

TRACCIA ESTRATTA

CONCORSO PUBBLICO, PER ESAMI, PER N. 2 ASSUNZIONI CON CONTRATTO A TEMPO INDETERMINATO DI PERSONALE DELLA FIGURA PROFESSIONALE DI FUNZIONARIO MUSEALE, AREA A.1 - MATEMATICA E CODING (1 POSTO), AREA A.2 - BIOTECNOLOGIE, SALUTE E ALIMENTAZIONE (1 POSTO), CATEGORIA D, LIVELLO BASE, 1^ POSIZIONE RETRIBUTIVA DEL RUOLO UNICO DEL PERSONALE PROVINCIALE, DA ASSEGNARE AL MUSEO DELLE SCIENZE (MUSE)

PROVA SCRITTA

10 luglio 2024

Tema n.2

AREA A.1 - MATEMATICA E CODING

Le geometrie non euclidee forniscono una alternativa descrizione dello spazio rispetto a quella fornita dai postulati di Euclide.

Domanda 1

Il/la candidato/a argomenti l'affermazione sopra riportata fornendo un quadro teorico di insieme.

Domanda 2

Il/la candidato/a sviluppi una proposta di mediazione scientifica nella forma di un corso di formazione per insegnanti di scuola secondaria di primo e secondo grado sul tema delle geometrie non euclidee, riferendosi in particolare alla geometria sferica. Il corso dovrà fornire spunti agli/alle insegnanti per proporre delle attività in classe in modalità esperienziale.

Domanda 3

Il/la candidato/a discuta gli obiettivi che intende raggiungere con una proposta come alla domanda 2 e le modalità di verifica degli stessi.

AREA A.2 - BIOTECNOLOGIE, SALUTE E ALIMENTAZIONE

L'organizzazione cellulare è fondamentale per il corretto funzionamento degli organismi viventi. La struttura e la disposizione delle varie componenti all'interno delle cellule, permettono loro di svolgere funzioni specifiche. La comunicazione cellulare è essenziale per la crescita, lo sviluppo, la risposta agli stimoli esterni e il mantenimento dell'omeostasi.

Domanda 1

Il/la candidato/a argomenti le affermazioni sopra riportate fornendo un quadro teorico di insieme.

Domanda 2

Il/la candidato/a sviluppi una proposta di mediazione scientifica nella forma di laboratori didattici per la scuola secondaria di secondo grado sui temi dell'organizzazione cellulare e della comunicazione cellulare.

Domanda 3

Il/la candidato/a discuta gli obiettivi che ha inteso raggiungere con tale proposta di mediazione scientifica e le modalità di verifica degli stessi.

Trento, 10 luglio 2024

I MEMBRI ESPERTI:

f.to dott.ssa Raffaella Canepel, anche con funzioni di Presidente

f.to dott.ssa Katia Danieli

f.to dott.ssa Michela Denti

IL SEGRETARIO VERBALIZZANTE

f.to dott.ssa Serena Prezzi

TRACCIA NON ESTRATTA

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PROVA SCRITTA

10 luglio 2024

Tema n.1

AREA A.1 - MATEMATICA E CODING

L'Orsa del Codice è un'iniziativa nata negli Stati Uniti nel 2013 per far sì che ogni studente e ogni studentessa in ogni scuola del mondo svolga almeno un'ora di programmazione.

Domanda 1

Il/la candidato/a descriva sinteticamente quali sono i fondamenti alla base della programmazione. Si soffermi inoltre sulla tecnica della ricorsione descrivendone le caratteristiche e fornendo un esempio di problema matematico che possa essere risolto efficacemente utilizzando un approccio ricorsivo.

Domanda 2

Il/la candidato/a sviluppi una proposta di mediazione scientifica nella forma di laboratorio didattico per il secondo ciclo della scuola primaria per l'iniziativa *L'ora del codice*. Si descrivano le attività proposte, dettagliando le procedure e i materiali delle singole esperienze e/o i linguaggi di programmazione o i software se utilizzati.

Domanda 3

Il/la candidato/a descriva le motivazioni che spingono a proporre iniziative come "L'ora del codice", gli obiettivi che si intendono raggiungere e le possibili modalità di verifica degli stessi.

AREA A.2 - BIOTECNOLOGIE, SALUTE E ALIMENTAZIONE

Più di vent'anni fa, il 14 aprile 2003, veniva annunciata la conclusione del Progetto Genoma Umano (Human Genome Project). Da allora, anche grazie ai notevoli progressi tecnologici, la ricerca nel campo della genetica ha aperto numerose nuove prospettive che promettono di rivoluzionare la nostra comprensione della biologia umana. Si è compreso che i fattori ambientali possono influenzare l'espressione dei geni senza alterare la sequenza del DNA ("epigenetica"). In medicina, la genomica ha permesso di comprendere le cause di molte malattie rare e di sviluppare trattamenti medici su misura ("medicina personalizzata" ed "oncogenomica"), terapie genetiche e terapie di editing genetico.

Domanda 1

Il/la candidato/a argomenti sinteticamente fornendo un quadro teorico di insieme.

Domanda 2

Il/la candidato/a sviluppi una proposta di mediazione scientifica sui temi descritti nella traccia, nella forma di un'esposizione al pubblico che preveda anche una parte interattiva specificando le singole esperienze e come si intende svilupparle nel percorso di visita per un pubblico a partire dagli 8 anni.

Domanda 3

Il/la candidato/a discuta gli obiettivi che ha inteso raggiungere con tale proposta di mediazione scientifica e le modalità di verifica degli stessi.

Trento, 10 luglio 2024

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f.to dott.ssa Serena Prezzi

TRACCIA NON ESTRATTA

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PROVA SCRITTA

10 luglio 2024

Tema n.3

AREA A.1 - MATEMATICA E CODING

Nel 1988 il museo di scienze Exploratorium di San Francisco organizza il primo appuntamento del PI day, vale a dire la giornata mondiale dedicata al Pi greco, che da allora si festeggia ogni anno il 14 marzo e che dal 2020 coincide con la giornata Internazionale della Matematica.

