English for Advanced Technologies

Contents

UNIT ONE 'DIGITAL TECHNOLOGIES'

Lead in

1.Answer the questions:

1. What is digital technology?
2. What is its purpose?
3. How does it work?
4. What are the biggest challenges in digital transformation?
5. What are examples of digital technology?
6. Are AI and digital technology the same?
7. Who created AI?
8. How old is Chat GPT?
9. What does Chat GPT stand for?
10. How does digital technology affect people?

2.Give the definitions or explanations of the words connected to computing.

Encrypt, debug, cookies, avatar, algorithm, browser, resolution, gateway, configuration, bandwidth, byte, domain name, frames, user interface, hypermedia.

3.Read the quotes, choose one of them and comment on it.

1. 'There is no alternative to digital transformation. Those that don't adapt will fail' Jeff Bezos, CEO, Amazon
2. 'Clearly, the thing that's transforming is not the technology- it's technology that is transforming you' Jeanne W. Rors, MIT, Sloan
3. 'The biggest part of our digital transformation is changing the way we think' Simeon Preston, Healthcare, Executive
4. 'New tech should simplify life, not add complexity' Tim Cook, CEO, Apple
5. 'Transformation without people is just automation' Julie Sweet, CEO, Accenture
6. 'We have to wonder whether digital technology, rather than making it easier to communicate, is actually doing opposite. We sit alone at a keyboard, firing off zeros and ones into ether. Offices are silent.' Tom Hodgekinson

PART 1 Internet of Things (IoT)

4. Answer the questions.

1. What is the Internet of things?
2. What do 'things' refer to?
3. What is the difference between the Internet and IoT?

5. Read the text, make sure you can pronounce the underlined words correctly and answer the questions given in brackets.

The Internet of Things (IoT): An Overview

Executive Summary

The Internet of Things is an emerging topic of technical, social, and economic significance. Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play. Projections for the impact of IoT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than $11 trillion by 2025.

At the same time, however, the Internet of Things raises significant challenges that could stand in the way of realizing its potential benefits. Attention-grabbing headlines about the hacking of Internet-connected devices,**1) surveillance** concerns, and privacy fears already have captured public attention. Technical challenges (**What challenges are the most essential?)** remain and new policy, legal and development challenges are emerging.

IoT Definitions: The term Internet of Things generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate exchange and consume data with minimal human intervention. There is, however, no single, universal definition **(Why is it difficult to define it?).**

Enabling Technologies: The concept of combining computers, sensors, and networks to monitor and control devices has existed for decades. The recent **2) confluence** of several technology market trends, however, is bringing the Internet of Things closer to widespread reality. These include Ubiquitous Connectivity, Widespread Adoption of IP-based Networking, Computing Economics, Miniaturization, Advances in Data Analytics, and the Rise of Cloud Computing **(How do these directions influence the advancement of IoT?).**

Connectivity Models: IoT implementations use different technical communications models, each with its own characteristics. Four common communications models described by the Internet Architecture Board include: Device-to-Device, Device-to-Cloud, Device-to-Gateway, and Back-End Data-Sharing (**Will you give some information about each of the models?).** These models highlight the flexibility in the ways that IoT devices can connect and provide value to the user.

Transformational Potential: If the projections and trends towards IoT become reality, it may force a shift in thinking about the implications and issues in a world where the most common interaction with the Internet comes from passive engagement with connected objects rather than active engagement with content. The potential realization of this outcome – a “hyperconnected world” — is testament to the general-purpose nature of the Internet architecture itself, which does not place inherent limitations on the applications or services that can make use of the technology.

Five key IoT issue areas are examined to explore some of the most pressing challenges and questions related to the technology. These include security; privacy; interoperability and standards; legal, regulatory, and rights; and emerging economies and development. **(Will you add some more challenges to programmers and engineers?)**

Security

While security considerations are not new in the context of information technology, the attributes of many IoT implementations present new and unique security challenges. Addressing these challenges and ensuring security in IoT products and services must be a fundamental priority. Users need to trust that IoT devices and related data services are secure from vulnerabilities, especially as this technology become more **3) pervasive** and integrated into our daily lives. Poorly secured IoT devices and services can serve as potential entry points for cyber-attack and expose user data to theft by leaving data streams inadequately protected. **(What measures are introduced to prevent cyber-attacks?)**

Privacy

The full potential of the Internet of Things depends on strategies that respect individual privacy choices across a broad spectrum of expectations.
Indeed, the Internet of Things is redefining the debate about privacy issues, as many implementations can dramatically change the ways personal data is collected, analyzed, used, and protected. For example, IoT amplifies concerns about the potential for increased surveillance and tracking, difficulty in being able **4) to opt out** of certain data collection, and the strength of aggregating IoT data streams to paint detailed digital portraits of users. While these are important challenges, they are not **5) insurmountable**. In order to realize the opportunities, strategies will need to be developed to respect individual privacy choices across a broad spectrum of expectations, while still **6) fostering** innovation in new technology and services**. (What innovations could protect personal data from hackers?)**

Interoperability / Standards

A fragmented environment of proprietary IoT technical implementations will 7) inhibit value for users and industry. While full interoperability across products and services is not always **8) feasible** or necessary **(Where is it not necessary at all?)**, purchasers may be hesitant to buy IoT products and services if there is integration inflexibility, high ownership complexity, and concern over vendor lock-in.

In addition, poorly designed and configured IoT devices may have negative consequences for the networking resources they connect to and the broader Internet. Appropriate standards, reference models, and best practices also will help **9) curb** the **10) proliferation** of devices that may act in **11) disrupted** ways to the Internet. The use of generic, open, and widely available standards as technical building blocks for IoT devices and services (such as the Internet Protocol) will support greater user benefits, innovation, and economic opportunity.

Legal, Regulatory and Rights

The use of IoT devices raises many new regulatory and legal questions as well as amplifies existing legal issues around the Internet.
One set of issues surrounds crossborder data flows, which occur when IoT devices collect data about people in one jurisdiction and transmit it to another jurisdiction with different data protection laws for processing. Further, data collected by IoT devices is sometimes **12) susceptible** to misuse, potentially causing discriminatory outcomes for some users. Other legal issues with IoT devices include the conflict between law enforcement surveillance and civil rights; data **13) retention** and destruction policies; and legal liability for unintended uses, security breaches or privacy lapses.

Emerging Economy and Development Issues

The Internet of Things holds significant promise for delivering social and economic benefits to emerging and developing economies. This includes areas such as sustainable agriculture, water quality and use, healthcare, industrialization, and environmental management, among others **(Will you give some more examples?)**. As such, IoT holds promise as a tool in achieving the United Nations Sustainable Development Goals.
The Internet of Things is happening now. It promises to offer a revolutionary, fully connected "smart" world as the relationships between objects, their environment, and people become more tightly **14) intertwined**. Yet the issues and challenges associated with IoT need to be considered and addressed in order for the potential benefits for individuals, society, and the economy to be realized.
(https://www.internetsociety.org/resources/doc/2015/iot-overview/)

6. Read the text again and find:

a. easily harmed;
b. action of stopping sth from coming out;
c. restrain or keep in check;
d. made it difficult for sth to proceed;
e. coming together;
f. choose not to be involved in sth;

g. careful watch kept on sb suspected of doing sth wrong;
h. restrict or prevent a process;
i. cannot be overcome;
j. present and seen everywhere;
k. twisted so as to be joined;
l. rapid growth or increase in numbers;
m. promoting;
n. possible;

7. Fill in the gaps with the suitable words in the correct form:
Inhibit, feasible, proliferation, retention, curb, disrupt, pervasive, intertwine, foster, opt out, surveillance, insurmountable, confluence, susceptible

1. A lot of innovations are introduced to many projects and programs that _____ in time and place in different countries.
2. In some countries students can_____ of testing by submitting a written request.
3. Business communication could be _____ in a cyber terrorism attack.
4. In fact, it is_____ to design and build a set up to create necessary conditions for this experiment.
5. The government had to_____ spending on experimental development.
6. All meetings in the hall are kept under video _____.
7. A _____ of achievements in the IoT is pushing the advancement of society.
8. Energy conservation and heat_____ are crucial for environmental sustainability and economic savings.
9. It's crucial for further research to see if the differences are __ they may become a new approach.
10. The_____ of media platforms is driven by technological advancements and changing consumer preferences.
11. There are a lot of _____themes which have always attracted attention of scientists in the world.
12. We live in the era of _____ innovations through developing digital technology.
13. A lack of oxygen can _____various cellular and physiological processes.
14. Fragile objects are_____ to damage from physical forces.

8. Read the text, fill in the gaps with the verbs from the list in the correct forms and answer the questions:
Experience, lead, seek, indicate, allow, provide, convert, limit, expose, design, receive.

Football Helmet Sensors- Shockbox

$ 179.99

As a trainer, coach or parent, do you know how many hits your athlete 1) ____ to in each game? Each Season? Little league baseball uses a "pitch count"2)

____repetitive damage to the elbow area in youngsters – why not limit damage to the brain?
Shockbox® football helmet sensors 3____ an immediate visual alert that a player 4) ____ an “at risk hit”, which may have resulted in a concussion. These alerts are sent via long range Bluetooth® transmission up to 325ft (100m) to your smartphone, tablet or computer.
Studies have shown that many concussions go undetected or unreported by the athletes and that multiple repeat impacts can 5_____ to serious lifelong physical and cognitive health issues. Shockbox® football helmet sensors are a tool that 6)_____coaches, trainers and parents to keep a history of head impact data for each player; assisting them in making more informed decisions from the sideline for athletes who may be at risk of sustaining a concussion.
The Shockbox Football Helmet Sensor 7) _____to be attached inside of a football helmet. The sensor provides an immediate wireless transmission to your smartphone, via Bluetooth that a player has experienced a head impact that could result in concussion. This takes the guess work away from determining when to take a player off the field and 8) _____ medical advice.
The Shockbox® software 9) _____ data from the sensor and 10) _____it to a visual color-coded alert. Each alert 11) _____ that an impact has occurred within a range of Peak G acceleration. Peak G is one of the most reliable and standard methods of head impact biomechanical analysis. The alert provides the user with a quantifiable measure of the head impact in order to start concussion protocols when necessary.
(https://gridiron-tech.com/product/football-helmet-sensors/)

1. What are the key elements for concussion prevention?
2. How does it work?
3. How are helmet technology sensors changing the game?
4. What’s new in the helmet technology?
5. What can be future trends in football helmet technology?
6. How can you choose the right helmets for your favorite team?

9. Describe the characteristics of any smart device from the list:

Smart Agriculture System, Home Automation System, Face Recognition Bot, Air Pollution Monitoring System, Smart Traffic Management System, Smart Gas Leakage Detector Bot, Smart Anti-theft System, Health Monitoring System, Flood Detector System and what not.

10. Watch a video ' Internet of bodies: Blurring the lines between humans and tech' and do the task.
(https://www.youtube.com/watch?v=me7ZvYNKmzk)

Read the statements and decide if they are true or false.

