (AD. 960-1279), long regarded as one of the high points in the history of China's **ceramic** industry.
2. The tradition of religious **sculpture** **extends over** most historical periods but is less clearly **delineated** than that of stonewares or porcelains, for it **embraces** the old custom of earthenware **burial** ceramics with later religious images and architectural ornament.
3. Ceramic products also include **lead-glazed** **tomb** models of the Han dynasty, three-color lead-glazed **vessels** and figures of the Tang dynasty, and Ming three-color temple ornaments, in which the **motifs** were **outlined** in a raised trail of **slip**—as well as the many burial ceramics produced in imitation of vessels made in materials of higher intrinsic value.
4. Just as painted designs on Greek pots may seem today to be purely **decorative**, whereas in fact they were carefully and precisely worked out so that at the time, their meaning was clear, so it is with Chinese **pots**.

5. The dragon represented the **emperor**, and the **phoenix**, the empress; the **pomegranate** indicated fertility, and a pair of fish, happiness; mandarin ducks stood for **wedded** bliss; the pine tree, peach, and crane are emblems of long life; and fish leaping from waves indicated success in the civil service examinations.

TPO10: Variations in The Climate

1. One of the most difficult aspects of deciding whether current climatic events reveal evidence of the impact of human activities is that it is hard to get a measure of what constitutes the natural variability of the climate.

2. We need therefore to know how much the climate can vary of its own accord in order to interpret with confidence the extent to which recent changes are natural as opposed to being the result of human activities.

3. Over long periods of time, substances whose physical and chemical properties change with the **ambient** climate at the time can be deposited in a **systematic** way to provide a continuous record of changes in those properties overtime, sometimes for hundreds or thousands of years.

4. Proxy temperature records have been reconstructed from ice core **drilled out** of the central Greenland ice **cap**, **calcite** shells embedded in layered lake sediments in Western Europe, ocean floor sediment cores from the tropical Atlantic Ocean, ice cores from Peruvian glaciers, and ice cores from eastern Antarctica.

5. While these records provide broadly consistent indications that temperature variations can occur on a global scale, there are nonetheless some **intriguing** differences, which suggest that the pattern of temperature variations in regional climates can also differ significantly from each other.

6. Some current analyses conclude that volcanoes and solar activity explain quite a considerable amount of the observed variability in the period from the seventeenth to the early twentieth centuries, but that they cannot be invoked to explain the rapid warming in recent decades.

TPO10: Seventeenth-Century European Economic Growth

1. At mid-century, an Antwerp financier only slightly **exaggerated** when he claimed, "one can no more trade without bills of exchange than sail without water." **Merchants** no longer had to carry gold and silver over long, dangerous journeys.

2. The exchanger would then send a bill of exchange to a colleague in Marseille, authorizing the colleague to pay the Marseille merchant in the merchant's own currency after the actual exchange of goods had taken place.

3. Unlike short-term financial cooperation between investors for a single commercial undertaking, joint-stock companies provided permanent funding of capital by drawing on the investments of merchants and other investors who purchased shares in the company.

TPO 11

TPO11: Ancient Egyptian Sculpture

1. Without this knowledge we can appreciate only the formal content of Egyptian art, and we will fail to understand why it was produced or the concepts that shaped it and caused it to adopt its distinctive forms.

2. In fact, a lack of understanding concerning the purposes of Egyptian art has often led it to be compared unfavorably with the art of other cultures: Why did the Egyptians not develop sculpture in which the body turned and twisted through space like classical Greek statuary?

3. When such statues are viewed in isolation, out of their original context and without knowledge of their function, it is easy to criticize them for their rigid attitudes that remained unchanged for three thousand years.

4. Other statues were designed to be placed within an architectural setting, for instance, in front of the monumental entrance gateways to temples known as pylons, or in pillared courts, where they would be placed against or between pillars: their frontality worked perfectly within the architectural context.

5. By contrast, wooden statues were carved from several pieces of wood that were pegged together to form the finished work, and metal statues were either made by wrapping sheet metal around a wooden core or cast by the lost wax process.

6. Unlike formal statues that are limited to static poses of standing, sitting, and kneeling, these figures depict a wide range of actions, such as grinding grain, baking bread, producing pots, and making music, and they are shown in appropriate poses, bending and squatting as they carry out their tasks.

TPO11: Orientation and Navigation

1. He then set up experiments with caged starlings and found that their orientation was, in fact, in the proper migratory direction except when the sky was overcast, at which times

there was no clear direction to their restless movements.

2. If the artificial Sun remained **stationary**, the birds would shift their direction with respect to it at a rate of about 15 degrees per hour, the Sun's rate of movement across the sky.

TPO11: Begging By Nestlings

1. The hypothesis that **begging calls** have **evolved** properties that reduce their potential for attracting predators yields a prediction: baby birds of species that experience high rates of nest predation should produce softer begging signals of higher frequency than **nestlings** of other species less often victimized by nest predators.

2. This prediction was supported by data collected in one survey of 24 species from an Arizona forest, more evidence that predator pressure favors the evolution of begging calls that are hard to detect and pinpoint.

3. One possibility is that a noisy baby bird provides accurate signals of its real hunger and good health, making it worthwhile for the listening parent to give it food in a nest where several other **offspring** are usually available to be fed.