Domanda 1

Il/la candidato/a definisca Pi greco, descriva la sua natura e le sue proprietà. Indichi inoltre almeno 3 ambiti della matematica in cui compare e in quali termini.

Domanda 2

Il/la candidato/a sviluppi un programma di attività per la giornata del Pi greco. L'evento si svolgerà all'interno di un museo scientifico. Il pomeriggio sarà dedicato alle famiglie e il tardo pomeriggio/sera al pubblico di giovani universitari. Si descrivano le attività proposte.

Domanda 3

Il/la candidato/a descriva le motivazioni che spingono i musei scientifici a proporre programmi di attività come descritti nella domanda 2, gli obiettivi che si intendono raggiungere e le possibili modalità di verifica degli stessi.

AREA A.2 - BIOTECNOLOGIE, SALUTE E ALIMENTAZIONE

Le biotecnologie svolgono un ruolo cruciale nella vita quotidiana, influenzando vari aspetti della nostra esistenza in modo spesso invisibile ma fondamentale: salute e medicina, ambiente e sostenibilità, ambiente ed agricoltura, industria ed innovazione, società ed etica.

Domanda 1

Il/la candidato/a argomenti le affermazioni sopra riportate fornendo un quadro teorico di insieme.

Domanda 2

Il/la candidato/a sviluppi una proposta di corso di formazione teorico e pratico per insegnanti di scienze delle scuole secondarie di primo e secondo grado sui temi delle biotecnologie.

Domanda 3

Il/la candidato/a discuta gli obiettivi che ha inteso raggiungere con tale proposta e le modalità di verifica degli stessi.

Trento, 10 luglio 2024

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DOMANDE PROVA ORALE

GRUPPO A

AREA A.1 – MATEMATICA E CODING

- A1)** Si proponga un'attività per ragazze/i di scuola secondaria di secondo grado per raccontare il problema dello scambio delle chiavi in crittografia.
- A2)** La/il candidata/o proponga esempi e/o un'attività affrontabili da un gruppo di ragazze/i nei primi anni della scuola secondaria di secondo grado su problemi di massimo e di minimo.
- A3)** Il concetto di isometria. La/il candidata/o proponga degli esempi e/o un'attività da proporre a un gruppo di bambini della scuola primaria su questa tematica.
- A4)** La/il candidato spieghi il concetto di ricorsione e fornisca un esempio di problema risolvibile in modo ricorsivo attraverso un'attività pratica.
- A5)** La/il candidata/o introduca a una classe prima di scuola secondaria di primo grado i poliedri regolari attraverso un'attività pratica, facendo sperimentare caratteristiche e proprietà.
- A6)** La/Il candidata/o introduca il concetto di equivalenza in topologia fornendo alcuni esempi di superfici topologicamente equivalenti e non, anche attraverso un'attività pratica.
- A7)** La/il candidata/o descriva una attività di coding da proporre alla scuola primaria senza l'utilizzo di un software specifico.

- A8)** Il problema dei ponti di Königsberg è un famoso problema matematico che ha dato origine alla teoria dei grafi. La/il candidato descriva un'attività per far sperimentare il problema a delle/dei bambini della scuola primaria.

AREA A.2 - BIOTECNOLOGIE, SALUTE E ALIMENTAZIONE

- A1)** Il candidato/la candidata descriva la struttura del DNA e spieghi come il processo di replicazione semiconservativa del DNA sia consentito dalla struttura stessa del DNA.
- A2)** La candidata/il candidato descriva l'organizzazione del genoma negli organismi eucariotici e procariotici, mettendo in evidenza le differenze strutturali e funzionali.
- A3)** Il candidato/la candidata descriva i diversi tipi di RNA presenti nelle cellule eucariotiche, spiegandone brevemente la funzione.
- A4)** Il candidato/la candidata spieghi cosa si intende per espressione genica e descriva i principali livelli di regolazione dell'espressione genica nelle cellule eucariotiche.
- A5)** Il candidato/la candidata spieghi cosa si intende per Epigenetica e come essa differisce dalla Genetica classica. La candidata/il candidato descriva inoltre i meccanismi molecolari alla base dell'Epigenetica.
- A6)** Il candidato/la candidata spieghi che cosa si intende per Ingegneria Genetica, porti alcuni esempi di tecniche di Ingegneria genetica e, relativamente ad una di esse, ne evidenzi i principi, i processi e le applicazioni.
- A7)** L'ingegneria genetica include tecniche come l'editing del genoma, la terapia genica e la creazione di organismi geneticamente modificati. La candidata/il candidato spieghi quali sono le preoccupazioni bioetiche sollevate da queste tecniche e quali principi bioetici universali sono stati adottati a garanzia della pratica scientifica e medica.
- A8)** Il candidato/la candidata spieghi che cos'è la riprogrammazione cellulare e quali sono i suoi principi fondamentali, e porti alcuni esempi di applicazioni della riprogrammazione cellulare nella medicina rigenerativa.
- A9)** Il candidato/la candidata descriva le principali fasi dello sviluppo embrionale nei mammiferi e i processi chiave che le caratterizzano.
- A10)** Negli ultimi venti anni la ricerca nel campo della genetica umana ha aperto nuove prospettive che promettono di rivoluzionare la nostra comprensione della biologia umana e delle malattie.

La candidata/il candidato porti alcuni esempi di tali nuove conoscenze in genetica umana e delle nuove tecnologie che ne hanno permesso la scoperta.