1. All the categories of IoB mainly depend on the computing power of the devices
2. The first generation of IoB is able to track our heart rates.
3. The third generation completely merges with our body.
4. A coin-sized chip is implanted to control our internal organs.
5. A paralyzed patient was the first to use the IoB of the third generation.
6. Nowadays IoB is being integrated into space exploration.
7. Dick Chency admitted that his heart implant once had saved him from serious heart attack.
8. IoB devices are all under the control of the U.S. Food and Administration control.
9. GDPR is responsible for the people's protection from cyber attacks
10. Connected medical device market is expected to reach $ 132 billion in the US alone by 2029. F

11. Answer the questions:

1. What is the main challenge of the internet of things?
2. How does Internet of Things work in everyday things?
3. Can IoT work without Internet?
4. Is a smartphone an IoT device?
5. Is VPN used in IoT?
6. What devices can be connected using the industrial IoT solution?
7. What are the challenges facing IoT adoption?
8. What impact will 5G have on IoT?
9. How does IoT work?
10. What is the future of IoT?

Part ll

Machine Learning

1.Answer the questions.

1. What is machine learning (ML)?
2. What are the main parts of ML?
3. What is the biggest problem with machine learning?
4. Can machine learning solve every problem?
5. Can you explain the terms Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL)?
6. What are the advantages of using unsupervised learning?

2. Give the definitions or explanations of the words related to computing.

Byte, refresh rate, protocol, frames, IP address, proxy, screen saver, upgrade, virus, character, interface, login, mainframe, firewall, folder, browser, hypermedia, java.

3.Read the text and answer the questions in brackets

Machine learning

By Sara Brown

Apr 21, 2021

Why It Matters

Machine learning is behind chatbots and **1) predictive text**, language translation apps, the shows Netflix suggests to you, and how your social **2)media feeds** are presented. It powers autonomous vehicles and machines that can diagnose medical conditions based on images.

With the growing ubiquity of machine learning, everyone in business is likely to encounter it and will need some working knowledge about this field.

A 2020 Deloitte survey found that 67% of companies are using machine learning, and 97% are using or planning to use it in the next year.

From manufacturing to retail and banking to bakeries, even legacy companies are using machine learning to unlock new value or boost efficiency. "Machine learning is changing, or will change, every industry, and leaders need to understand the basic principles, the potential, and the limitations," said MIT computer science professor Aleksander Madry, director of the MIT Center for Deployable Machine Learning.

What is machine learning

Machine learning is a subfield of artificial intelligence, which is broadly defined as the capability of a machine to imitate intelligent human behavior. Artificial intelligence systems are used to perform complex tasks in a way that is similar to how humans solve problems **(How does it work?)**

The goal of AI is to create computer models that exhibit "intelligent behaviors" like humans, according to Boris Katz, a principal research scientist and head of the InfoLab Group at CSAIL. This means machines that can recognize a visual scene, understand a text written in natural language, or perform an action in the physical world.

Machine learning is one way to use AI. It was defined in the 1950s by AI pioneer Arthur Samuel as "the field of study that gives computers the ability to learn without explicitly being programmed."

But in some cases, writing a program for the machine to follow is time-consuming or impossible, such as training a computer to recognize pictures of different people. While humans can do this task easily, it's difficult to tell a computer how to do it. Machine learning takes the approach of letting computers learn to program themselves through experience.

Machine learning starts with data — numbers, photos, or text, like bank transactions, pictures of people or even bakery items, repair records, time series data from sensors, or sales reports. The data is gathered and prepared

to be used as training data, or the information the machine learning model will be trained on. The more data, the better the program.
From there, programmers choose a machine learning model to use, supply the data, and let the computer model train itself to find patterns or make predictions. Over time the human programmer can also **3) tweak** the model, including changing its parameters, to help push it toward more accurate results.
Some data is held out from the training data to be used as evaluation data, which tests how accurate the machine learning model is when it is shown new data. The result is a model that can be used in the future with different sets of data.
Successful machine learning algorithms can do different things **(What things can they do?)**, Malone wrote in a recent research brief about AI and the future of work that was co-authored by MIT professor and CSAIL director Daniela Rus and Robert Laubacher, the associate director of the MIT Center for Collective Intelligence.
"The function of a machine learning system can be **descriptive**, meaning that the system uses the data to explain what happened; **predictive**, meaning the system uses the data to predict what will happen; or **prescriptive**, meaning the system will use the data to make suggestions about what action to take," the researchers wrote.
There are three subcategories of machine learning:

Supervised machine learning models are trained with labeled data sets, which allow the models to learn and grow more accurate over time. For example, an algorithm would be trained with pictures of dogs and other things, all labeled by humans, and the machine would learn ways to identify pictures of dogs on its own. Supervised machine learning is the most common type used today**. (Where is this type of ML used?)**
In **unsupervised** machine learning, a program looks for patterns in unlabeled data. Unsupervised machine learning can find patterns or trends that people aren't explicitly looking for. For example, an unsupervised machine learning program could look through online sales data and identify different types of clients making purchases. **(Can you give some examples of its application?)**
Reinforcement machine learning trains machines through trial and error to take the best action by establishing a reward system. Reinforcement learning can train models to play games or train autonomous vehicles to drive by telling the machine when it made the right decisions, which helps it learn over time what actions it should take**. (What are the areas of its use?)**
Machine learning is also associated with several other artificial intelligence subfields: natural language processing, neural networks, deep learning. **(Will you tell something about each of them?)**

How businesses are using machine learning

Machine learning is the core of some companies' business models, like in the case of Netflix's suggestions algorithm or Google's search engine. Other companies are engaging deeply with machine learning, though it's not their main business proposition.

In a 2018 paper, researchers from the MIT Initiative on the Digital Economy outlined a 21-question rubric to determine whether a task is suitable for machine learning. The researchers found that no occupation will be untouched by machine learning **(Do you agree with this statement?)**, but no occupation is likely to be completely taken over by it. The way to **4)unleash** machine learning success, the researchers found, was to reorganize jobs into discrete tasks, some which can be done by machine learning, and others that require a human.

Companies are already using machine learning in several ways, including:

Recommendation algorithms. The recommendation engines behind Netflix and YouTube suggestions, what information appears on your Facebook feed, and product recommendations are fueled by machine learning. "[The algorithms] are trying to learn our preferences," Madry said. "They want to learn, like on Twitter, what tweets we want them to show us, on Facebook, what ads to display, what posts or liked content to share with us."

Image analysis and object detection. Machine learning can analyze images for different information, like learning to identify people and tell them apart — though facial recognition algorithms are controversial **(Why can it be so difficult for a machine to identify a person?).** Business uses for this vary. Shulman noted that 5)hedge funds famously use machine learning to analyze the number of cars in parking lots, which helps them learn how companies are performing and make good bets.

Fraud detection. Machines can analyze patterns, like how someone normally spends or where they normally shop, to identify potentially **6)fraudulent** credit card transactions, log-in attempts, or spam emails.

Automatic helplines or chatbots. Many companies are deploying online chatbots, in which customers or clients don't speak to humans, but instead interact with a machine. These algorithms use machine learning and natural language processing, with the bots learning from records of past conversations to come up with appropriate responses**.(Do these algorithms always work perfectly?)**

Self-driving cars. Much of the technology behind self-driving cars is based on machine learning, deep learning in particular.

Medical imaging and diagnostics. Machine learning programs can be trained to examine medical images or other information and look for certain markers of illness, like a tool that can predict cancer risk based on a mammogram.

How machine learning works: promises and challenges

While machine learning is fueling technology that can help workers or open new possibilities for businesses, there are several things business leaders should know about machine learning and its limits.

One area of concern is what some experts call explainability, or the ability to be clear about what the machine learning models are doing and how they make decisions. This is especially important because systems can be fooled and undermined, or just fail on certain tasks, even those humans can perform easily. For example, adjusting the **7) metadata** in images can confuse computers — with a few adjustments, a machine identifies a picture of a dog as an ostrich.

The importance of explaining how a model is working — and its accuracy — can vary depending on how it's being used, Shulman said. While most well-posed problems can be solved through machine learning, he said, people should assume right now that the models only perform to about 95% of human accuracy. It might be okay with the programmer and the viewer if an algorithm recommending movies is 95% accurate, but that level of accuracy wouldn't be enough for a self-driving vehicle or a program designed to find serious **8) flaws** in machinery.

Bias and unintended outcomes

Machines are trained by humans, and human biases can be incorporated into algorithms — if **9) biased** information, or data that reflects existing inequities, is fed to a machine learning program, the program will learn to replicate it and perpetuate forms of discrimination. Chatbots trained on how people converse on Twitter can pick up on offensive and racist language, for example.

Ways to fight against bias in machine learning including carefully **10) vetting** training data and putting organizational support behind ethical artificial intelligence efforts, like making sure your organization embraces human-centered AI, the practice of seeking input from people of different backgrounds, experiences, and lifestyles when designing AI systems. Initiatives working on this issue include the Algorithmic Justice League and The Moral Machine project.

Putting machine learning to work

'Executives tend to struggle with understanding where machine learning can actually add value to their company. What's gimmicky for one company is core to another, and businesses should avoid trends and find business use cases that work for them.

Machine learning is changing, or will change, every industry, and leaders need to understand the basic principles, the potential, and the limitations '.

Aleksander Madry MIT Computer Science Professor

It's also best to avoid looking at machine learning as a solution in search of a problem. Some companies might end up trying to **11) backport** machine learning into a business use. Instead of starting with a focus on technology, businesses should start with a focus on a business problem or customer need that could be met with machine learning.
https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained

4.Read the text again and find:

a) update software with new features from newer versions;
b) deceitful, dishonest;
c) information that describes other data;
d) a feature on electronic devices that anticipates and suggests words or phrases as you type;
e) examining sth carefully;
f) release;
g) a mistake that makes sth weaker or less acceptable;
h) constantly updating lists of posts or stories that appear in the middle of your home page when you log in;
i) improve a mechanism or system by fine adjustments;
j) private, unregistered investment funds;
k) influenced unfairly, distorted.

5.Fill in the gaps with words from the list.

metadata, tweak, bias, media feeds, predictive text, backport, fraudulent, unleash, vet, hedge fund, flaws

1. If __isn't working on your smartphone it means that a device needs adjusting.
2.Money laundering is one of the examples of __ schemes which present significant risks not only for organizations but for individuals.
3. Social __display a continues update, photos, videos, links which are relevant to your interests, depending on the platform's algorithm.
4.It is possible __both hardware and software to optimize a PC beyond its default settings.
5.__ can invest in land, real estate, stock and currencies.
6. For any data protection it's crucial to be aware of the potential ML__data.
7. __a game means modifying it to run on an older firmware version.
8. The IoT devices have got vulnerabilities that have to be discovered and assessed through__.
9. __the potential benefits of cloud computing for users include saves on money, office space and in-house support staff.
10. Major security__ in microprocessors inside can allow hackers to steal the entire memory of computers.