4. When experimentally **deprived** baby robins are placed in a nest with normally fed **siblings**, the hungry nestlings beg more loudly than usual—but so do their better-fed siblings, though not as loudly as the hungrier birds.

5. Indeed, if you take baby tree swallows out of a nest for an hour feeding half the set and starving the other half, when the birds are replaced in the nest, the starved youngsters beg more loudly than the fed birds, and the parent birds feed the active beggars more than those who beg less vigorously.

6. The answer lies apparently not in the increased energy costs of exaggerated begging—such energy costs are small relative to the potential gain in calories—but rather in the damage that any successful **cheater** would do to its **siblings**, which share genes with one another.

TPO 12

TPO12: Which Hand did they use?

1. Most engravings, for example, are best lit from the left, as **befits** the work of right-handed artists, who generally prefer to have the light source on the left so that the

shadow of their hand does not fall on the tip of the engraving tool or brush.

2. Right-handers tend to have longer, stronger, and more **muscular** bones on the right side, and Marcellin Boule as long ago as 1911 noted the La Chapelle-aux-Saints Neanderthal skeleton had a right upper arm bone that was noticeably stronger than the left.

3. The part of the brain responsible for **fine control** and movement is located in the left cerebral **hemisphere**, and the findings above suggest that the human brain was already asymmetrical in its structure and function not long after 2 million years ago.

4. Among Neanderthals of 70,000–35,000 years ago, Marcellin Boule noted that the La Chapelle-aux-Saints individual had a left hemisphere slightly bigger than the right, and the same was found for brains of **specimens** from Neanderthal, Gibraltar, and La Quina.

TPO12: Transition to Sound in Film

1. Despite all the highly visible technological developments in **theatrical** and home delivery of the moving image that have occurred over the decades since then, no single innovation has come close to being regarded as a similar kind of watershed.

2. In many instances, spectators in the era before recorded sound experienced elaborate aural presentations alongside movies' visual images, from the Japanese benshi (narrators) crafting multivoiced dialogue narratives to original musical compositions performed by **symphony-size orchestras** in Europe and the United States.

3. In Berlin, for the **premiere** performance outside the Soviet Union of The Battleship Potemkin, film director Sergei Eisenstein worked with Austrian composer Edmund Meisel (1874-1930) on a **musical score** matching sound to image; the Berlin screenings with live music helped to bring the film its wide international fame.

4. Though it may be difficult to imagine from a later perspective, a **strain** of critical opinion in the 1920s predicted that sound film would be a technical novelty that would soon **fade** from sight, just as had many previous attempts, **dating well back** before the First World War, to link images with recorded sound.

5. To be sure, their evaluation of the technical flaws in 1920s sound experiments was not so **far off** the mark, yet they neglected to take into account important new forces in the motion picture field that, **in a sense**, would not **take no for** an answer.

6. In 1929 the United States motion picture industry released more than 300 sound films—a rough figure, since a number were silent films with music tracks, or films prepared in dual versions, to **take account of** the many cinemas not yet wired for sound.

7. In Europe it took a little longer, mainly because there were more small producers for whom the costs of sound were prohibitive, and in other parts of the world problems with rights or access to equipment delayed the shift to sound production for a few more years (though cinemas in major cities may have been wired in order to play foreign sound films).

TPO12: Water in The Desert

1. This is useful for irrigation, but the high temperatures, low humidities, and different day lengths of the dry season, compared to the normal growing season, can present difficulties with some crops.

TPO 13

TPO13: Types of Social Groups

1. Sociologists view primary groups as bridges between individuals and the larger society because they transmit, mediate, and interpret a society's cultural patterns and provide the sense of **oneness** so critical for social solidarity.
2. For instance, some social groups employ shunning (a person can remain in the community, but others are forbidden to interact with the person) as a device to **bring into line** individuals whose behavior goes beyond that allowed by the particular group.

TPO13: Biological Clocks

1. The relations between animal activity and these periods, particularly for the daily rhythms, have been of such interest and importance that a huge amount of work has been done on them and the special research field of **chronobiology** has emerged.
2. Normally, the constantly changing levels of an animal's activity—sleeping, feeding, moving, reproducing, metabolizing, and producing enzymes and hormones, for example—are well coordinated with environmental rhythms, but the key question is whether the animal's schedule is driven by external **cues**, such as sunrise or sunset, or is instead dependent somehow on internal timers that themselves generate the observed biological rhythms.
3. Indeed, stability of the biological clock's period is one of its major features, even when the organism's environment is subjected to considerable changes in factors, such as

temperature, that would be expected to affect biological activity strongly.

4. The disorienting effects of this mismatch between external time cues and internal schedules may persist, like our jet lag, for several days or weeks until certain cues such as the daylight/darkness cycle reset the organism's clock to synchronize with the daily rhythm of the new environment.

5. Such an external cue not only coordinates an animal's daily rhythms with particular features of the local solar day but also—because it normally does so day after day—seems to keep the internal clock's period close to that of Earth's rotation.

TPO13: Methods of Studying Infant Perception

1. Similarly, changes in the infant's general level of motor activity —turning the head, blinking the eyes, crying, and so forth — have been used by researchers as visual indicators of the infant's **perceptual** abilities.

2. Therefore, when observational assessment is used as a technique for studying infant perceptual abilities, care must be taken not to overgeneralize from the data or to rely on one or two studies as conclusive evidence of a particular perceptual ability of the infant.