- A11)** Il candidato/la candidata definisca che cos'è il microbiota, spieghi brevemente come esso può essere studiato e descriva le sue principali funzioni nella biologia umana.
- A12)** Il candidato/la candidata descriva i criteri sui quali si basa la classificazione dei virus e porti alcuni esempi di virus nei diversi gruppi di classificazione.
- A13)** Il candidato/la candidata descriva come sono cambiate le malattie infettive nel corso del tempo e spieghi quali fattori hanno influenzato la loro evoluzione, portando anche alcuni esempi.
- A14)** Il candidato/la candidata spieghi brevemente che cos'è la bioinformatica e qual è il suo ruolo nella ricerca scientifica moderna, portando alcuni esempi del tipo di analisi che la bioinformatica consente di effettuare.
- A15)** Le biotecnologie svolgono un ruolo cruciale nella vita quotidiana, influenzando vari aspetti della nostra esistenza in modo spesso invisibile ma fondamentale. Il candidato/la candidata spieghi in cosa consistono le biotecnologie e porti alcuni esempi di utilizzo delle biotecnologie nella vita quotidiana.
- A16)** Il candidato/la candidata descriva i principali macronutrienti e ne spieghi il ruolo nel metabolismo energetico.
- A17)** Il candidato/la candidata spieghi cosa sono le mutazioni e come esse contribuiscono alla variabilità genetica e all'evoluzione.

GRUPPO B

- B1)** Il/La candidato/a illustri i principali obblighi previsti nel codice di comportamento dei dipendenti della P.A.T. in merito all'anticorruzione.
- B2)** L'obbligo di astensione previsto dal Codice di comportamento dei dipendenti della Provincia autonoma di Trento
- B3)** Il Codice di comportamento dei dipendenti della Provincia autonoma di Trento cosa prevede per il dipendente nei rapporti con il pubblico?
- B4)** Il/La candidato/a illustri gli obblighi dei pubblici dipendenti per contrastare il fenomeno corruttivo.
- B5)** Misure organizzative generali di cui al Piano triennale per la prevenzione della corruzione e trasparenza del MUSE per contrastare il fenomeno corruttivo.
- B6)** Il principio di rotazione di cui al Piano triennale per la prevenzione della corruzione e trasparenza del MUSE ed eventuali misure alternative.
- B7)** Il sistema museale trentino di cui all'art.23 della L.P. 3 ottobre 2007, n. 15
- B8)** Obiettivi generali della L.P. 3 ottobre 2007, n. 15
- B9)** Il comitato scientifico di cui all'art.6 del Regolamento concernente la "Disciplina del Museo delle Scienze":componenti e funzioni
- B10)** Rapporti tra Museo e Giunta provinciale di cui all'art.9 del Regolamento concernente la "Disciplina del Museo delle Scienze"
- B11)** Il conflitto di interessi nel codice di comportamento dei dipendenti pubblici della PAT
- B12)** Che cosa si intende con il termine whistleblowing?
- B13)** I principi generali previsti dal codice di comportamento dei dipendenti della Provincia autonoma di Trento, a cui il dipendente deve conformare la propria condotta

- B14)** Sulla base di quanto previsto dal codice di comportamento dei dipendenti della Provincia autonoma di Trento, le circostanze in base alle quali vi è l'obbligo di astensione
- B15)** Il concetto di "corruzione", così come delineato nel piano provinciale per la prevenzione della corruzione e per la trasparenza del MUSE
- B16)** Misure organizzative di carattere generale contenute nel piano provinciale per la prevenzione della corruzione e per la trasparenza del MUSE
- B17)** Le finalità del Piano provinciale per la prevenzione della corruzione e per la trasparenza del MUSE
- B18)** Qual'è la finalità della rotazione del personale nel Piano triennale per la prevenzione della corruzione e per la trasparenza del MUSE?
- B19)** Quale tutela prevede il Piano triennale per la prevenzione della corruzione e per la trasparenza del MUSE per un dipendente che effettua una segnalazione di illecito di cui è venuto a conoscenza?
- B20)** Quali sono le conseguenze per il dipendente in caso di violazione del Codice di comportamento dei dipendenti della Provincia autonoma di Trento?
- B21)** Il dipendente, secondo il Codice di comportamento dei dipendenti della Provincia autonoma di Trento, può partecipare ad associazioni e altre organizzazioni?
- B22)** In riferimento all'art.10 del Regolamento concernente la "Disciplina del Museo delle Scienze", qual è il principale strumento di programmazione?
- B23)** In riferimento all'art.5 del Regolamento concernente la "Disciplina del Museo delle Scienze", il candidato/a esponga da chi è nominato il Presidente del MUSE e quali sono le sue funzioni
- B24)** Chi è all'interno del MUSE il responsabile del piano provinciale per la prevenzione della corruzione e per la trasparenza ? Indicarne compiti, funzioni e doveri

GRUPPO C

C1) They are not on the maps, but in our oceans there are five floating plastic islands that threaten to eradicate much of the marine life and contribute to climate change. Some of these garbage patches are equivalent in size to France, Spain and Germany put together.

The United Nations (UN) has long warned the international community of the damage ocean garbage does to the economy and the environment. This waste decimates marine ecosystems by killing more than a million animals a year, and also makes the conservation of the oceans more expensive by billions of dollars.

Ocean plastic also compromises the livelihoods and prosperity of many small fishing communities, damages air quality, pollutes the atmosphere and contributes to global warming. Along these lines, researchers discovered in 2018 that polyethylene — one of the most widely used disposable plastics — emits greenhouse gases, such as ethylene and methane, when decomposed in the sun.

Nevertheless, organisations like Greenpeace report that floating plastic accounts for only 15% of the total, while 85% remains hidden under water —at depths of up to 11,000 metres, or even trapped in Arctic ice. Ocean garbage is proliferating to such an extent that, by 2050, the World Economic Forum (WEF) predicts that the oceans could contain more tonnes of plastic than fish.

(Iberdrola group, 2024, <https://www.iberdrola.com/sustainability/5-garbage-patches-in-the-ocean>)

C2) Recent advancements in artificial intelligence (AI) might enable us for the first time to directly translate from animal communication to human language and back again. Not only is this theoretically possible, but scientists are actively developing two-way communication with other animals. If we do gain this ability, it would have profound implications for animal rights, conservation and our understanding of animal sentience.