11. Online__will show users all hidden information of video, images, and eBooks.

6. Read the text, fill in the gaps with the words in the correct form and answer the questions.

Theoretical, recognition, principles, focus, resemble, accomplish, overlap, discipline

What is Natural Language Processing?

Natural language processing (NLP) is the 1) __ of building machines that can manipulate human language — or data that 2) __human language — in the way that it is written, spoken, and organized. It evolved from computational linguistics, which uses computer science to understand the 3) __of language, but rather than developing 4) __ frameworks, NLP is an engineering discipline that seeks to build technology to 5) __useful tasks. NLP can be divided into two 6) __subfields: natural language understanding (NLU), which 7) __on semantic analysis or determining the intended meaning of text, and natural language generation (NLG), which focuses on text generation by a machine. NLP is separate from — but often used in conjunction with — speech 8)__ which seeks to parse spoken language.
https://www.deeplearning.ai/resources/natural-language-processing/

1. What is Natural Language processing (NLP)?
2. Is NLP supervised or unsupervised?
3. How accurate is NLP?
4. What is the difference between NLP and AI?
5. What problems can NLP solve?
6. What are the applications of NLP in AI?
7. What are the main challenges in NLP?

7.Watch the video' How Voice Recognition Works' and match the beginnings of sentences with their endings.

1. Computers copy the method the linguists use to analyse human speech and
2. The computer splits up the image into pieces, analyses each of them and
3. The computer identifies the sound and
4. It analyses previous slices and
5. spectrograms for some different phrases
6. The most advanced speech recognition systems today
7. The greatest challenge speech recognition systems face nowadays is p proper interpretation of sentences because

a) have got down an error rate of 11%
b) makes judgment based on how words tend to be constructed

c) computers don't have pre-existing knowledge which makes a sentence too difficult for understanding
d) use ML to train themselves on every new piece of audio
e) are going to look very similar
f) moves on to the next one
g) compares it to a library of spectrograms of different sounds.

(https://www.youtube.com/watch?v=2RRT1YuyBCo)

8. Answer the questions about the Machine Learning.

1. How are Artificial Intelligence and Machine Learning related?
2. What are some real-world examples of applications of machine learning in the field?
3. What are the different fields of study in data mining?
4. What are differences in research nature between the two fields: machine learning & data mining?
5. How do I know if the problem is solvable through machine learning?
6. What are the origins of machine learning?
7. How was classification, as a learning machine, developed?
8. What are the different types of Machine Learning?
9. What is overfitting, and how can you avoid It?
10. What is 'training Set' and 'test Set' in a Machine Learning Model?
11. How do you handle missing or corrupted data in a dataset?
12. What is the difference between deep learning and usual machine learning?
13. Why did it take so long for deep networks to be invented?
14. What are some good books/papers for learning deep learning?
15. Why do some people hate neural networks /deep learning?

9. Speak on one of the topics (5 min) related to digital technologies.

Artificial intelligence and IoT, wearables, body sensors, smart portable edge devices, design space exploration techniques for IoT devices and systems, Internet of underwater things, IoT in research and others

GRAMMAR

CONDITIONALS

Conditionals deal with imagined situations: some are possible some are unlikely some are impossible. The speaker imagines that something can or cannot happen or have happened and then compares that situation with possible consequences, or offers further logical conclusions about the situation. Conditionality is conveyed chiefly by means of conditional sentences. They are mainly introduced by the conjunction if. We use a comma when we begin with if clause.

TYPE I

- Type l conditional sentences can be called ‘future’ conditional. Both refer to the future, although the verb in the **if** clause is in present tense.

e.g. If you think over the question, you will answer it.

- We use an imperative more often than a future form of the verb in a conditional clause to give instructions or advice.

e.g. If you have problems with the Internet, connect with the support group.

- We can also use Present Continuous, Present Perfect, or going to in the conditional l

e.g. If you are working, I will call you later. If you have finished the lunch, we can check our emails. If you are going to repeat the experiment, I will vet the set up.

1. Put the verbs in brackets into the correct form.

1. If you (upgrade)__ your PC, you’ll be able to run multimedia applications.
2. If I (get)__ a sound card, I’ll be able to create my own music with MIDI.
3. If I can afford it , I (buy)__ a Multimedia PC.
4. If a marketing manager (have)__ a multimedia system, he will make more effective presentations.
5. Users will avoid risks if they (set) __all security alerts.
6. If you (not/open)__ email attachments from strangers, you’ll protect your system.
7. If the connection (not/be) __secure, Web browsers will warn you.
8. If one of the intermediary computers (infiltrate)__ by hackers, your data will be copied.
9. All valuable information such as bank accounts, business and research reports will be stolen if private networks connected to the Internet (be)__ attacked by intruders.
10. If you download files, they probably (compress)__.

- **Unless** is used in conditionals with the meaning ‘if…not’ but not in most questions.

e.g. If you aren’t (or Unless you are) going to be responsible for the day-day running of our data –processing equipment, we won’t offer this job.

What will you do if you don’t pass the exam?

2. Fill in the gaps with ‘if ‘or ‘unless’

1. You will access a locked computer system or network __ you type your user name and password.
2. You won’t access a locked computer system or network __ you type your user name and password.
3. __one of the intermediate computers is infiltrated by hackers your data can be hacked.
4. Web browsers will warn you __ the connection is not secure.
5. Users will avoid risks __ you set all security alerts.
6. You will be really sorry __ you take the opportunity.

7. The students will be happy __ they are given to take part in the project.
8. __you have at least two years' experience in DIGITUM you won't be able to work on the full range of analysis, design, and coding.
9 You will be excited creating animated drawing and moving images __you use Java.
10 __users recognized acronyms and abbreviations associated with programming they will not develop their skills.

3.Paraphrase the following sentences according to the model.

A How to become a good programmer

Model: Revise it again and you will do the task successfully
If you revise it again you will do the task successfully

1. Start with basics and you will become a good programmer.
2. Choose a language or framework that aligns with your future goals and it will be easier for you to study programming.
3. Learn a programming language C++ or Java and you will become a good programmer in college.
4. Start with small things and you will get the motivation to keep going.
5. Communicate effectively and you will become a good team player.
6. Work with different codes or developers and you will gain lots of knowledge.
7. Test your code like a user and it will help you to discover flaws.
8. Stay up-to-date with security issues and you will protect your data from leaks.
9. Use Google for every problem you have and it will help you to find a solution.
10. Keep on learning and you will stay up to date.

B If you have some problems with your PC

Model: Send me instructions by email, or else I won't do the task on time.
If you don't send me instructions by email, I won't do the task on time.

1. Monitor the system temperatures, or else it will be overheated.
2. Install reliable antivirus software, or else viruses will corrupt or delete data.
3. Restart your router, or else you will face the problem of the Internet connectivity.
4. Enhance your computer by adding more RAM, or else you will experience lag while multitasking.
5. Use built-in tools to delete temporary files, or else your computer will perform slowly.
6. Restart your computer and enter Safe Mode, or else it will be infected.
7. Replace the old fans, otherwise the hardware will malfunction.
8. Keep your operational system and software up-to-date, otherwise you will have the risk of connectivity issues.

9. Close unused tabs and programs, otherwise they will slow down the computer performance.
10. Implement reliable backup procedures, or else you will experience considerable data loss.

- We can sometimes use **should** before the verb in the **if** clause to express less possibility.

e.g. If you should leave your smartphone at home you will always be able to use mine.

- In a formal, written texts "should" is used instead of "if".

e.g. Should students miss seminars, they will write Explanation letters.

4. Paraphrase the sentences according to the model

Model: If you work harder at university, you will get a better job.
Should you work harder at university, you will get a better job.

1. If people drink too little water, they will suffer from dehydration.
2. If children spend too much time on the Internet, their muscles will weaken.
3. If pupils read more books, they will develop their imagination.
4. If people use more recycled paper, they will save our planet from deforestation.
5. If students apply their knowledge in practice, they will become highly-qualified specialists.

- The following expressions can be used instead of '**if'**: **providing** (spoken language) **provided that** (written language), **as long as, on condition that** suggest reservation, we use **only if** to express similar meaning, while **supposing** implies an act of imagination. **In case** suggests the need to be ready for something.

e.g. The article will be published **provided that** the editor's remarks are taken into account.

Young scientists will participate in the conference **on condition that** they take part in our projects.

I'm always happy **as long as** I get six or seven hours of sleep.

In case you are hungry, take a sandwich.

Only if you are a Bachelor of Science, will you get a job in our company (when the sentence starts with 'only if' we have to use inversion.

5. Now complete these sentences with your own ideas.

How to conduct a successful experiment

1. You will design your experiment carefully if …
2. You will create a testable hypothesis providing …
3. You will be able to define objectives accurately on condition that …
4. You will set up testing software as long as …
5. You won't choose the right metrics unless …
6. It will be important to test more than one variable at a time should …

7. It can be useful to consider an alternative hypothesis in case …
8. If only your experiment fails …
9. You succeed in analyzing the data if …
10. A successful experiment will give you opportunities for progress or promotion on condition that …

Unit TWO. Innovations: Robots and VR.

Part 1

Robotics

'Robotics and other combinations will make the world pretty fantastic compared with today.' – Bill Gates

1. Answer these questions with your partner:

1) What is a robot?
2) What are the main parts of a robot?
3) In what areas of life can we use robots?

2. You are going to watch a video about the history of robots. Before watching, make sure you know these words and match them with their definitions:

1. ICT convergence	a. beginning to grow or increase rapidly; flourishing
2. a paragon	b. to increase very steeply or rapidly
3. to subject	c. to prosper, flourish
4. to coin	d. the merging together of technologies from different sectors such as telecommunications, information technology, and media
5. to skyrocket	e. to underline, to emphasize the importance of something
6. burgeoning	f. to bring (a person or country) under one's control or jurisdiction, typically by using force
7. to underscore	g. the most perfect or typical example of something, which can be positive or negative
8. to thrive	h. a model of excellence or a heroic example of something good (only positive), a flawless diamond of at least 100 carats
9. an epitome	i. invent (a new word or phrase)

3. **Watch the video "All about Robot. History" and answer the questions below:**
    1. Where does the word "robot" come from?
    2. What kind of machine did Chapek depict in his play? What was special about that machine?
    3. According to the video, what is the definition of the word "robot"?
    4. How did G. Devol control his machines?
    5. What was the first industrial robot in charge of?
    6. What are the three years mentioned in the video famous for?
    7. The robotics industry thrived in Korea only with the help of the government, didn't it?

4. **How many different components of a robot can you name? How do robots work? Talk about this with your partner(s).**

5. **Now read the 1st part of the text to check your ideas and complete the gaps with the words given after it.**

ROBOTICS: WHAT IS IT? HOW DOES IT WORK? (PART 1)

What Is Robotics?

Robotics is the 1)_____ of science, engineering and technology that produces machines, called robots, that replicate or substitute for human actions. Robots perform basic and repetitive tasks with greater efficiency and accuracy than humans, making them ideal for industries like manufacturing. However, the introduction of artificial intelligence in robotics has given robots the ability to handle increasingly 2)_____ situations in various industries.