TPO 14

TPO14: Children and Advertising

1. The Independent Television Commission, regulator of television advertising in the United Kingdom, has criticized advertisers for "misleadingness"—creating a wrong impression either intentionally or unintentionally—in an effort to control advertisers' use of techniques that make it difficult for children to judge the true size, action, performance, or construction of a toy.

2. However, research has shown that children often have difficulty understanding disclaimers: children may interpret the phrase "when part of a nutritionally balanced breakfast" to mean that the **cereal** is required as a necessary part of a balanced breakfast.

3. The author George Comstock suggested that less than a quarter of children between the ages of six and eight years old understood standard **disclaimers** used in many toy advertisements and that disclaimers are more readily comprehended when presented in both audio and visual formats.

4. A study of children in Hong Kong, however, found that the presence of celebrities in advertisements could negatively affect the children's perceptions of a product if the children did not like the celebrity in question.

TPO14: Maya Water Problems

1. To understand the ancient Mayan people who lived in the area that is today southern Mexico and Central America and the ecological difficulties they faced, one must first consider their environment, which we think of as "jungle" or "tropical rainforest."

2. While that made things hard for ancient Maya living in the south, it has also made things hard for modern archaeologists who have difficulty understanding why ancient droughts caused bigger problems in the wet south than in the dry north.

3. Making matters worse, most of the Yucatan Peninsula consists of karst, a porous sponge-like limestone terrain where rain runs straight into the ground and where little or no surface water remains available.

4. The explanation is that the Maya excavated depressions, or modified natural depressions, and then plugged up **leaks** in the karst by **plastering** the bottoms of the depressions in order to create **reservoirs**, which collected rain from large plastered catchment **basins** and stored it for use in the dry season.

TPO14: Pastoralism in Ancient Inner Eurasia

1. Archaeological evidence suggests that by 3000 B.C., and perhaps even earlier, there had emerged on the steppes of Inner Eurasia the distinctive types of **pastoralism** that were to dominate the region's history for several **millennia**.

2. The remarkable mobility and range of **pastoral** societies explain, in part, why so many linguists have argued that the Indo-European languages began their astonishing expansionist career not among farmers in Anatolia (present-day Turkey), but among early pastoralists from Inner Eurasia.

3. Such theories imply that the Indo-European languages evolved not in Neolithic (10,000 to 3,000 B.C.) Anatolia, but among the foraging communities of the cultures in the region of the Don and Dnieper rivers, which took up stock breeding and began to exploit the neighboring steppes.

4. **Inequalities** of wealth and **rank** certainly exist, and have probably existed in most pastoralist societies, but except in periods of military **conquest**, they are normally too slight to generate the stable, **hereditary** hierarchies that are usually implied by the use of the term class.

5. Inequalities of gender have also existed in pastoralist societies, but they seem to have been softened by the absence of steep hierarchies of wealth in most communities, and also by the requirement that women acquire most of the skills of men, including, often, their military skills.

TPO 15

TPO15: The Warm-Blooded Turtle

1. In a countercurrent exchange system, the blood vessels carrying cooled blood from the **flippers** run close enough to the blood vessels carrying warm blood from the body to pick up some heat from the warmer blood vessels; thus, the heat is transferred from the outgoing to the ingoing vessels before it reaches the flipper itself.

TPO15: Glacier Formation

1. When the ice is thick enough, usually over 30 meters, the weight of the snow and firn will cause the ice crystals toward the bottom to become plastic and to flow outward or downward from the area of snow accumulation.

2. For a glacier to grow or maintain its mass, there must be sufficient snowfall to match or exceed the annual loss through melting, evaporation, and calving, which occurs when the glacier loses solid **chunks** as **icebergs** to the sea or to large lakes.

3. Glaciers move slowly across the land with tremendous energy, carving into even the hardest rock formations and thereby reshaping the landscape as they engulf, push, drag, and finally deposit rock debris in places far from its original location.

TPO15: Mass Extinctions

1. Some of the proposed mechanisms required a very brief period during which all extinctions suddenly took place; other mechanisms would be more likely to have taken place more gradually, over an extended period, or at different times on different continents.

2. American paleontologists David Raup and John Sepkoski, who have studied extinction rates in a number of fossil groups, suggest that episodes of increased extinction have recurred periodically, approximately every 26 million years since the mid-Cretaceous period.

3. The possibility that mass extinctions may recur periodically has given rise to such hypotheses as that of a companion star with a long-period orbit deflecting other bodies from their normal orbits, making some of them fall to Earth as meteors and causing widespread devastation upon impact.

TPO 16

TPO16: Trade and the Ancient Middle East

1. This has been so since ancient times, partly due to the geology of the area, which is mostly limestone and sandstone, with few deposits of metallic ore and other useful materials. Ancient demands for obsidian (a black volcanic rock useful for making mirrors and tools) led to trade with Armenia to the north, while jade for cutting tools was brought from Turkistan, and the precious stone lapis lazuli was imported from Afghanistan.

2. Records show **merchant caravans** and trading posts set up by the Sumerians in the surrounding mountains and deserts of Persia and Arabia, where they traded grain for raw materials, such as timber and stones, as well as for metals and **gems**.

3. In these shops differences of rank were **blurred** as **artisans** and masters labored side by side in the same modest **establishment**, were usually members of the same **guild** and religious **sect**, lived in the same neighborhoods, and often had assumed (or real) kinship relationships.