Animals, including human animals, make noises and body expressions that are all just different types of data — audio data, visual data and even pheromone data. Machine learning algorithms can take that data and use it to detect patterns. With the help of animal welfare scientists, AI can help us figure out that one noise is the sound of a happy animal, while a different noise is the sound of an animal in distress.

Researchers are even exploring the possibility of automatically translating between human and animal languages based on the fundamental properties of language itself — such as how words relate to each other to create meaningful sentences about the real world — potentially bypassing the need to interpret the meaning of individual sounds. While this remains a theoretical possibility, if achieved, it could revolutionize our ability to communicate with diverse species.

(Sentient, 2024, <https://sentientmedia.org/ai-animal-communication-breakthroughs/>)

C3) Researchers have found a new way in which great apes are similar to humans: they tease each other.

A new study by an international team of scientists has documented “playful teasing” in orangutans, chimpanzees, bonobos and gorillas, according to a press release published Wednesday.

Like joking behaviour in humans, ape teasing is provocative, persistent, and includes elements of surprise and play. Because all four great ape species used playful teasing, it is likely that the prerequisites for humour evolved in the human lineage at least 13 million years ago.

The team had theorized that because human babies can tease others even before they can speak, as early as eight months old, similar behaviour could be exhibited by non-human animals.

Babies’ first attempts at teasing involve repetitive provocations that often involve an element of surprise, such as offering and withdrawing objects and disrupting other peoples’ activities.

Playful teasing tends to occur when apes are relaxed, such as when grooming, resting or foraging, and is similar to human behaviour in that it involves repetition and waiting for a response from the target.

The researchers also rarely observed an aggressive reaction from the target of teasing.

Next, the researchers plan to investigate the function of teasing in apes, which in humans is used to test social boundaries and strengthen relationships.

(CNN, 2024, <https://edition.cnn.com/2024/02/14/world/playful-teasing-great-apes-study-scli-intl-scn/index.html>)

C4) No other animal is as inexorably linked with extinction as the dodo, an odd-looking flightless bird that lived on the island of Mauritius in the Indian Ocean until the late 17th century.

The arrival of sailors brought with them invasive species like rats and practices like hunting. They doomed the dodo, which showed no fear of humans, to extinction in the space of just a few decades. Now, a team of scientists wants to bring back the dodo in a bold initiative that will incorporate advances in ancient DNA sequencing, gene editing technology and synthetic biology. They hope the project will open up new techniques for bird conservation.

However, the work that’s needed to resurrect the animal — programming cells from a living relative of the dodo with the lost bird’s DNA — will be significantly challenging. Scientists hope to adapt an existing technique used involving primordial germ cells, the embryonic precursors of sperm and eggs, that has already been used to create a chicken fathered by a duck.

The approach involves removing primordial germ cells from an egg, cultivating them in the lab and editing the cells with the desired genetic traits before injecting them back to an egg at the same developmental stage, she explained.

Even if the team is successful in this high-stakes endeavour, they won’t be making a carbon copy of the dodo that lived four centuries ago, but an altered, hybrid form.

CNN 2024, <https://edition.cnn.com/2023/01/31/world/dodo-bring-back-from-extinction-colossal-scn/index.html>)

C5) The human brain is unrivalled in its capacity to process information.

Sure, we have days where our minds don't feel as sharp. But the extraordinary 3-pound organ is still capable of things that supercomputers and robots can't do.

The human brain evolved to form billions of neurons, enabling us to learn and make complex logical decisions. We can look at two different animals, such as a cat and a dog, and tell them apart, while a computer struggles at the task.

Advances in artificial intelligence have caused some to wonder when computers will cross the line that divides humans from technology, like the sentient computer HAL 9000 from the sci-fi novel and film "2001: A Space Odyssey."

So far, no form of AI has made such a leap toward humanity. But there may be a new game in town. A new field called organoid intelligence could be the basis for computers powered by human brain cells.

Lab-grown brain organoids — nicknamed "intelligence in a dish" — are pen dot-size cell cultures that contain neurons capable of brainlike functions.

Researchers announced Tuesday their plan eventually to use brain organoids to create energy-efficient "biocomputers" that rival today's supercomputers and may revolutionize pharmaceutical testing for diseases like Alzheimer's.

But the biological hardware comes with a variety of ethical concerns, including whether organoids can achieve consciousness or sentience or feel pain.

(CNN, 2023, <https://edition.cnn.com/2023/03/04/world/brain-computers-science-newsletter-wt-scn/index.html>)

C6) Carbon capture and storage facilities aim to prevent CO₂ produced from industrial processes and power stations from being released into the atmosphere.

Most of the CO₂ from burning fossil fuels is captured, transported, and then stored deep underground.

The European Union aims to have capacity to capture and store 50 million tonnes a year by 2030, while the United States has also boosted funding.

Carbon dioxide removal is where CO₂ already in the air is taken out and stored.

There are two main approaches.

Firstly, humans can try to increase the CO₂ taken up by the natural world. For example, one global initiative aims to conserve, restore and plant one trillion trees worldwide by 2030.

The land and ocean take up more than half the CO₂ that humans emit anyway, so carbon removal refers to the extra CO₂ that is taken up due to deliberate action by people.

Secondly, there are "novel" human-designed methods to take CO₂ out of the atmosphere, although these are at very early stages.

These include machines to directly capture CO₂ from the air, or processes involving growing plants, burning them or converting them into fuels, and capturing and storing their emissions.

All of the different carbon removal methods are "negative emissions" technologies, because they take CO₂ out of the atmosphere - unlike carbon capture, which simply reduces the amount of CO₂ being released.

(BBC, 2023, <https://www.bbc.com/news/science-environment-64723497>)

C7) Record ocean temperatures suggest the seas are warming faster than expected.

The world's oceans absorb huge amounts of heat, which is then released slowly. So far, our oceans have soaked up over 90% of the heat trapped in the Earth's atmosphere by rising greenhouse gas emissions. But recently, their rate of warming has been dramatic.