What Is a Robot?

A robot is a programmable machine that can complete a task, while the term robotics describes the field of study focused on developing robots and automation. Each robot has a different level of 3)_____. These levels range from human-controlled bots that carry out tasks to fully-autonomous bots that perform tasks without any external influences.

Robotics Aspects

Mechanical Construction

The mechanical aspect of a robot helps it complete tasks in the environment for which it's designed. For example, the Mars 2020 Rover's wheels are individually 4)_____ and made of titanium tubing that help it firmly grip the harsh terrain of the red planet.

Electrical Components
Robots need electrical components that control and power the machinery. Essentially, an electric current — a 5)_____, for example — is needed to power a large majority of robots.

Software Program
Robots contain at least some level of computer programming. Without a set of 6)_____ telling it what to do, a robot would just be another piece of simple machinery. Inserting a program into a robot gives it the ability to know when and how to carry out a task.

What Are the Main Components of a Robot?

Control System
Computation includes all of the components that make up a robot's central processing unit, often referred to as its control system. Control systems are programmed to tell a robot how to 7)_____ its specific components, similar in some ways to how the human brain sends signals throughout the body, in order to complete a specific task. These robotic tasks could comprise anything from minimally invasive surgery to assembly line packing.

Sensors
Sensors provide a robot with stimuli in the form of electrical signals that are processed by the controller and allow the robot to interact with the outside world. Common sensors found within robots include video cameras that function as eyes, 8)_____that react to light and microphones that operate like 9)_____ . These sensors allow the robot to capture its surroundings and process the most logical conclusion based on the current moment and allows the controller to relay commands to the additional components.

Actuators
A device can only be considered to be a robot if it has a movable frame or body. Actuators are the components that are responsible for this movement. These components are made up of motors that receive signals from the control system and move 10)_____ to carry out the movement necessary to complete the assigned task. Actuators can be made of a variety of materials, such as metal or elastic, and are commonly operated by use of compressed air (pneumatic actuators) or oil (hydraulic actuators) but come in a variety of formats to best fulfill their specialized roles.

Power Supply

Like the human body requires food in order 11) _____, robots require power. Stationary robots, such as those found in a factory, may run on AC power through a wall outlet but more commonly, robots operate via an internal battery. Most robots utilize lead-acid batteries for their safe qualities and long shelf life while others may utilize the more compact but also more expensive silver-cadmium variety. Safety, weight, replaceability and lifecycle are all important 12)___ _____ to consider when designing a robot's power supply.

Some potential power sources for future robotic development also include pneumatic power from compressed gasses, solar power, hydraulic power, flywheel energy storage organic garbage through anaerobic digestion and nuclear power.

End Effectors

End effectors are the physical, typically external components that allow robots to finish carrying out their tasks. Robots in factories often have 13)_____ tools like paint sprayers and drills, surgical robots may be equipped with scalpels and other kinds of robots can be built with gripping claws or even hands for tasks like deliveries, packing, bomb diffusion and much more.

How Do Robots Work?

Some robots are pre-programmed to perform specific functions, meaning they operate in a controlled environment where they do simple, monotonous tasks — like a mechanical arm on an automotive assembly line.

Other robots are autonomous, operating independently of human operators to carry out tasks in open environments. In order to work, they use sensors to 14)_____ the world around them, and then employ decision-making structures (usually a computer) to take the optimal next step based on their data and mission.

Robots may also work by using wireless networks to enable human control from a safe distance. These teleoperated robots usually work in extreme geographical conditions, weather and circumstances. Examples of teleoperated robots are the human-controlled 15)_____ used to fix underwater pipe leaks during the BP oil spill or drones used to detect landmines on a battlefield.

a. utilize	d. in tandem	g. battery	j. complex	m. interchangeable
b. intersection	e. autonomy	h. motorized	k. code	n. to function
c. perceive	f. ears	i. factors	l. submarines	o. photoresistors

6. **Find the words in the text for the following definitions (the paragraph names will help you):**

1. To manage (a situation or a problem) [What is Robotics?]
2. able to resume its normal shape spontaneously after being stretched or compressed [Actuators]
3. an object or tool for picking things up that looks something like that of an animal, bird, or insect [End Effectors]
4. take into one's possession or control by force [Sensors]
5. use something or someone instead of another thing or person [What is Robotics?]
6. capable of being moved; not fixed in one place, position, or posture [Actuators]
7. the length of time for which an item remains usable, fit for consumption, or saleable [Power supply]
8. given a particular job or piece of work [Actuators]
9. controlled remotely [How do robots work?]

7. **What kinds of robots do you know? Where and how are they used? Collect your ideas together with your partner(s).**

8. **Now read the 2nd part of the text to check your answers and choose the correct option while reading:**

ROBOTICS: WHAT IS IT? HOW DOES IT WORK? (PART 2)

Types of Robotics

Humanoid Robots

Humanoid robots are robots that look like or 1) ***mimic/mime*** human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us, even having human faces and expressions. Two of the most prominent examples of humanoid robots are Hanson Robotics' Sophia and Boston Dynamics' Atlas.

Cobots

Cobots, or collaborative robots, are robots designed to work alongside humans. These robots 2) ***priorities/prioritize*** safety by using sensors to remain aware of their surroundings, executing slow movements and ceasing actions when their movements are obstructed. Cobots typically perform simple tasks, freeing up humans to address more complex work.

Industrial Robots

Industrial robots automate processes in manufacturing environments like 3) ***factories/fabrics*** and warehouses. Possessing at least one robotic arm, these robots

are made to handle heavy objects while moving with speed and precision. As a result, industrial robots often work in assembly lines to 4) ***boost/bust*** productivity.

Medical Robots
Medical robots assist healthcare professionals in various scenarios and support the physical and mental health of humans. These robots rely on AI and sensors to navigate healthcare facilities, interact with humans and execute 5)***precise/precious*** movements. Some medical robots can even converse with humans, encouraging people's social and emotional growth.

Agricultural Robots
Agricultural robots handle repetitive and labor-intensive tasks, allowing farmers to use their time and energy more efficiently. These robots also operate in greenhouses, where they monitor crops and help with harvests. Agricultural robots come in many forms, ranging from autonomous tractors to drones that collect data for farmers to analyze.

Microrobotics
Microrobotics is the study and development of robots on a miniature scale. Often no bigger than a millimeter, microrobots can vary in size, depending on the situation. Biotech researchers typically use microrobotics to monitor and treat diseases, with the goal of improving diagnostic tools and creating more 6) ***goaled/targeted*** solutions.

Augmenting Robots
Augmenting robots, also known as VR robots, either enhance current human capabilities or replace the capabilities a human may have lost. The field of robotics for human augmentation is a field where science fiction could become reality very soon, with bots that have the ability to redefine the definition of humanity by making humans faster and stronger. Some examples of current augmenting robots are robotic prosthetic limbs or exoskeletons used to lift hefty weights.

Software Bots
Software bots, or simply 'bots,' are computer programs which carry out tasks autonomously. They are not technically considered robots. One common use case of software robots is a chatbot, which is a computer program that 7) ***stimulates/simulates*** conversation both online and over the phone and is often used in customer service scenarios. Chatbots can either be simple services that answer questions with an automated response or more complex digital assistants that learn from user information.

Robotics Applications
Beginning as a major boon for manufacturers, robotics has become a 8) ***stay main/mainstay*** technology for a growing number of industries.

Manufacturing
Industrial robots can assemble products, sort items, perform welds and paint objects. They may even be used to fix and maintain other machines in a factory or warehouse.

Healthcare
Medical robots transport medical supplies, perform surgical procedures and offer emotional support to those going through rehabilitation.

Companionship
Social robots can support children with learning disabilities and act as a therapeutic tool for people with dementia. They also have business applications like providing in-person customer service in hotels and moving products around warehouses.

Home Use
Consumers may be most familiar with the Roomba and other robot vacuum cleaners. However, other home robots include lawn-mowing robots and personal robot assistants that can play music, engage with children and help with household 9) ***chores/choirs***.

Search and Rescue
Search and rescue robots can save those stuck in flood waters, deliver supplies to those stranded in remote areas and put 10) ***out/into*** fires when conditions become too extreme for firefighters.

https://builtin.com/robotics

9. Give your own definitions for these words and expressions from both parts:

Repetitive, autonomy, carry out tasks, a stimulus (stimuli), movable, replaceability, anaerobic digestion, bomb diffusion, obstructed movements, greenhouses, exoskeletons, to assemble, to perform welds, put out fires.

10. Make sentences with the provided words and phrases:

1) Relay, interchangeable, exoskeleton
2) Handle, carry out tasks, stranded
3) Substitute, a greenhouse, harsh
4) Enhance, movable, a shelf life

11. Answer the questions:

1) What is robotics?
2) Why can’t robots function without a control system?

3) Why are sensors important for robots?
4) What do you need to take into account designing a robot's power supply?
5) What are end effectors? Give examples.
6) Can a mechanical arm work autonomously? Why?
7) Give examples of at least two types of robots.
8) In your opinion which is the most promising area of the robotics application? Why?

12. As any innovation robotics comes with a number of benefits and drawbacks. In pairs decide which notions belong to either pros or cons. Explain your choice. Think of two more possible advantages and disadvantages of robotics.

- Rapid innovation
- Job losses
- Limited creativity
- Increased accuracy
- Enhanced productivity
- Environmental waste
- Data security risks
- Improved safety
- Greater cost-efficiency
- Maintenance cost

13. One of the disadvantages of robotics is job losses. Will robots take our jobs? Talk about this with your partner. Then, watch the video "Will Robots Take Our Jobs?" and check your ideas.

14. Watch the video again and say if the statements are true or false.

1. Robots will be able to cope with everything better than us.
2. The number of jobs lost to robots will decrease in the future.
3. About 45% of jobs are going to be automated over the next 20 years.
4. Creative monotonous jobs are especially at high risk.
5. Robotics and automation will create new jobs.
6. When a car was created, no jobs related to trains disappeared.
7. It is hardly possible that robots will learn empathy.
8. The problem of robots replacing low-skilled workers will lead to stress, depression and unhappy people.
9. We need to have our skills trained if we want to cooperate successfully with robots.

15. Together with your partner think of the positions that are being taken/will be taken by robots and jobs that can be performed only by humans. Prove your ideas.

Mini-grammar

What if robots replaced all humans in almost all the jobs? To talk about different unreal or hypothetical situations we use Conditionals.

The *second* conditional uses the past simple after ‘if’, then 'would' and the infinitive:
if + past simple, ...would + infinitive
(We can use 'were' instead of 'was' with 'I' and 'he/she/it'. This is mostly done in formal writing).
We can use it to talk about things in the future that are probably not going to be true, or smth impossible in the present.

- If I **had** a robodog, I **would not feel** lonely. (I don’t have one and probably won't have one).