4. The growth of independent guilds was furthered by the fact that **surplus** was not a result of domestic craft production but resulted primarily from international trading; the government left working people to govern themselves, much as **shepherds** of **tribal confederacies** were left alone by their leaders.

5. In the multiplicity of small-scale local egalitarian or quasi-egalitarian organizations for fellowship, worship, and production that flourished in this **laissez-faire** environment, individuals could interact with one another within a community of harmony and ideological equality, following their own popularly elected leaders and governing themselves by shared consensus while minimizing distinctions of wealth and power.

6. As among tribespeople, personal relationships and a careful weighing of character have always been crucial in a **mercantile** economy with little regulation, where one's word is one's **bond** and where informal ties of trust cement together an international trade network.

7. Nor have merchants and artisans ever had much tolerance for aristocratic professions of moral **superiority**, favoring instead an egalitarian ethic of the open market, where steady hard work, the loyalty of one's fellows, and **entrepreneurial** skill make all the difference.

8. The central state, though often very rich and very populous, was intrinsically fragile, since the development of new international trade routes could undermine the **monetary** base and **erode** state power, as occurred when European **seafarers** circumvented Middle Eastern merchants after Vasco da Gama's **voyage** around Africa in the late fifteenth century opened up a southern route.

TPO16: Development of the Periodic Table

1. When the elements known at the time were ordered by increasing atomic mass, it was found that successive elements belonged to different chemical groups and that the order of the groups in this sequence was fixed and repeated itself at regular intervals.

2. Thus when the series of elements was written **so as to** begin a new horizontal row with each **alkali** metal, elements of the same groups were automatically assembled in **vertical** columns in a periodic table of the elements.

3. Because there is no space in the periodic table between these two elements, Mendeleev suggested that the atomic mass of indium be changed to a completely different value, where it would fill an empty space between cadmium and tin.

4. Ramsay then studied a gas that was present in natural gas deposits and discovered that it was helium, an element whose presence in the Sun had been noted earlier in the spectrum of sunlight but that had not previously been known on Earth.

TPO16: Planets in Our Solar System

1. Also, because the molecular motion of a gas depends on temperature, at the low temperatures of the Jovian planets even the lightest gases are unlikely to acquire the speed needed to escape.

2. The explanation may be that the **terrestrial** planets were once much larger and richer in these materials but eventually lost them because of these bodies' relative closeness to the Sun, which meant that their temperatures were relatively high.

TPO 17

TPO17: Europe's Early Sea Trade with Asia

1. In the fourteenth century, a number of political developments cut Europe's overland trade routes to southern and eastern Asia, with which Europe had had important and highly profitable commercial ties since the twelfth century.
2. Widely reported, if somewhat distrusted, accounts by figures like the famous traveler from Venice, Marco Polo, of the willingness of people in China to trade with Europeans and of the immensity of the wealth to be gained by such contact made the idea irresistible.
3. In the largest **caravels**, two main **masts** held large square **sails** that provided the bulk of the **thrust** driving the ship forward, while a smaller forward mast held a triangular-shaped sail, called a lateen sail, which could be moved into a variety of positions to maneuver the ship.
4. A **maritime** code known as the Consulate of the Sea, which originated in the western Mediterranean region in the fourteenth century, won acceptance by a majority of sea **goers** as the **normative** code for maritime conduct; it defined such matters as the authority of a ship's officers, protocols of command, pay structures, the rights of sailors, and the rules of engagement when ships met one another on the sea-lanes.

TPO17: Animal Signals in the Rain Forest

1. In the green-to-yellow lighting conditions of the lowest levels of the forest, yellow and green would be the brightest colors, but when an animal is signaling, these colors would not be very visible if the animal was sitting in an area with a yellowish or greenish background.
2. This species, which lives in the rain forests and **scrublands** of the east coast of Australia, has a brown-to-black **plumage** with **bare**, bright-red skin on the head and neck and a neck **collar** of orange-yellow loosely hanging skin.
3. During **courtship** and aggressive displays, the turkey enlarges its colored neck collar by **inflating** **sacs** in the neck region and then **flings** about a **pendulous** part of the colored signaling **apparatus** as it **utters** calls designed to attract or **repel**.

TPO17: Symbiotic Relationship

1. The third type of symbiosis, mutualism, benefits both partners in the relationship

Legume plants and their nitrogen-fixing bacteria, and the interactions between flowering plants and their pollinators, are examples of mutualistic association.

2. When the ants are removed, the trees usually die, probably because **herbivores** damage them so much that they are unable to compete with surrounding vegetation for light and growing space.

TPO 18

TPO18: Industrialization in the Netherlands and Scandinavia

1. In view of their later start and their lack of coal—undoubtedly the main reason they were not among the early industrializers—it is important to understand the sources of their success.

2. The people of the Netherlands, with a long tradition of fisheries and mercantile shipping, had difficulty in developing good **harbors** suitable for steamships: eventually they did so at Rotterdam and Amsterdam, with exceptional results for transit trade with Germany and central Europe and for the processing of overseas foodstuffs and raw materials (sugar, tobacco, chocolate, grain, and eventually oil).

3. In Denmark and Sweden agricultural reforms took place gradually from the late eighteenth century through the first half of the nineteenth, resulting in a new class of **peasant** landowners with a definite market **orientation**.