Every day since late March 2023, global ocean surface temperatures have set new records for the hottest temperature ever recorded on that date.

But in some regions last year, ocean temperatures were similar to those expected if overall global warming of surface air temperatures reached 3C above pre-industrial levels – suggesting quicker ocean heating than expected.

Ocean warming is already having damaging effects on people and ecosystems alike. Coral reefs are currently undergoing their fourth planet-wide bleaching event, set to be the most extensive yet.

Other impacts include de-oxygenation of the deep seas, more intense rain in the skies above.

Two factors are primarily responsible for the past year's record ocean heat. The first is the atmosphere's ever-rising greenhouse gas concentrations.

The second was 2023's major El Niño event, in which warmer-than-average surface waters in the tropical Pacific Ocean led to increased evaporation – and a vast transfer of heat to the atmosphere.

(BBC, 2024, <https://www.bbc.com/future/article/20240508-how-record-ocean-warming-is-destabilising-weather-and-climate>)

C8) The Sun is extremely active right now, blasting the Earth with the biggest solar storms in 20 years.

If you happened to look skywards on a few nights in May 2024, there was a good chance of seeing something spectacular. For those at relatively low latitudes, there was a rare chance to see the flickering red, pink, green glow of our planet's aurorae.

The dazzling displays of aurora borealis were visible far further south than they might normally be – and far further north in the case of aurora australis thanks to the power of the geomagnetic storm, the strongest in two decades.

The effects of these changes in solar activity extend far across the Solar System. Earth is not the only planet to be hit by solar storms as they billow across interplanetary space. Mercury, the closest planet to the Sun, has a much weaker magnetic field than Earth – about 100 times less – and lacks a substantial atmosphere. But solar activity can cause the surface of the planet to glow with X-rays as solar wind rains down. Venus also lacks a substantial magnetic field, but the planet does still create auroras as the solar wind interacts with the planet's ionosphere.

The flares can cause the temperature of the Martian atmosphere to dramatically increase. It can even double in the upper atmosphere. The atmosphere itself inflates. The entire atmosphere expands dozens of kilometres.

(BBC, 2024, <https://www.bbc.com/future/article/20240702-beyond-the-northern-lights-how-solar-flares-spill-out-across-the-solar-system>)

C9) Scientists have for the first time discovered a cave on the Moon.

At least 100m deep, it could be an ideal place for humans to build a permanent base.

It is just one in probably hundreds of caves hidden in an underground, undiscovered world.

Countries are racing to establish a permanent human presence on the Moon, but they will need to protect astronauts from radiation, extreme temperatures, and space weather.

Lorenzo Bruzzone and Leonardo Carrer at the University of Trento found the cave by using radar to penetrate the opening of a pit on a rocky plain called the Mare Tranquillitatis.

It is visible to the naked eye from Earth and is also where Apollo 11 landed in 1969.

The cave was made millions or billions of years ago when lava flowed on the Moon, creating a tunnel through the rock.

Once Prof Bruzzone and Prof Carrer understood how big the cave was, they realised it could be a good spot for a lunar base.

The cave has yet to be fully explored, but the researchers hope that ground-penetrating radar, cameras or even robots could be used to map it.

The Moon cave might be useful to humans, but the scientists also stress that it could help answer fundamental questions about the history of the Moon, and even our solar system.

The rocks inside the cave will not be as damaged or eroded by space weather, so they can provide an extensive geological record going back billions of years.

(BBC, 2024, <https://www.bbc.com/news/articles/ce784r9njz0o>)

C10) Based on 2019 data, scientists estimate that air pollution exposure shortens the average person's lifespan by 1.8 years. This impact ranks just behind some of the leading causes of death and disease worldwide. For example, the average decrease in life expectancy attributable to

- cancer is 2.5 years
- diseases related to tobacco smoking is 2.1 years
- malaria is 0.3 years
- inadequate water/sanitation/hygiene is 0.6 years

Outdoor and indoor exposures to PM2.5 together account for almost all of air pollution's impact on life expectancy. Ozone accounts for only a small portion.

Regions with especially large loss in life expectancy from ambient PM2.5 include the Middle East; North Africa; and South, Central, and East Asia. Results include 2.11 years of lost life expectancy in Egypt, 1.91 years in Saudi Arabia, 1.51 years in India, 1.32 years in China, and 1.31 years in Pakistan. The lowest impacts on longevity tend to be in regions with high baseline life expectancy and very low levels of ambient PM2.5, including Norway, Sweden, Australia, and New Zealand (0.07–0.1 yr).

Countries with older populations tend to be more heavily impacted by air pollution because diseases worsened by air pollution occur mainly in older people. India and China provide an example. PM2.5 exposures are similar in these two countries, but China sees more air pollution-related deaths than India, largely because its population is much older.

(State of global air, 2024, <https://www.stateofglobalair.org/hap/life-expectancy#sig-impacts>)

C11) Women make up only 34% of the workforce in science, technology, engineering and math (STEM), and men vastly outnumber women majoring in most STEM fields in college. The gender gaps are particularly high in some of the fastest-growing and highest-paid jobs of the future. Engineering and computer science — two of the most lucrative STEM fields — remain heavily male dominated. Only 21% of engineering majors and 19% of computer science majors are women. Giving women equal opportunities to pursue STEM careers helps narrow the gender pay gap.

Key factors perpetuating gender STEM gaps:

- **Gender Stereotypes:** STEM fields are often viewed as masculine, and teachers and parents often underestimate girls' math abilities starting as early as preschool.
- **Male-Dominated Cultures:** Because fewer women study and work in STEM, these fields tend to perpetuate inflexible, exclusionary, male-dominated cultures that are not supportive of or attractive to women and minorities.
- **Fewer Role Models:** girls have fewer role models to inspire their interest in these fields, seeing limited examples of female scientists and engineers in books, media and popular culture. There are even fewer Black women role models in math and science.
- **Math Anxiety:** Teachers, who are predominantly women, often have math anxiety they pass onto girls, and they often grade girls harder for the same work, and assume girls need to work harder to achieve the same level as boys.