We make the *third* conditional by using the past perfect after 'if' and then 'would have' and the past participle in the second part of the sentence:
if + past perfect, ...would + have + past participle
It talks about the past. It's used to describe a situation that didn't happen, and to imagine the result of this situation.

- She **wouldn't have been** tired if she **had bought** herself a robot vacuum cleaner. (She was really tired yesterday. She hadn’t bought a vacuum cleaner before)

16. Fill in the gaps with the correct verb forms:

1) If I_____ (be) you, I _____(not agree) to be operated by a robot.
2) She _____(get) a degree in Physics five years ago if she _____(enter) NSU.
3) If I _____(want) to advertise my services and help my clients get all the answers they need, I _____(use) a chat bot.
4) Matt _____(to be saved) if they _____(have) a robot-fireman last year.
5) If she _____(not forget) to charge her phone yesterday, she _____(read) the message.
6) What ____ you _____(feel) if you _____(need) a prosthetic limb?
7) If there _____(be) no teachers, there _____(not be) any students.
8) . If I _____(win) the lottery last week, I _____(buy) myself a delivery robot.

17. Continue with your own ideas:

1. I would have entered Mathematics &Mechanics Department if

2. If I could choose a robot for my family,
3. If it was +30 today,
4. If I had witnessed a robotic failure,
5. I would join a robotics club if

18. Write a short passage (about 150 words) answering the question "What would happen if robots replaced teachers?"

19. Robots are not likely to become teachers in the near future. But can a robot be a leader? Read the text and find out if you were right.

Can a robot be a leader?

Artificial intelligence (AI) is increasingly able to make decisions in complex situations. Digital machines are replacing all kinds of human tasks, whether repetitive, specific, manual or cognitive.

There is, however, a worrying dark side to this potent force. We are increasingly bombarded with news stories on the way machines may threaten jobs — something that has huge implications for modern capitalist society.

Robots are eliminating jobs in factories, warehouses and customer service centres at an accelerating pace.

The future of work will be shaped by digital automation, which may open the door to hyper-productive corporations without employees. But with ever-greater AI capabilities, the future could also be one that dispenses with human management. With intelligent automation, managers at various levels may also become redundant. We could well see data-processing networks making decisions and sending electronic instructions to the corporate structure round the clock. What is better than an intelligent algorithm to analyse data and to make decisions in Marketing, Human Resources, Operations, and Finance?

The electronic CEO

We might even have a future 'Digital CEO' (just an algorithm) that would continuously analyse all worthwhile information on the news, review customer comments on social networks and supervise internal production indicators.

This electronic CEO would give the right orders to manufacturing plants to maximise corporate results. The entire management could be replaced by a digital machine that would learn all by itself and become more productive with every passing day.

Given this backdrop, many questions arise that go far beyond just the economic implications of AI. How will artificial intelligence affect the practice of management itself?

Operations management and strategy

Machines are clearly superior in the interpretation of big data, pattern identification, error prevention and subsystem coordination. Management processes that are strongly based on logic, statistics, and rational decision-making will soon be performed much better by intelligent algorithms.

This will obviously soon be the case in the fields of Operations Management, where decisions and policies bearing on stock management, procurement, supply chains, production planning, quality control, distribution logistics, all require a high level of mathematical reasoning.
This is also the case in Financial Management. Once the strategy is defined and the corporate objectives are set, machines can be left to get on with implementing the strategy all by themselves.
Under these models, not only will production lines be robotised but so too will Operations Management in those fields that are highly susceptible to automation.

Will robots replace managers?

Leadership is an example of a very human activity – it requires understanding and interpretation of emotions (your own and those of others). It is an activity that needs interaction among people, recognition of individual needs, and the use of this recognition to guide teams toward achieving defined goals.
Artificial intelligence still lacks the emotional skills to successfully complete interactions with people.
___People could accept a robot as a boss. __1_Can a robot be a leader? ___To do so, trust must be forged — something for which emotional skills are needed.
___But it is one thing to give cold instructions to a human team mate and quite another to lead people, to have the emotional ability to guide a team in VUCA (Volatile, Uncertain, Complex and Ambiguous) situations. ____MIT researchers show that it would not be difficult for people to receive robot instructions**.**
Although artificial intelligence is highly capable when it comes to, say, determining the key characteristics of a product to be launched in a particular market, or in diagnosing some types of cancer, AI still lacks the emotional skills to successfully complete interactions with people (for instance, creating brands with emotional values, persuading a customer, negotiating a major contract, or communicating a serious illness in a medical process).
Machines cannot assume the functions of institutional representation. Could a machine act as a company's institutional representative? Could it have legal responsibilities? Could a machine even be the owner of a business or, say, a patent?
It is likely that processes that involve persuasion, leadership, institutional relations, and ownership will resist the encroachments of artificial intelligence better.

This article is based on research published in the Journal of Management Inquiry
https://dobetter.esade.edu/en/robot-leader

20. Order the sentences in the mixed paragraph (the first is done for you).

21. Find the words from the text for the definitions:

1. liable to change rapidly and unpredictably, especially for the worse
2. intrusion on a person's territory, rights, etc.
3. manage without or get rid of
4. the action of obtaining something
5. the extent of someone's or something's ability
6. putting (a decision, plan, agreement, etc.) into effect
7. to be created (something) strong, enduring, or successful

8. completely remove or get rid of (something)
9. worth the time, money, or effort spent; of value or importance

22. **Give your own definitions for the following words:** redundant, implications, susceptible, recognition, negotiating, persuasion

23. Answer the following questions:
1. How do robots threaten jobs?
2. Why will managers become redundant?
3. What can a "digital CEO" do?
4. In what kind of tasks are robots superior to people?
5. What does leadership require?
6. What is the difference between just giving instructions and leading people?
7. Do you agree that trust must be forged? Why?
8. Do you think it's possible that AI will get emotional skills one day? Why?

Part II

Virtual Reality

1. Answer the questions:
1. What is VR?
2. Where is VR applied?
3. Have you ever tried VR? If yes, how was it? If no, would you like to?

2. Read the 1st part of the text about VR and put the pieces taken from it back in their places. There is one extra piece:
a) which airlines and militaries use to train their pilots
b) under the umbrella term *extended reality*
c) With augmented reality
d) as treadmills or stationary bicycles to provide
e) delivers the greatest level of virtual reality
f) such as goggles, headsets or bodysuits to interact with the environment

What is Virtual Reality? How is it Used and How will it Evolve? (part 1)

<u>What is Virtual Reality?</u>

Virtual reality, or VR, is a simulated three-dimensional (3D) environment that lets users explore and interact with a virtual surrounding in a way that approximates

reality, as it's perceived through the users' senses. The environment is created with computer hardware and software, although users might also need to wear devices 1)_____.

The more deeply users can immerse themselves in a VR environment -- and block out their physical surroundings -- the more they can suspend their belief and accept it as real, even if it's fantastical in nature.

What are the main types of virtual reality?

The VR industry still has far to go before realizing its vision of a totally immersive environment that lets users engage multiple sensations in a way that approximates reality. However, virtual reality technology has come a long way in providing realistic sensory engagement and shows promise for business use in several industries.

VR systems can vary significantly, depending on their purpose and the technology used, although they generally fall into one of the following six categories:

Non-immersive

This type of VR typically refers to a 3D simulated environment that's accessed through a computer screen. The environment might also generate sound, depending on the program. The user has some control over the virtual environment using a keyboard, mouse or other device, but the environment doesn't directly interact with the user. A video game is a good example of non-immersive VR, as is a website that lets a user design a room's decor.

Semi-immersive

This type of VR offers a partial VR experience that's accessed through a computer screen or some type of glasses or headset. It focuses primarily on the visual 3D aspect of virtual reality and doesn't incorporate physical movement in the way that full immersion does. A common example of semi-immersive VR is a flight simulator, 2)_____.

Fully immersive

This type of immersive VR delivers the greatest level of virtual reality, completely immersing the user in the simulated 3D world. It incorporates sight, sound and, in some cases, touch. There have even been some experiments with the addition of smell. For example, Olorama technology offers a digital scent synthesizer olfactory device that can be used to diffuse scents in various full-body immersive settings such as during movies, events and escape rooms. For fully immersive experiences, users wear special equipment, like headgear, goggles or gloves, to interact with the environment. The environment might also incorporate such equipment 3)_____users with the experience of moving through the 3D space. Fully immersive VR technology is a field still in its infancy, but it has made important inroads into the gaming industry and to some extent the healthcare industry, and is generating a great deal of interest in others.

Collaborative VR

This is sometimes cited as a type of virtual reality. In this model, people from different locations come together in a virtual environment to interact with one another, with each person represented by a projected 3D character. Users typically communicate through microphones and headsets.

Augmented reality

AR is also sometimes referred to as a type of virtual reality, although many would argue that it's a separate but related field. 4)_____, virtual simulations are overlaid with real-world environments to enhance or augment those environments. For example, a furniture retailer might provide an app that lets users point their phones at a room and visualize what a new chair or table might look like in that setting.

Mixed reality

This category blends the physical and virtual worlds into a single space. Like augmented reality, however, it's more often considered a separate but related field. In fact, there's been a growing consensus to group virtual reality, augmented reality and mixed reality 5)_____, which provides a handy way to reference all three, while still distinguishing among them.

Today's VR technologies and applications have inspired multiple companies and experts to advocate for advanced uses of the metaverse, which encompasses diverse digital realities, platforms and experiences, forming an interconnected network of virtual realms.

3. **Which VR type has the most perspectives? Why?**

4. **Can you name any features of VR? What are they? Read the 2nd part of the text about VR and put the headlines into the correct spaces:**

a) Complete 360-degrees views
b) Immersion
c) Multi-sensory haptic feedback
d) Realistic visuals
e) Adaptive environment
f) Spatial audio
g) Spatial collaboration
h) Interaction

What is Virtual Reality? How is it Used and How will it Evolve? (part 2)

Features of virtual reality

Virtual reality has several essential features that make it an immersive and interactive medium. Unlike traditional interfaces, VR positions the user inside the virtual environment, delivering a truly immersive experience.

The primary characteristics and features of virtual reality include the following:

1._____

By immersing users in a computer-generated world that seems and feels genuine, VR seeks to evoke a feeling of immersion. The level of immersion can vary depending on the type of VR system and the quality of the content. By donning and using wearable technology interactive gear -- such as data gloves, motion controllers, game consoles and head-mounted displays, like Meta Quest 2 -- viewers can fully immerse themselves in the virtual world.

2._____

Virtual reality is a highly interactive experience where people can interact with various elements realistically. The elements of interaction depend on range, speed and mapping, letting users manipulate and control objects, navigate through virtual space and engage in activities within the virtual world.

3. _____

High-resolution monitors and sophisticated graphics rendering techniques are used in VR to produce vivid, lifelike images. This includes realistic lighting and textures, realistic 3D visuals and stereoscopic imaging for depth perception.

4._____

Spatial audio technology offers realistic sound effects positioned physically within the virtual environment. By producing an audio experience that corresponds with the user's visual environment, VR increases the user's sensation of presence and immersion.