4. The key factor in the success of these countries (along with high literacy, which contributed to it) was their ability to adapt to the international division of labor determined by the early industrializers and to **stake out** areas of specialization in international markets for which they were especially well suited.

5. This meant a great dependence on international commerce, which had **notorious** fluctuations; but it also meant high returns to those factors of production that were fortunate enough to be well placed in times of prosperity.

TPO18: The Mystery of Yawning

1. According to conventional theory, **yawning** takes place when people are bored or sleepy and serves the function of increasing alertness by reversing, through deeper breathing, the drop in blood oxygen levels that are caused by the shallow breathing that accompanies lack of sleep or boredom.

2. About the closest any research has come to supporting the tiredness theory is to confirm that adults yawn more often on weekdays than at weekends, and that school children yawn more frequently in their first year at primary school than they do in kindergarten.
3. But, while accepting that not everything in life can be explained by Darwinian evolution, there are sound reasons for being skeptical of theories like this one, which avoid the issue of what yawning does for adults.
4. Such yawning is often referred to as "incongruous" because it seems out of place, at least on the tiredness view: soldiers yawning before combat, musicians yawning before performing, and athletes yawning before competing.

TPO18: Lightning

1. Below this large, cold, negatively charged region, the cloud is warmer than -15°C , and at these temperatures, collisions between ice crystals and falling ice pellets produce positively charged ice pellets that then populate a small region at the base of the cloud.
2. However, as the storm cloud develops, the ground beneath the cloud becomes positively charged and lightning can take place in the form of an electrical discharge between the negative charge of the cloud and the positively charged ground.
3. Once a channel has been formed, it is usually used by several lightning discharges, each of them consisting of a stream of electrons from the cloud meeting a stream of positive particles along the established path.

TPO 19

TPO19: The Roman Army's Impact on Britain

1. In the wake of the Roman Empire's conquest of Britain in the first century A.D., a large number of troops stayed in the new province, and these troops had a considerable impact on Britain with their camps, fortifications, and participation in the local economy.
2. The army also provided a mean of personal advancement for auxiliary soldiers recruited from the native peoples, as a man obtained hereditary Roman citizenship on retirement after service in an auxiliary regiment.
3. The reverse process brought young men to Britain, where many continued to live after

their 20 to 25 years of service, and this added to the cosmopolitan Roman character of the frontier population.

TPO19: Succession, Climax, and Ecosystems

1. Their major point was that the distribution of a given species was controlled by the habitat requirements of that species and that therefore the vegetation types were a simple consequence of the ecologies of individual plant species.
2. With "climax," "biome," "superorganism," and various other technical terms for the association of animals and plants at a given locality being criticized, the term "ecosystem" was more and more widely adopted for the whole system of associated organisms together with the physical factors of their environment.

TPO19: Discovering The Ice Ages

1. In the middle of the nineteenth century, Louis Agassiz, one of the first scientists to study glaciers, immigrated to the United States from Switzerland and became a professor at Harvard University, where he continued his studies in geology and other sciences.
2. From this analysis of marine sediments, geologists have learned that there were many shorter, more regular cycles of glaciation and deglaciation than geologists had recognized from the glacial drift of the continents alone.

TPO 20

TPO20: Westward Migration

1. The story of the westward movement of population in the United States is, in the main, the story of the expansion of American agriculture—of the development of new areas for the raising of livestock and the cultivation of wheat, corn, tobacco, and cotton.
2. The European ancestors of some Americans had for centuries lived rooted to the same village or piece of land until some religious, political, or economic crisis uprooted them and drove them across the Atlantic.
3. In American society, however, the class structure was less rigid; some people changed occupations easily and believed it was their duty to improve their social and economic position.

4. The West had plenty of attractions: the **alluvial** river bottoms, the **fecund** soils of the rolling forest lands, the black **loams** of the prairies were tempting to New England farmers working their rocky, **sterile** land and to southeastern farmers **plagued** with soil depletion and erosion.

TPO20: Early Settlements in the Southwest Asia

1. Pollen samples from freshwater lakes in Syria and elsewhere tell us forest cover expanded rapidly at the end of the Ice Age, for the southwestern Asian climate was still cooler and considerably wetter than today.

2. Thanks to extremely fine-grained excavation and extensive use of flotation methods (through which seeds are recovered from soil samples), we know a great deal about the **foraging** practices of the inhabitants of Abu Hureyra in Syria's Euphrates valley.

3. Many complex factors led to the adoption of the new economies, not only at Abu Hureyra, but at many other locations such as 'Ain Ghazal, also in Syria, where goat toe bones showing the telltale marks of **abrasion** caused by foot tethering (binding) testify to early herding of domestic stock.

TPO20: Fossil Preservation

1. Water containing dissolved silica, calcium carbonate, or iron may circulate through the **enclosing** sediment and be deposited in **cavities** such as **marrow** cavities and **canals** in bone once occupied by blood vessels and nerves.

2. Among the **superbly** preserved Messel fossils are insects with **iridescent** **exoskeletons** (hard outer coverings), frogs with skin and blood vessels **intact**, and even entire small mammals with preserved fur and soft tissue.

TPO 21

TPO21:Geothermal Energy

1. Geothermal energy becomes available in a practical form when underground heat is transferred by water that is heated as it passes through a **subsurface** region of hot rocks (a heat reservoir) that may be hundreds or thousands of feet deep.