(AAUW, 2024, <https://www.aauw.org/resources/research/the-stem-gap/>)

C12) Taylor Swift's Eras Tour has left a significant carbon footprint. The carbon emissions from her flights—and those of her crew and equipment—amplify the already concerning impact of aviation on the environment. Aviation accounts for roughly 2.5% of global emissions, and each hour flown emits about 100 times more CO₂ emissions than other forms of transport. In addition, private jet flyers release 20–30 times more pollution than an economy class flyer on board a commercial flight. In February 2024 alone, Taylor Swift's use of her private jet to attend 11 shows resulted in a whopping 393 metric tonnes of CO₂ emissions —and this does not include the actual show emissions or the fans' travelling emissions. Swift's air travel emissions are 28 times more than an average person's annual emissions in the USA.

Taylor Swift has committed to compensating for her carbon emissions by purchasing more than double the carbon credits (also known as carbon units) needed to offset her emissions.

Carbon compensation involves investing in environmental projects that reduce or remove CO₂ from the atmosphere, effectively balancing out the emissions generated by activities like touring. This can be achieved through projects such as reforestation, renewable energy, or energy efficiency improvements. For Swift, this means purchasing carbon units that support these types of projects, ensuring that for every tonne of CO₂ her tour emits, a tonne is saved elsewhere in a verifiable manner.

(DGB Group, 2024, <https://www.green.earth/blog/taylor-swifts-eras-tour-its-carbon-footprint-and-offset-strategies#:~:text=Swift's%20air%20travel%20emissions%20are,77%20tonnes%20of%20CO2>)

C13) Tourism is responsible for roughly 8% of the world's carbon emissions. From plane flights and boat rides to souvenirs and lodging, various activities contribute to tourism's carbon footprint. The majority of this footprint is emitted by visitors from high-income countries. As the number of people who can afford to travel grows, so will tourism's environmental footprint.

Today, transportation is tourism's main source of greenhouse gas emissions. On average, planes and cars generate the most CO₂ per passenger mile, with tour buses, ferries, and trains coming well behind. In recent years, the number of people traveling internationally skyrocketed as airfare became more affordable. It would take an acre of forest a year to absorb the same amount of CO₂ emissions of a one-way flight from London to New York. That's about the same amount of emissions that the average person in Zimbabwe generates over an entire year.

In the same way your house generates emissions from energy use, so do the hotels, homestays, and rental homes that you stay in while on vacation. Many accommodations rely on heating and air conditioning to keep guest rooms at a pleasant temperature in hot or cold climates. These energy-intensive systems create CO₂, as do the water heaters used to warm showers, pools, and spas. Electricity used to power lights, TVs, refrigerators, laundry machines, and other equipment is also a big contributor, especially in areas with dated or inefficient systems.

(Sustainable international travel, 2024, <https://sustainabletravel.org/issues/carbon-footprint-tourism/>)

C14) Whales can help mitigate climate change impacts by storing carbon in their bodies and transporting nutrients that benefit ocean food chains.

The ocean captures about 31 percent of all carbon dioxide emissions, removing carbon from the atmosphere that would otherwise continue to trap heat and increase temperatures. Blue carbon, or carbon captured by ocean ecosystems includes:

- Carbon absorbed by aquatic plants, algae, and phytoplankton
- Carbon stored in the bodies of living animals
- Carbon sequestered in deep-sea sediments

Scientists believe whales contribute to all three of these carbon storage mechanisms. They likely supported even greater amounts of blue carbon storage before their populations were depleted by commercial whaling in the 1800s. Conserving and recovering whale populations can mitigate climate change by increasing blue carbon capture, benefiting marine and terrestrial species alike.

Like trees in a rainforest or marine algae in a kelp forest, whales are efficient at capturing and storing atmospheric carbon directly in their large bodies throughout their long lives. When whales die, their carbon-rich carcasses often sink to the seafloor; that carbon is trapped and prevented from returning to the atmosphere as carbon dioxide. Whales also indirectly contribute to carbon capture by providing nutrient-rich waste to phytoplankton, which absorb large amounts of carbon dioxide.

(NOAA Fisheries, 2024, <https://www.fisheries.noaa.gov/feature-story/whales-and-carbon-sequestration-can-whales-store-carbon#:~:text=Whales%20efficiently%20digest%20and%20store,carbon%20dioxide%20over%20its%20lifespan>)

C15) For the first time in human history, over half of the world's population lives in cities. If current

projections turn out accurate, by 2050, two-thirds of humanity will be living in urban areas.

Cities are a major driver of climate change, responsible for an estimated 75% of all carbon dioxide emissions globally but at the same time, they are particularly vulnerable to its effects. Inland and coastal flooding, heat stress, extreme precipitation, droughts, water scarcity, and increased air pollution are just some of the expected impacts.

Climate risks are unevenly distributed, both within and between cities. Cities with outdated infrastructure, urban sprawl, inadequate housing regulations and supply, are at particularly high risk.

In this context, nature-based solutions are both cost-effective and scalable. Urban and peri-urban trees and forests are one such solution.

In 2019, the United Nations Economic Commission for Europe (UNECE) launched the "Trees in Cities Challenge". This initiative invites mayors and local governments worldwide to make a concrete tree-planting pledge that will be implemented within a year and set up their objectives for making their cities greener, resilient, and more sustainable. The "Trees in Cities Challenge" will last until the end of 2022.

Mayors and local authorities are invited to offer their residents benefits from the many ecosystem services that trees and forests in and around cities provide.

(Trees in cities challenge, 2024, <https://treesincities.unece.org/sites/default/files/2024-01/Trees%20in%20Cities%20Challenge%20Information%20Note.pdf>)

C16) Emails. Most of us receive hundreds of them every day. We send a lot too. More than 306 billion emails were sent in 2021 and that is expected to top 376 billion in 2025. But just how significant is the impact of all those emails?