5._____

Advanced virtual reality systems can also include haptic feedback, which gives tactile sensations to the users. This can involve force feedback, vibrations, or even full-body haptic suits that let users experience real-world bodily sensations in a virtual setting.

6._____

The capacity for individuals or groups to work together and communicate in a common virtual environment through the use of virtual reality technology is known as spatial collaboration. Regardless of where they're physically located, it lets users collaborate virtually on projects, exchange ideas and interact as if they were in the same space. For example, Vision Pro, which is Apple's first spatial computer, combines mixed reality and VR to create an immersive experience without completely obstructing the outside world.

7._____

With a full 360-degree spherical field of view that most VR systems offer, users can look in any direction and explore the virtual space from different perspectives, just as they would in the real world.

8._____

When generative AI is integrated with VR settings, the result is a responsive and personalized experience that can change dynamically in response to human inputs. AI-driven systems, for instance, can evaluate user behavior in real time, enabling virtual environments to adjust and react to the user's activities to create a genuinely personalized and engaging experience.

5. **Where and how can we use VR? Name as many areas as possible. Then look through the 3rd part of the text about VR and check your ideas. Have all of your ideas been mentioned?**

What is Virtual Reality? How is it Used and How will it Evolve? (part 3)

How can virtual reality be used?

Virtual reality is often associated with gaming because the industry has been at the **forefront** of the VR effort, as evidenced by the popularity of products such as Beat Saber, Minecraft VR and Skyrim VR. Even so, there has been a growing interest in the potential of VR across several other areas, including the following:

Training

VR makes it possible to train personnel safely, efficiently and cost-effectively. It can be especially beneficial to those in high-risk or highly specialized positions, such as firefighters, emergency medical responders, police officers, soldiers, **surgeons** or other medical personnel. The training sector has also begun to embrace the benefits that VR learning presents, with corporations such as Bank of America sourcing 10,000 headsets and Walmart providing VR training to its one million employees.

Education

VR offers educational institutions new methods for teaching and learning. It can provide students with intimate insights into environments that are typically **inaccessible**, while keeping them engaged in the learning process. For example, a history teacher might use VR to show students firsthand what life was like in ancient Greece or China.

Healthcare

VR has the potential to benefit individuals across the healthcare industry, including patients, practitioners and researchers. For example, VR shows promise in treating disorders such as anorexia, anxiety or post-traumatic stress **disorder**. On the other hand, doctors might be able to use VR when working with patients to explain diagnoses or treatment options. VR could also benefit individuals who have physical limitations.

Retail

VR has already made some inroads into retail, but the industry has only **scratched** the surface. Many apps now let customers virtually try on clothes, decorate their homes, experiment with hairstyles, test eyeglasses and in general make more informed decisions about products and services.

Real estate

VR benefits real estate in several ways. For example, architects can show detailed plans in 3D; home buyers can tour homes virtually; building engineers can tour heating, ventilation and air conditioning systems; and homeowners can see what their remodels would look like.

Entertainment

VR has already had an impact on gaming, but it also promises to transform the film and television industries, providing viewers with an **immersive** experience that puts them right into the scene. VR could also lead to an entire industry in virtual tourism, making it possible for people to experience places that they might never be able to see in person.

Architecture and design

Virtual reality lets architects and designers conduct virtual tours of structures and places before they're built and enables clients to see and feel the design in a more immersive and realistic way. For example, if someone wants to add an **extension** to their home, they might visualize the room and how it will appear before it's built and then make modifications in real time. This saves time and money for both the customer and the architect while also improving project satisfaction.

Sports

VR is transforming the sports industry and revolutionizing the way people experience sporting events. For example, fans can now watch basketball, football and other virtual reality games from several **vantage points** in the stadium as if they're actually there. Meta* also expanded its partnership with the National Basketball Association in 2023, so fans can now watch live games with a Meta Quest VR headset on their social VR world known as Meta Horizons World.

The simplest form of virtual reality is a 3D image that can be explored interactively through a PC, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out. More **sophisticated** efforts involve such approaches as wraparound display screens, physical rooms augmented with wearable devices, or **haptic** devices that let users *feel* the virtual images.

6. Match the words in bold with their definitions:

a) a doctor who is specially trained to perform medical operations
b) to break or mark the surface of by rubbing, scraping, or tearing with something sharp or rough
c) a part that is added to something to enlarge or prolong it
d) relating to the sense of touch, in particular relating to the perception and manipulation of objects using the senses of touch and proprioception
e) the leading or most important position or place
f) unable to be reached or entered
g) seeming to surround the audience, player, etc. so that they feel completely involved in something
h) a place or position providing a good view of something
i) highly complicated or developed
j) an illness of the mind or body

7. **What are the perspectives of the VR future development? In what areas of our lives could we use VR in a clever way? Read the last part of the text about VR and put the letters of the words on bold into the correct order.**

Future of virtual reality: how will it evolve?

Virtual reality is progressing rapidly, with ongoing breakthroughs anticipated across diverse industries. According to a recent International Market Analysis Research and Consulting Group report, the global virtual reality market is expected to reach $313.5 billion by 2032.

The following are a few **iighnsst** and predictions into the future of VR:

The future of VR is propelled by its growing accessibility. Previously confined to costly, specialized equipment, VR has become more attainable with the emergence of affordable headsets and the integration of VR features into mobile devices. This increased accessibility is creating new possibilities for VR applications across diverse industries, such as enterprise, healthcare and education. This affordability will also enable a wider audience to **aeebcmr** this technology.

As the demand for VR grows, users can anticipate heightened levels of immersion by bringing them even closer to real-life. VR will keep its focus on creating hyper-realistic experiences by engaging multiple senses. With the rapid adoption of haptic gloves, suits and spatial audio, the exploration into incorporating smells into deep immersive experiences will gain **eoummmnt**.

VR will enable virtual workplace communication that's just as effective as face-to-face engagement. Nvidia, for instance, is making it possible to have high-fidelity 3D video conferences **iiiuglntz** merely consumer webcams and AI-mediated methods.

The integration of augmented reality with VR is expected to open up new possibilities. For example, AR glasses will soon be able to overlay directions, places of interest and pertinent data over the user's field of vision, making navigation easier and more natural. This technology is promising for the travel and tourism industry as well as for helping those with vision impairments.

Ensuring **eeucrs** and age-appropriate virtual experiences is going to be a major worldwide concern in the future. Meta* lowered the minimum age for Quest accounts in 2023, letting kids between the ages of 10 and 12 get a parent-managed account for age-appropriate VR experiences. As VR devices become even more popular with younger users, businesses and parents will be looking into strong controls for VR access.

*banned in Russia
https://www.techtarget.com/whatis/definition/virtual-reality

8. **Give your own definitions:** engagement, treadmills, interconnected, visualize the room, tactile sensations, embrace the benefits, vision impairments

9. **Answer the questions based on the information you know now about VR:**

1. What is VR?
2. What types of VR do you know? What is specific about each type?
3. What essential features does VR need to have?
4. Where can VR be used? In your opinion, what are the most promising areas and why?
5. How can our world change if VR becomes cheaper and more accessible?

10. **Here are some quotes about VR. Whose opinion do you agree with? Why?**

1. "When virtual reality gets cheaper than dating, our society is doomed." - Scott Adams (an American author and cartoonist)
2. "Virtual reality is the first step in a grand adventure into the landscape of imagination." – Frank Biocca (Dr. Biocca, a former Silicon Valley executive working on mobile and portable computing, has held several endowed chaired professorships including World Class University Professor (Samsung SKKU University), Newhouse Endowed Chair (Syracuse) and AT&T Endowed Chair (MSU))
3. "VR is a way to escape the real world into something more fantastic. It has the potential to be the most social technology of all time" – Palmer Luckey (Founder of Oculus Rift)
4. "It is a conundrum. If you're going to make the virtual experience so good, why should you have to go to Hawaii to experience it. How do you entice people to go if in fact they can see everything they want to see virtually?" – Jim Blascovich (Professor of Psychological and Brain Sciences)

11. **There is no correct answer whether VR is a boon or a curse. But as any new technology it has its own benefits and drawbacks. Watch the video "VR Pros and Cons" and name the advantages and disadvantages mentioned.**
12. **If necessary, watch the video again and say if the statements are true or false. Correct the wrong information.**
    1. VR can take you anywhere by playing with your dreams.
    2. VR can improve your learning process.
    3. Using VR, you can float in the air and not be afraid of getting hurt.
    4. Getting yourself a VR set is not costly.
    5. VR causes neither psychological, nor physical problems.
    6. Still the most developed VR area is gaming nowadays.

Mini Grammar - Linkers

There are 4 main groups of linkers you can use in your discourse:

Result	Contrast	Reason	Purpose
I want to buy a new VR headset, **so** I started saving money. It had rained hard all night. **As a result,** there were a lot of puddles in the street. We regret that you do not have the necessary experience, **therefore/consequently** we cannot accept you.	I liked playing that VR game, **but** I had a terrible headache in the morning. She started getting used to that robot, **yet** she realized it was just one of the samples. It's a really good idea. **However/nevertheless,** it might be dangerous. We enjoyed the show **although/though/even though** it was quite long. **In spite of/Despite having** (Ving) a smart house, he still washes the dishes by himself. **In spite of the fact that/ Despite the fact that (full clause)** he has a smart house… **In spite of his gadgets/Despite his gadgets (a noun)**,…	I have stopped contacting my supervisor, **because/as/since** he never answers me. The plane was late because of the fog. Flight 123 has been delayed **due to/owing to** bad weather conditions.	I did a Java course t**o/in order to/so as to** improve my programming skills. She closed the door quietly **in order not to/so as not to** attract the guards' attention. They bought a robot vacuum cleaner **so (that)** they could relax more. I'm not going to tell Ann **in case** she tells everyone else.

13. Choose the right linker:

1. *Even though/Despite* she's working really hard, I don't think she will finish her project on time.
2. We can't afford to have a holiday this year *as/so* we bought VR sets for the whole family.
3. Could we rearrange my timetable *so that/in case* I don't have so many classes on Fridays?
4. I got to the job interview on time *due to/in spite of* the fact that my flight was delayed.
5. The company has had a very difficult year. *Nevertheless, /As a result,* they haven't had to close any of their offices.
6. He gets a good salary *though/ since* the job is quite monotonous.

14. Join the sentences using bold words, making any necessary changes.

1. We only use energy-efficient light bulbs. We don't want to waste electricity. **so as** We_____
2. Our seats were a long way from the stage. We liked the holographic show. **In spite** We_____
3. It took us hours to get to the factory. The traffic was heavy. **because of** It_____
4. I took the price off the robodog and hid the receipt. I didn't want Sam to know how much it had cost. **so** I_____
5. Keep the receipt for the VR glasses. Your uncle might not like them. **in case** Keep_____
6. Laura is from a wealthy family. She isn't spoilt. **even though** Laura_____
7. Prices have risen because production costs have increased. **due to** Prices_____

UNIT THREE. LASER: SUPER TOOL OF THE 20th CENTURY

PART 1. The History of Lasers. How Lasers Work

LEAD-IN

1. Answer the following questions.

1. What is a laser?
2. What does the acronym LASER stand for?
3. What is the difference between a laser beam and ordinary light?