2. Geothermal energy is in a sense not renewable, because in most cases the heat would

be drawn out of a reservoir much more rapidly than it would be replaced by the very slow geological processes by which heat flows through solid rock into a heat **reservoir**.

3. Although the potential is enormous, it is likely that in the near future geothermal energy can make important local contributions only where the resource is close to the user and the economics are favorable, as they are in California, New Zealand, and Iceland.

TPO21: The Origins of Agriculture

1. It would appear that the instability of the climatic conditions led populations that had originally been nomadic to settle down and develop a sedentary style of life, which led in turn to population growth and to the need to increase the amount of food available.

2. It is archaeologist Steven Mithen's thesis, brilliantly developed in his book *The Prehistory of the Mind* (1996), that approximately 40,000 years ago the human mind developed cognitive fluidity, that is, the integration of the specializations of the mind: technical, natural history (geared to understanding the behavior and distribution of natural resources), social intelligence, and the linguistic capacity.

3. Mithen proposes the existence of four mental elements to account for the emergence of farming: (1) the ability to develop tools that could be used intensively to harvest and process plant resources; (2) the tendency to use plants and animals as the medium to acquire social prestige and power; (3) the tendency to develop "social relationships" with animals structurally similar to those developed with people—specifically, the ability to think of animals as people (anthropomorphism) and of people as animals (totemism); and (4) the tendency to manipulate plants and animals.

4. The fact that some societies domesticated animals and plants, discovered the use of metal tools, became **literate**, and developed a state should not make us forget that others developed **pastoralism** or **horticulture** (vegetable gardening) but remained illiterate and at low levels of productivity; a few entered the modern period as hunting and gathering societies.

TPO21: Autobiographical Memory

1. Perhaps the explanation goes back to some ideas raised by **influential** Swiss psychologist Jean Piaget—namely, that children under age two years represent events in a qualitatively different form than older children do.

2. When researchers had one year olds imitate an action sequence one year after they first saw it, there was correlation between the children's verbal skills at the time they first saw the event and their success on the later memory task.

3. A final suggestion is that children must begin to develop a "theory of mind"—an awareness of the concept of mental states (feelings, desires, beliefs, and thoughts), their own and those of others—before they can talk about their own past memories.

TPO 22

TPO22: Spartina

1. As the seaweed and marsh grass leaves die, bacteria break down the plant material, and insects, small shrimplike organisms, fiddler crabs, and marsh snails eat the decaying plant tissue, digest it, and excrete wastes high in nutrients.
2. It spreads primarily by underground stems; colonies form when pieces of the root system or whole plants float into an area and take root or when seeds float into a suitable area and germinate.
3. Once established, a stand of Spartina begins to trap sediment, changing the substrate elevation, and eventually the stand evolves into a high marsh system where Spartina is gradually displaced by higher-elevation, brackish-water species.
4. Leaving its insect predators behind, the cordgrass has been spreading slowly and steadily along Washington's tidal estuaries on the west coast, crowding out the native plants and drastically altering the landscape by trapping sediment.
5. Efforts to control Spartina outside its natural environment have included burning, flooding, shading plants with black canvas or plastic, smothering the plants with dredged materials or clay, applying herbicide, and mowing repeatedly.
6. Even with a massive effort, it is doubtful that complete eradication of Spartina from nonnative habitats is possible, for it has become an integral part of these shorelines and estuaries during the last 100 to 200 years.

TPO22: The Birth of Photography

1. The images produced by the camera obscura, a boxlike device that used a pinhole or lens to throw an image onto a ground-glass screen or a piece of white paper, were already familiar—the device had been much employed by topographical artists like the Italian painter Canaletto in his detailed views of the city of Venice.
2. Because the medium was so prolific, in the sense that it was possible to produce a

multitude of images very cheaply, it was soon treated as the **poor relation** of fine art, rather than its **destined** successor.

3. The rapid technical development of photography—the introduction of lighter and simpler equipment, and of new **emulsions** that coated photographic **plates**, film, and paper and enabled images to be made at much faster speeds—had some unanticipated consequences.

4. The new candid photography—unposed pictures that were made when the subjects were unaware that their pictures were being taken—confirmed these scientific results, and at the same time, thanks to the radical **cropping** (trimming) of images that the camera often imposed, suggested new **compositional** formats.

TPO22: The Allende Meteorite

1. Sometime after midnight on February 8, 1969, a large, bright meteor entered Earth's atmosphere and broke into thousands of pieces, plummeted to the ground, and **scattered** over an area 50 miles long and 10 miles wide in the state of Chihuahua in Mexico.

2. When broken open, Allende stones are revealed to contain an assortment of small, distinctive objects, **spherical** or irregular in shape and embedded in a dark gray matrix (binding material), which were once constituents of the solar **nebula**—the interstellar cloud of gas and dust out of which our solar system was formed.

3. A few **chondrules** contain grains that survived the melting event, so these **enigmatic** chondrules must have formed when compact masses of nebular dust were **fused** at high temperatures—approaching 1,700 degrees Celsius—and then cooled before these surviving grains could melt.

4. However, studies of the **textures** of inclusions reveal that the order in which the minerals appeared in the inclusions varies from inclusion to inclusion, and often does not match the theoretical **condensation** sequence for those metals.