Calculating the emissions generated by an email is no easy task. It depends on the device used to create the email, whether it is the latest phone or an old desktop computer. You then must factor in how long it took for the sender to write it and the reader to read it. Did the sender add pictures, attach a big document, or sign off with a signature including the company logo? Then there is the energy used to send it and how efficient the various data centres are through which it passes. All these things have an impact. So, the best we can come up with is a range:

Globally emails could account for as much as 150m tonnes CO₂ in 2019, or about 0.3% of the world's carbon footprint. That is based on around half of all emails sent being spam and the remainder being reasonably useful messages that took the sender 3 minutes to write and the reader about 1 minute to read. On that basis, average email usage is equivalent to driving a small petrol car for around 128 miles.

There are a number of things that you can do that not only keep email volumes to a minimum:

- Only subscribe to news services that you want
- Unsubscribe from mailing lists that are no longer relevant to you
- Ensure the mailing lists you use are up to date
- Write concisely and keep messages as brief as possible
- Only message those who need the information.

(Carbon literacy project, 2024, <https://carbonliteracy.com/the-carbon-cost-of-an-email/>)

C17) It is widely accepted that modern birds are descendants of dinosaurs. One need only look at a bird's foot to see the unmistakable similarity to that of a theropod dinosaur such as *Tyrannosaurus rex* or *Velociraptor*.

When we think of birds, the first thing we think of is feathers.

Somewhere on their evolutionary journey, dinosaurs' scales must have developed into these filaments which today help birds dazzle, impress, stay warm and, of course, fly.

New research might help explain how and when that transition occurred. Palaeontologists have found that some feathered dinosaurs had scaly skin like reptiles. Their results are based on an analysis of a new specimen of the feathered dinosaur *Psittacosaurus*. There are up to 12 known species of *Psittacosaurus* – the most of any dinosaur genus. One specimen made waves when it was discovered with preserved filaments on its tail – early feathers.

This discovery suggests that soft, bird-like skin initially developed only in feathered regions of the body, while the rest of the skin was still scaly, like in modern reptiles. This zoned development would have maintained essential skin functions, such as protection against abrasion, dehydration and parasites. The first dinosaur to experiment with feathers could therefore survive and pass down the genes for feathers to their offspring.

(Cosmos, 2024, <https://cosmosmagazine.com/history/palaeontology/dinosaur-feathers-scales-evolution/>)

C18) Our ocean is a network of currents that circulate water around the world, called gyres. There are a total of five sub-tropical gyres. These five massive, slow rotating whirlpools accumulate marine debris and especially plastics which do not wear down; they simply break into tinier and tinier pieces, that will remain in the ocean for decades or longer.

For many people, the idea of a “garbage patch” conjures up images of an island of trash floating on the ocean. In reality, these patches are not easily visible, because they consist of very small plastic particles suspended at or just below the surface. It is impossible to detect the islands by aircraft or satellite. Instead, the size of the patch is determined by sampling. Estimates of size range from the size of Texas to about twice the size of the United States.

Ocean trash is counted in three ways: through beach surveys, computer models based on samples collected at sea, and estimates of the amount of trash entering the oceans.

The impacts of plastic pollution through ingestion and entanglement of marine fauna, ranging from zooplankton to cetaceans, seabirds and marine reptiles, are well documented.

Adsorption of persistent organic pollutants onto plastic and their transfer into the tissues and organs through ingestion is impacting marine megafauna as well as lower trophic-level organisms and their predators.

(Visualeyed, 2024, <https://stories.visualeyed.com/garbage-island/>)

C19) Microplastics, as the name implies, are tiny plastic particles. Officially, they are defined as plastics less than five millimetres (0.2 inches) in diameter—smaller in diameter than the standard pearl used in jewellery. There are two categories of microplastics: primary and secondary.

Primary microplastics are tiny particles designed for commercial use, such as cosmetics, as well as microfibers shed from clothing and other textiles, such as fishing nets. Secondary microplastics are particles that result from the breakdown of larger plastic items, such as water bottles. This breakdown is caused by exposure to environmental factors, mainly the sun's radiation and ocean waves.

The problem with microplastics is that they do not readily break down into harmless molecules. Plastics can take hundreds or thousands of years to decompose. On beaches, microplastics are visible as tiny multi-coloured plastic bits in sand.

Microplastics have been detected in marine organisms from plankton to whales, in commercial seafood, and even in drinking water. Alarming, standard water treatment facilities cannot remove all traces of microplastics. To further complicate matters, microplastics in the ocean can bind with other harmful chemicals before being ingested by marine organisms.

Scientists are still unsure whether consumed microplastics are harmful to human or animal health—and if so, what specific dangers they may pose.

(National Geographic, 2024, <https://education.nationalgeographic.org/resource/microplastics/>)

C20) Electric cars or vehicles (EVs) have the potential to reduce air pollution compared to traditional internal combustion engine vehicles.

Vehicle emissions from internal combustion engine vehicles are a major contributor to air pollution and have adverse health impacts, especially in areas with heavy traffic congestion like China. In contrast, electric vehicles produce zero tailpipe emissions, so they do not release harmful pollutants like Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs) into the atmosphere.

The widespread adoption of electric cars can contribute to cleaner air and improved public health by reducing air pollution, like fine particulate matter (PM2.5) and ozone (O3).

Still, the environmental benefits of electric cars vary depending on several factors, including the electricity grid's cleanliness, the type of manufacturing processes used for the vehicles and batteries, and the end-of-life disposal or recycling of batteries. Plus, the potential reduction in air pollution can be offset when electric cars are powered by electricity generated from high-emission sources.

Nevertheless, the benefits of electric vehicles outweigh the disadvantages when it comes to air quality. They emit fewer harmful gasses than gasoline cars even when accounting for their energy consumption. Plus, battery manufacturing emissions are offset by lower operational emissions during the EV's lifetime.