PRE READING

2. Match terms with their definitions.

1. amplification	a. the property of light that consists of a single wavelength or frequency.
2. coherence	b. the process of aligning the optical axes of two or more devices, such as telescopes.
3. collimation	c. expresses the potential for two waves to interfere.
4. directionality	d. the phenomenon of emission of electromagnetic radiation.
5. femtosecond	e. the growth of the radiation field in the laser resonator cavity.
6. fluorescence	f. a device that produces coherent electromagnetic waves through amplification by stimulated emission.
7. irradiance	g. the amount of energy transmitted by acoustic or electromagnetic radiation.
8. intensity	h. the property of laser light to move in a well-defined direction.
9. maser	i. a unit of time equal to 10^{-15} second.
10. monochromaticity	j. the radiant flux received by a surface per unit area.

READING

3. Read the text called Laser Operation Basics paying attention to the subheadings which can be used as an outline for your oral presentation of this topic.

LASER OPERAION BASICS

Lasers are amazing light beams powerful enough to zoom miles into the sky or cut through lumps of metal. Although they seem pretty recent inventions, they've actually been with us over half a century: the theory was figured out in 1958; the first practical laser was built in 1960. At that time, lasers were thrilling examples of cutting-edge science. The basic idea of a laser is simple. It's a tube that concentrates light over and over again until it emerges in a powerful beam.

What is a laser?

Lasers are more than just powerful flashlights. The difference between ordinary light and laser light is like the difference between ripples in your bathtub and huge waves on the sea. If you've

even seen a laser in a science lab, you'll notice three important differences. Where a flashlight produces «white» light, a laser makes what's called monochromatic light. Where a flashlight beam spreads out through a lens into a short and fairly fuzzy cone, a laser shoots a much tighter, narrower beam over a much longer distance (we say it's highly collimated). Where the light waves in a flashlight beam are all jumbled up (with the crests of some beams mixed with the troughs of others), the waves in laser light are exactly in step: the crest of every wave is lined up with the crest of every other wave. We say laser light is coherent. These three things make lasers precise, powerful, and amazingly useful beams of energy.

How lasers work

What do you need to make a laser? We need two basic parts. 1. A load of atoms (a solid, liquid, or gas) with electrons in them that we can stimulate. This is known as the medium or, sometimes, the amplifying medium. 2. Something to stimulate the atoms with, such as a flash tube (like the xenon flash lamp in a camera) or another laser.

A high-voltage electric supply makes the tube flash on and off. Every time the tube flashes, it «pumps» energy into the ruby crystal. The flashes it makes inject energy into the crystal in the form of photons.

Atoms in the ruby crystal soak up this energy in a process called absorption. Atoms absorb energy when their electrons jump to a higher energy level. After a few milliseconds, the electrons return to their original energy level (ground state) by giving off a photon of light. This is called spontaneous emission. The photons that atoms give off zoom up and down inside the ruby crystal, traveling at the speed of light.

Every so often, one of these photons stimulates an already excited atom. When this happens, the excited atom gives off a photon and we get our original photon back as well. This is called stimulated emission. Now one photon of light has produced two, so the light has been amplified (increased in strength).

A mirror at one end of the laser tube keeps the photons bouncing back and forth inside the crystal. A partial mirror at the other end of the tube bounces some photons back into the crystal but lets some escape. The escaping photons form a very concentrated beam of powerful laser light.

Spontaneous emission

The radiation lasers make has nothing to do with dangerous radioactivity, the stuff that makes Geiger counters click, which atoms spew out when they smash together or fall apart. Lasers make electromagnetic radiation, although it's still produced by atoms, they emit it in a totally different way, when electrons jump up and down inside them. We can think of electrons in atoms sitting on energy levels, which are a bit like rungs on a ladder. Normally, electrons sit at the lowest possible level, which is called the atom's ground state. If you fire in just the right amount of energy, you can shift an electron up a level, onto the next rung of the «ladder». It very quickly returns to the ground state by giving off the energy it absorbed as a photon. We call this process spontaneous emission of radiation: the atom is giving off light (emitting radiation) all by itself (spontaneously).

Stimulated emission

Normally, a typical bunch of atoms would have more electrons in their ground states than their excited states, which is one reason why atoms don't spontaneously give off light. But what if we excited those atoms – pumped them full of energy - so their electrons were in excited states. In that case, the «population» of excited electrons would be bigger than the «population» in their

ground states, so there would be plenty of electrons ready to make photons of light. We call this situation a population inversion, because the usual state of affairs in the atoms is swapped around. Now suppose also that we could maintain our atoms in this state for a little while so they didn't automatically jump back down to their ground state (a temporarily excited condition known as a meta-stable state). Then we'd find something really interesting. If we fired a photon with just the right energy through our bunch of atoms, we'd cause one of the excited electrons to jump back down to its ground state, giving off both the photon we fired in and the photon produced by the electron's change of state. Because we're stimulating atoms to get radiation out of them, this process is called stimulated emission. We get two photons out after putting one photon in, effectively doubling our light and amplifying it. These two photons can stimulate other atoms to give off more photons, so, pretty soon, we get a cascade of photons throwing out a brilliant beam of pure, coherent laser light.

If that's how lasers make light, why do they make a single color and a coherent beam? It boils down to the idea that energy can only exist in fixed packets, each of which is called a quantum. To make an electron jump from a lower to a higher level, you have to feed in a precise amount (quantum) of energy, equal to the difference between the two energy levels. When electrons flip back down from their excited to their ground state, they give out the same, precise amount of energy, which takes the form of a photon of light of a particular color. Stimulated emission in lasers makes electrons produce a cascade of identical photons—identical in energy, frequency, wavelength—and that's why laser light is monochromatic. The photons produced are equivalent to waves of light whose crests and troughs line up (in other words, they are «in phase»)—and that's what makes laser light coherent.

Types of lasers

Solids, liquids, and gases are the three main states of matter – and give us three different kinds of lasers. Solid-state lasers produce high-powered beams, typically in very brief pulses. Gas lasers, by contrast, produce continuous bright beams using compounds of noble gases (in what are called excimer lasers) or carbon dioxide as their medium, pumped by electricity. CO_2 lasers are powerful, efficient, and typically used in industrial cutting and welding. Liquid dye lasers use a solution of organic dye molecules as the medium, pumped by something like an arc lamp, a flash lamp, or another laser. Their big advantage is that they can be used to produce a broader band of light frequencies than solid-state and gas lasers, and they can even be «tuned» to produce different frequencies.

While solid, liquid, and gas lasers tend to be large, powerful, and expensive, semiconductor lasers are cheap, tiny, chip-like devices used in things like laser printers and barcode scanners. They work like a cross between a conventional Light-emitting diode (LED) and a traditional laser. Like an LED, they make light when electrons and «holes» (effectively, «missing electrons») hop about and join together; like a laser, they generate coherent, monochromatic light. That's why they're sometimes referred to as laser diodes (or diode lasers).

https://www.explainthatstuff.com/lasers.html

VOCABULARY

4. Define the following words in English in pairs or small groups.

Active medium, fiber optics, lasing, optical resonance, population inversion, pump energy, stimulated emission.

5. Insert the correct word in each of the following sentences as it is given in the text.

1. Lasers are amazing light beams powerful enough to … miles into the sky or cut through lumps of metal.

a. move b. zoom c. overcome

2. At that time lasers were … examples of cutting-edge science.

a. thrilling b. trembling c. rousing

3. Where the light waves in a flashlight beam are all … , the waves in laser light are exactly in step.

a. mixed up b. mingled with c. jumbled up

4. Atoms in the ruby crystal soak up the energy in a process called … .

a. amplification b. absorption c. radiation

5. The radiation lasers make has nothing to do with dangerous radioactivity, the stuff that makes Geiger counters click, which atoms … when they smash together or fall apart.

a. spew out b. expel from c. erupt into

6. We can think of electrons in atoms sitting on energy levels, which are a bit like … on a ladder.

a. steps b. slats c. rungs

7. It … to the idea that energy can only exist in fixed packets, each of which is called a quantum.

a. comes down b. shrinks back c. boils down

8. The photons produced are equivalent to waves of light whose … line up.

a. pros and cons b. crests and troughs c. for and against

9. A typical … of atoms would have more electrons in their ground states than their excited states.

a. cluster b. heap c. bunch

10. Liquid dye lasers use a … of organic dye molecules as a medium, pumped by something like an arc lamp.

a. solution b. grout c. slurry

6. Choose the correct phrase to complete the sentence in each of these statements.

1. A laser is a machine that makes billions of atoms pump out trillions of photons all at once so they … .

a. produce oscillations of atoms or molecules between energy levels.
b. line up to form a really concentrated light beam.
c. generate or amplify electromagnetic radiation.

2. A laser is a tube that concentrates light over and over again until it … .

a. exceeds the permissible limits.
b. transforms into something else.
c. emerges in a really powerful beam.

3. The photons that atoms give off zoom up and down inside the ruby crystal, … .

a. traveling at the speed of light.

b. gradually improving physical quantities.
c. leading to significant perturbations.

4. Normally, a typical bunch of atoms would have more electrons in their ground states than their excited states, which is one reason why atoms … .

a. spontaneously give off light.
b. don't spontaneously give off light.
c. spontaneously amplify light using stimulated emission.

5. What we've done here is amplify light using stimulated emission of radiation – and … .

a. pump out trillions of photons all at once.
b. have an exciting new theory.
c. that's how a laser gets its name.

6. … , you have to feed in a precise amount of energy, equal to the difference between the two energy levels.

a. To investigate plasma heating by electron beams
b. To make an electron jump from a lower to a higher level
c. To predict the maximum intensity to which the unstable waves grow in the two-stream instability phase of the interaction

7. Stimulated emission in lasers makes electrons produce a cascade of identical photons – identical in energy, frequency, wavelength – and that's why … .

a. light is only a fraction of the total energy emitted by the Sun incident on the Earth.
b. laser light is coherent.
c. laser light is monochromatic.

8. … produce continuous bright beams using compounds of noble gases or carbon dioxide as their medium, pumped by electricity.

a. Gas lasers
b. Liquid lasers
c. Solid lasers

9. While solid, liquid, and gas lasers tend to be large, powerful, and expensive,… are cheap, tiny, chip-liked devices used in things like laser printers and barcode scanners.

a. krypton fluoride lasers
b. semiconductor lasers
c. excimer lasers

10. Fiber lasers work their magic inside optical fibers; in effect, a doped fiber-optic cable becomes … .

a. an alternative source of energy.
b. a model with different degrees of sophistication.
c. the amplifying medium.