5. However, detailed studies of the chondrite matrix suggest that much of it, too, has been formed by condensation or melting in the nebula, although minute amounts of surviving interstellar dust are mixed with the **processed** materials.

6. Since practically all the solar system's mass **resides** in the Sun, this similarity in chemistry means that chondrites have average solar system composition, except for the most volatile elements; they are truly lumps of nebular matter, probably similar in composition to the matter from which planets were assembled.

TPO23

TPO23: Urban Climates

1. The second factor is that radiant heat coming into the city from the Sun is trapped in two ways: (1) by a continuing series of reflection among the numerous **vertical** surfaces that buildings present and (2) by the dust **dome**, the cloudlike layer of polluted air that most cities produce.
2. Shortwave radiation from the Sun passes through the pollution dome more easily than outgoing longwave radiation does; the latter is absorbed by the **gaseous** pollutants of the dome and reradiated back to the urban surface.

TPO23:Seventeenth-Century Dutch Agriculture

1. **Dutch** agriculture was modernized and commercialized new crops and agricultural techniques raised levels of production so that they were in line with market demands, and cheap grain was imported annually from the Baltic region in large quantities.
2. Importing the grain, which would have been expensive and time consuming for the Dutch to have produced themselves, kept the price of grain low and thus stimulated individual demand for other foodstuffs and consumer goods.
3. As the demand for agricultural produce from both consumers and industry increased, agricultural land became more valuable and people tried to work the available land more intensively and to reclaim more land from wetlands and lakes.
4. In order to increase production on existing land, the peasants made more use of crop rotation and, in particular, began to apply animal waste to the soil regularly, rather than leaving the fertilization process up to the grazing livestock.
5. Noorderkwartier in Holland, with its numerous lakes and stretches of water, was particularly suitable for land **reclamation** and one of the biggest projects undertaken there was the draining of the Beemster lake which began in 1608.
6. Forty-three **windmills** powered the drainage pumps so that they were able to lease the reclamation to farmers as early as 1612, with the investors receiving annual leasing payments at an interest rate of 17 percent.

TPO23: Rock Art of the Australia Aborigines

1. Early in the nineteenth century, encounters with **Aboriginal** rock art tended to be

infrequent and open to **speculative** interpretation, but since the late nineteenth century, awareness of the extent and variety of Australian rock art has been growing.

2. In order to create a sense of structure to this picture, researchers have relied on a distinction that still underlies the forms of much **indigenous** visual culture—a distinction between **geometric** and **figurative** elements.

3. The frequency with which certain simple **motifs** appear in these oldest sites has led rock-art researchers to adopt a descriptive term—the Panaramitee style—a label which takes its name from the extensive rock **pavements** at Panaramitee North in desert South Australia, which are covered with motifs **pecked** into the surface.

4. Certain features of these **engravings** lead to the conclusion that they are of great age—geological changes had clearly happened after the designs had been made and local **Aboriginal** informants, when first questioned about them, seemed to know nothing of their origins.

5. Lesley Maynard, the archaeologist who **coined** the **phrase** “Panaramitee style,” suggested that a sequence could be determined for Australian rock art, in which a geometric style gave way to a simple figurative style (outlines of figures and animals), followed by a range of complex figurative styles that, unlike the pan-Australian geometric tradition, tended to much greater regional diversity.

6. While accepting that this sequence fits the archaeological profile of those sites, which were occupied continuously over many thousands of years a number of writers have warned that the underlying assumption of such a sequence—a development from the simple and the geometric to the complex and naturalistic—obscures the cultural continuities in Aboriginal Australia, in which geometric symbolism remains fundamentally important.

TPO 24

TPO24: Lake Water

1. Then exchanges with the atmosphere are calculated by finding the difference between the gains from rain, as measured (rather roughly) by rain **gauges**, and the losses by evaporation, measured with models that correct for the other sources of water loss.

2. Changes in lake level not explained by river flows plus exchanges with the atmosphere must be due to the **net difference** between what **seeps** into the lake from the groundwater

and what leaks into the groundwater.

3. The residence time is an average; the time spent in the lake by a given molecule (if we could follow its fate) would depend on the route it took: it might flow through as part of the fastest, most direct current, or it might circle in a backwater for an indefinitely long time.

4. In the period 1970 to 1986, rainfall in the area decreased from 1,000 millimeters to 650 millimeters per annum, while above-average temperatures speeded up the evapotranspiration rate (the rate at which water is lost to the atmosphere through evaporation and the processes of plant life).

TPO24: Breathing During Sleep

1. During NREM (the phase of sleep in which there is no rapid eye movement) breathing becomes deeper and more regular, but there is also a decrease in the breathing rate, resulting in less air being exchanged overall.

2. The amount of air exchanged is even lower in REM than NREM because, although breathing is more rapid in REM, it is also more irregular, with brief episodes of shallow breathing or absence of breathing.

TPO24: Moving Into Pueblos

1. In the Mesa Verde area of the ancient North American Southwest, living patterns changed in the thirteenth century, with large numbers of people moving into large communal dwellings called pueblos, often constructed at the edges of canyons, especially on the sides of cliffs.

2. Few of the cultural traditions and rules that today allow us to deal with dense populations existed for these people accustomed to household autonomy and the ability to move around the landscape almost at will.