(PurleAir, 2024, <https://www2.purpleair.com/blogs/blog-home/how-electric-cars-impact-air-quality#:~:text=EVs%20produce%20zero%20tailpipe%20emissions,contribute%20to%20outdoor%20air%20pollution>)

C21) Electric Vehicle Myths

Myth #1: Electric vehicles are worse for the climate than gasoline cars because of power plant emissions.

FACT: Electric vehicles typically have a smaller carbon footprint than gasoline cars, even when accounting for the electricity used for charging.

Myth #2: Electric vehicles are worse for the climate than gasoline cars because of battery manufacturing.

FACT: The greenhouse gas emissions associated with an electric vehicle over its lifetime are typically lower than those from an average gasoline-powered vehicle, even when accounting for manufacturing.

Myth #3: The increase in electric vehicles entering the market will collapse the U.S. power grid.

FACT: Electric vehicles have charging strategies that can prevent overloading the grid, and, in some cases, support grid reliability.

Myth #4: There is nowhere to charge.

FACT: Electric vehicles can be plugged into the same type of outlet as your toaster! When you need to charge while on the road, you'll find over 68,000 stations in the U.S. available to the public.

Myth #5: Electric vehicles don't have enough range to handle daily travel demands.

FACT: Electric vehicle range is more than enough for typical daily use in the U.S.

Myth #6: Electric vehicles are not as safe as comparable gasoline vehicles.

FACT: Electric vehicles must meet the same safety standards as conventional vehicles.

(EPA, 2024, [https://www.epa.gov/greenvehicles/electric-vehicle-myths#:~:text=comparable%20gasoline%20vehicles.-,Myth%20%231%3A%20Electric%20vehicles%20are%20worse%20for%20the%20climate%20than,EVs\)%20have%20no%20tailpipe%20emissions](https://www.epa.gov/greenvehicles/electric-vehicle-myths#:~:text=comparable%20gasoline%20vehicles.-,Myth%20%231%3A%20Electric%20vehicles%20are%20worse%20for%20the%20climate%20than,EVs)%20have%20no%20tailpipe%20emissions))

C22) Communication in dolphins appears to be extensive and complex. Dolphins hunt together to find food. Pods of dolphins coordinate their movements to herd prey, and then take turns swimming into the middle of the assembled fish to eat.

Sound travels 4.5 – 5 times faster through water than through the air. For this reason dolphins rely on sound for communication more than any other mode. Scientists believe that every dolphin develops a distinctive high-pitched whistle, called a signature whistle. This whistle appears to serve as a means of individual identification, much like a name. It may let the rest of the pod know which pod members are around, where they are, and, perhaps, something about their mental state.

Dolphins are capable of imitating certain sounds very accurately and often learn other dolphins' whistles. One reason for imitating another dolphin's whistle may be to get its attention within a large group. Preliminary research seems to support this idea although details of the exact reason for imitation are still under investigation.

Dolphins do not generally rely on visual communication, although they have excellent eyesight both above and below the water's surface. There is often silt and other particles floating in the water column that can make it difficult for dolphins to communicate visually over long distances. However, when close to each other, body language may play a role in dolphin communication.

(Dolphin Research Centre, 2024, <https://dolphins.org/communication>)

C23) Thousands of them plague our beaches to the horror of holidaymakers who dread their sting, but thanks to man's disruption of the oceans, jellyfish are thriving. Jellyfish have been on Earth longer than we have—they are believed to have roamed the oceans for nearly 600 million years.

But human activity, from over-fishing to plastic waste and climate change, has created an environment in which they are even more at home.

The proliferation of the jellyfish could lead to what some observers are calling the "jellyfication" of the oceans. There are more jellyfish in certain zones in the world: the Black Sea, off the Namibian coast and the Sea of Japan.

These three factors provoke eruptions of the jellyfish population. These always happen but they are a lot more frequent and we sometimes see absolutely incredible quantities.

Overfishing has eliminated some of their natural predators, such as tuna and sea turtles that are often accidentally caught in nets, but also the fish who feed on plankton.

With their predators reduced in number, the jellyfish have more plankton to feed on themselves and have thrived unchecked.

Deep-sea trawling has also helped them. The trawlers drag giant nets across the ocean floor pulling up everything indiscriminately: sponges, worms and coral.

And while global warming and the acidification of the oceans might have hit some species, it has done jellyfish no harm.

(PHYS ORG, 2024, <https://phys.org/news/2019-09-jellyfish-man-made-disruption-oceans.html>)

C24) More than 60,000 koalas were among the animals impacted by the bushfire crisis in 2020. Impacts include death, injury, trauma, smoke inhalation, heat stress, dehydration, loss of habitat, reduced food supply, increased predation risk, and conflict with other animals after fleeing to unburnt forest. About 143 million mammals, 2.46 billion reptiles, 181 million birds, and 51 million frogs occupied areas hit by the fires. The fires impacted more than 41,000 koalas on South Australia's Kangaroo Island, more than 11,000 in Victoria, nearly 8,000 in NSW, and nearly 900 in Queensland. Sixty thousand koalas impacted is a deeply disturbing number for a species already in trouble. That's why WWF has just announced Koalas Forever – a bold vision to double the number of koalas in eastern Australia by 2050. Koalas Forever includes a trial of seed dispersing drones to create koala corridors and the establishment of a fund to encourage landowners to create koala safe havens. Their recommendations include implementing mapping and monitoring of plants and animals in bioregions most at risk in future fires and developing strategies to protect these areas during fires. People have been shocked by the research. With long-term monitoring we would be in a much better position to know where and when to act and what resources are needed to save at risk species.

(WWF, 2020, <https://wwf.org.au/news/2020/wwf-60000-koalas-impacted-by-bushfire-crisis/>)

Trento, 5 agosto 2024

I MEMBRI ESPERTI:

f.to dott.ssa Raffaella Canepel, anche con funzioni di Presidente

f.to dott.ssa Katia Danieli

f.to dott.ssa Michela Denti

f.to dott.ssa Claudia Marsilli, membro esperto aggiunto per la prova orale

IL SEGRETARIO VERBALIZZANTE

f.to dott.ssa Serena Prezzi