3. Some scholars expand on this idea by emphasizing a corresponding need for arable land to feed growing numbers of people: construction of small dams, reservoirs, terraces, and field houses indicates that farmers were intensifying their efforts during the 1200s.

4. Archaeologists find that even the most isolated residences during the eleventh and twelfth centuries obtained some pottery, and probably food, from some distance away, while major ceremonial events were opportunities for sharing food and crafts.

5. Scholars believe that this cooperation allowed people to contend with a patchy environment in which precipitation and other resources varied across the landscape: if you produce a lot of food one year, you might trade it for pottery made by a distant ally who is having difficulty with crops—and the next year, the flow of goods might go in the opposite

direction.

TPO 25

TPO25: The Surface of Mars

1. It is no accident that Maxwell Mons on Venus and the Hawaiian shield volcanoes on Earth rise to about the same height (about 10 kilometers) above their respective bases-Earth and Venus have similar surface gravity.
2. Scientists have no direct evidence for recent or ongoing eruptions, but if these volcanoes were active as recently as 100 million years ago (an estimate of the time of last eruption based on the extent of impact **cratering** on their slopes), some of them may still be at least intermittently active.

TPO25: The Decline of Venetian Shipping

1. In the fifteenth century there was little problem recruiting sailors to row the galleys (large ships **propelled** by **oars**): guilds (business associations) were required to provide rowers, and through a draft system free citizens served **compulsorily** when called for.
2. The step from buying foreign **timber** to buying foreign ships was regarded as a short one, especially when complaints were heard in the latter sixteenth century that the standards and traditions of the Arsenale were running down.
3. Historian Frederic Lane observes that after the loss of ships in battle in the late sixteenth century, the shipbuilding industry no longer had the capacity to recover that it had displayed at the start of the century.
4. The conventional explanation for the loss of Venetian dominance in trade is establishment of the Portuguese direct sea route to the East, replacing the overland Silk Road from the Black sea and the highly profitable Indian Ocean-caravan-eastern Mediterranean route to Venice.
5. Prices of spices delivered by ship from the eastern Mediterranean came to equal those of spices transported by Portuguese vessels, but the increase in quantity with both routes in operation drove the price far down.
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TPO25: The Evolutionary Origin of Plants

1. Water temperature can fluctuate seasonally or even daily and changing level of rainfall can lead to fluctuations in the concentration of chemical in the water or even to period in which the aquatic habitat dries up.
2. From a plant's evolutionary view point, however, it was also a land of opportunity, free of competitors and predators and full of carbon dioxide and sunlight (the raw materials for photosynthesis, which are present in far higher concentrations in air than in water).
3. They include roots or root like structures, a waxy cuticle that covers the surfaces of leaves and stems and limits the evaporation of water, and pores called stomata in leaves and stems that allow gas exchange but close when water is scarce, thus reducing water loss.
4. These include conducting vessels that transport water and minerals upward from the roots and that move the photosynthetic products from the leaves to the rest of the plant body and the stiffening substance lignin, which support the plant body, helping it expose maximum surface area to sunlight.
5. So the most successful groups of land plants are those that evolved methods of fertilized sex cell dispersal that are independent of water and structures that protect developing embryos from drying out.

TPO 26

TPO26: Energy and the Industrial Revolution

1. The success of the steam engine resulted in increased demands for coal, and the consequent increase in coal production was made possible as the steam-powered pumps drained water from the ever-deeper coal seams found below the water table.
2. The resulting boom in the iron industry expanded the annual iron output by more than 170 times between 1740 and 1840, and by the 1850s Great Britain was producing more tons of iron than the rest of the world combined.

TPO26: Survival of Plants and Animals in Desert Conditions

1. Most plant tissues die if their water content falls too low: the nutrients that feed plants are transmitted by water; water is a raw material in the vital process of photosynthesis; and water regulates the temperature of a plant by its ability to absorb heat and because water vapor lost to the atmosphere through the leaves helps to lower plant temperatures.
2. There are two general classes of vegetation: long-lived perennials, which may be **succulent** (water-storing) and are often dwarfed and woody, and annuals or ephemerals, which have a short life cycle and may form a fairly dense stand immediately after rain.
3. They possess drought-resisting adaptations: loss of water through the leaves is reduced by means of dense hairs covering waxy leaf surfaces, by the closure of pores during the hottest times to reduce water loss, and by the rolling up or **shedding** of leaves at the beginning of the dry season.
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TPO26: Sumer and the First Cities of the Ancient Near East

1. The earliest of the city states of the ancient Near East appeared at the southern end of the Mesopotamian plain, the area between the Tigris and Euphrates rivers in what is now Iraq.
2. Uruk, for instance, had two **patron** gods—Anu, the god of the sky and **sovereign** of all other gods, and Inanna, a goddess of love and war—and there were others, patrons of different cities.
3. It used to be believed that before 3000 B.C.E. the political and economic life of the cities was centered on their temples, but it now seems probable that the cities had **secular** rulers from earliest times.
4. Within the city lived administrators, craftspeople, and merchants. (Trading was important, as so many raw materials, the semiprecious stones for the decoration of the temples, timbers for roofs, and all metals, had to be imported.)
5. A major development was the discovery, again about 3000 B.C.E., that if copper, which had been known in Mesopotamia since about 3500 B.C.E., was mixed with tin, a much harder metal, bronze, would result.

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