7. Find the words that mean the same as the following definition.

1. A device or object that emits coherent microwave radiation produced by the natural oscillations of atoms or molecules between energy levels.

a. maser b. laser c. spectrometer

2. The act of energy transfer from an external source into the gain medium of a laser.

a. welding b. engraving c. pumping

3. An arrangement of mirrors that forms a standing wave cavity resonator for light waves.

a. diffraction b. optical cavity c. absorption

4. A device that emits light through process of optical amplification based on the stimulated emission of electromagnetic radiation.

a. seismograph b. oscilloscope c. laser

5. An electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave.

a. electronic oscillator b. beam divergence c. multi-anvil high pressure apparatus

6. The study of the interaction between matter and electromagnetic radiation.

a. spectroscopy b. mode-locking c. ultrafast science

7. A flexible, transparent fiber made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair.

a. optical fiber b. internal reflection c. population inversion

8. The process of removing material from a solid surface by irradiating it with a laser beam.

a. frequency spacing b. photoablation c. precipitation

9. A device that amplifies an optical signal directly, without the need to first convert it to an electrical signal.

a. diode laser b. nitrogen laser c. optical amplifier

10. The lowest excitation level at which a laser's output is dominated by stimulated emission rather than by spontaneous emission.

a. nonlinearity b. annihilation c. lasing threshold

8. Complete each sentence by matching it with the appropriate ending.

1. Curves are plotted for the spatial and temporal coherence …	a. obtained at a laser intensity of 100 GM/cm^2.
2. The analysis is based on the solution of …	b. to have directionality in the transmission of elastic waves.
3. The main part of the laser is …	c. bouncing back and forth inside the crystal.
4. A microwave signal with a voltage amplitude of 2 V is …	d. by way of a specific example.
5. When the maser techniques were adapted to the shorter wavelengths of optical light, …	e. fundamental investigations and practical applications.
6. The structure was found to be stable at the	f. the equation for the fourth-order coherence

enormous pressures and …	function.
7. Once a population inversion is established in a medium …	g. the devices then became known as lasers.
8. Lasers have developed into one of the most important tools in …	h. microwaves and radio waves instead of visible light.
9. A mirror at the end of the laser tube keeps the photons …	i. an active medium in which the laser action occurs.
10. Lasers evolved from masers, which are similar but produce …	j. it can be used to amplify light.

POST-READING

9. Answer the questions.

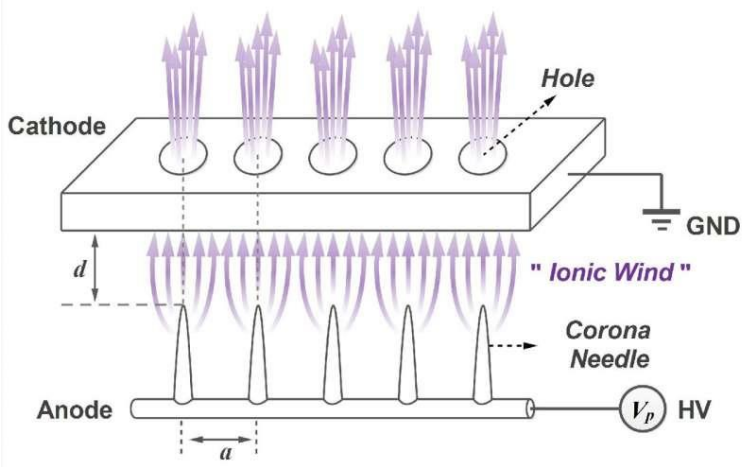
1. What are the unique characteristics of a laser?
2. How was the laser developed?
3. Who gave the theoretical basis for the development of lasers?
4. Why are lasers hazardous?
5. What are some of the main types of lasers?
6. What is the difference between lasers and masers?
7. What is the wavelength spread of laser light?
8. What type of lasers is the most common at present?
9. What precautions should be taken while operating laser equipment and why are they important?

10 What is the future of laser technology?

10. Read the following text carefully and fill in the gaps with the words from the list.

circulation	*discharge*	*glow*	*influence*	*lightweight*
nonlinear	*pump*	*spacing*	*vibration*	*volume*

Advanced Electrohydrodynamics Pump Model Developed for Ultra-Compact Gas Lasers.



A research group from the Institute of Optics and Fine Mechanics, proposes a coupling analysis model revealing the flow characteristics and control laws of a multi-needle Electrohydrodynamics (EHD) (1) _____.

This model, designed for non-mechanical medium (2) _____ in ultra-compact gas laser systems, addresses application challenges in these systems. The research results were published in Physics of Fluids, and selected by the journal as Editor's Pick.

The traditional gas laser adopts a mechanical circulation device to form high-speed medium circulation, which has the characteristics of large (3) _____, strong (4) _____ and serious noise.

EHD pumps generate «ionic wind» through corona discharge and have the advantages of (5) _____, no vibration, no noise, etc., that can replace traditional mechanical circulation devices in miniaturized gas laser systems and expand the application of gas lasers.

In this study, researchers investigated the flow distribution and velocity characteristics of a multi-needle corona discharge EHD pump. They derived a simplified (6) _____ steady-state EHD equation and designed a high-precision and fast numerical calculation algorithm for the flow velocity profile. The control characteristics of steady velocity with voltage and electrode (7) _____ were given.

This study revealed, for the first time, the flow characteristics and the (8) _____ of parameters of the multi-needle corona (9) _____ EHD pump. Furthermore, it provided guidance for the practical design of miniaturized EHD pumps and their application in gas lasers.

The designed electrohydrodynamic pumps can be used as the non-mechanical dielectric cycle driver of the ultra-compact gas laser system, supporting the normal (10) _____ discharge of the main electrode and expanding the applications of these systems in specialized environments such as airborne, vehicular, and shipborne settings.

https://phys.org/news/2024-08-advanced-electrohydrodynamics-ultra-compact-gas.html

WRITING

11. Search for the necessary information and write an essay (250-300 words).

1. The impact of laser technology on society.
2. Advantages and disadvantages of lasers.
3. Discoveries, inventions, new products, and their effects on laser technology (positive and negative).

SPEAKING

12. Search for necessary information and prepare for oral reports.

a. A brief history of lasers.
b. Characteristics of lasers.
c. The laser: how it works
d. Holographic technologies of the future.
e. Share your experience with different types of lasers.

13. Extended discussion.

How has the world benefited from the invention of the laser? Of all advantages that the laser has brought to the modern world, which is the most useful?

LISTENING

14. You are going to watch a video named *HiPER – High Power Energy Research.* Before you start, read the following words and word combinations from this video and make sure you understand their meaning.

viable laser fusion, a major driver for …, underpin, a fuel pellet, to have in abundance, long-term commitment.

15. Watch the video and answer the questions below.

1. What is the major scientific driver for the HiPER project?
2. What is the proposed HiPER facility comparable in size with?
3. What happens to intense laser impulses as they reach the vacuum chamber?
4. What is the laser's beam width?
5. What does the cycle within the reactor chamber begin with?
6. What happens when the first set of light pulses impacts the pellet?
7. What is the second pulse laser system aimed at?
8. How is the energy security defined in the video?
9. Which demands does fusion energy generation meet?
10. Which another technique of controlled fusion has a great potential alongside laser fusion?

16. Watch the video and choose if the following statements are true or false.

1. The temperatures within HiPER reactors are akin to the ones in the stellar centers.
2. The energy generation from the fuel would require three laser pulses.
3. Each pulse of light is focused into a beam of 10 mm across.
4. The first pulse from the laser system is much shorter than the second one.
5. The second pulse is fired in an exceptionally thin beam.
6. During the fusion process the atoms of hydrogen isotopes overcome their repulsion causing them to fuse.
7. The heat is generated due to emission of protons during the fusion reaction.
8. The HiPER project would require many years to be accomplished.
9. One cubic kilometer of seawater can generate as much as energy as entire world's oil deposits if used in fusion.
10. The HiPER project is a collaboration of only the European nations.

MINI GRAMMAR

Emphatic structures

Emphatic structures are used to make statements more expressive, often by breaking standard rules.

a. *It is … that (which, who, not until)*.

The construction itself is not translated but we put the word «именно» or «только» before the word that is singled out, e.g.

It is these properties of light *that* are the subject of the present chapter. - Именно эти свойства света являются темой данного раздела.

A special type of this structure is the model with *not till, not until*, e.g.

It was *not until* about 1960 *that* the first practical laser was built. – Первый промышленный лазер был создан только в 1960-м году.

b. emphatic «*do*».

Normally the auxiliary verb to do is used in negative and interrogative sentences; the emphasizing «*do*» is used in affirmative ones. «*Do*» is translated as «действительно», «на самом деле», «все же», e.g.

Liquid dye lasers *do* use a solution of organic dye molecules as the medium. – Лазеры на красителях действительно используют растворы органических молекул красителей в качестве среды

17. Translate into Russian paying attention to the emphatic construction «It is … that».

1. It is neural representations that separate and recombine content and style of arbitrary images.
2. It is through the development of metamaterials that we are able to create structures possessed the ability to calculate complex algorithms.
3. It was 10 minutes since they have been centrifugating the amine-coated test tube.
4. It is a runtime monitoring and validation framework that we introduce to decide when the model needs to be re-learned due to inaccurate predictions.
5. It was not until 1996 that the first smart contract technology was proposed.
6. It is a technique which we are interested in to predict the future states of a system under unforeseen actuator faults.
7. It was the energy transformation from potential to kinetic that powered the moving car.
8. It is the acceleration due to gravity that determines the speed at which objects fall.
9. It is the topological connection of the soft materials and rigid elements that defines the kinematic structure.
10. It was not until the online stage when the unmanned aerial vehicle with an untrained fault was tasked to follow a trajectory.

18. Translate the following sentences into Russian paying attention to the emphatic «do».

1. Emerging research in the field of mechanical metamaterials demonstrates that they do have the capability to revolutionize the field of counting and sequential information processing.
2. Reconstructions from the style features do produce texturized versions of the input that capture its general appearance in terms of colour and localized structures.
3. The approach does allow us to trick the system into trying to follow a reference trajectory different than the actual desired one.
4. It is through their transformative properties that mechanical metamaterials do open doors to new possibilities in efficient and precise counting and sequential information processing.
5. Scientists proved that the movement of electrons and photons in two-dimensional materials with hexagonal symmetry, such as graphene, does submit to the same laws.
6. If the two new quarks do exist, there must also be two new properties of matter, which some physicists have taken to calling «truth» and «beauty».
7. We do find evidence that the black holes pumping out the most energy have influenced their host systems across thousands of light-years.
8. Significant discrepancies between theory and experiment still do exist, some of which greatly exceed the expected precision.

9. Such effects are local, but in general most of the experiments conducted using ion scattering do rely on a reasonable degree of long-range order at the surface.
10. We did generate a trajectory with three different speed values.

PART 2. Laser Applications

LEAD-IN

1. Answer the following questions:

1. Do you know any household appliances with a built-in laser?
2. In your opinion, what is the most unconventional use of lasers?
3. What are the possible new applications of lasers in the future technology?

PRE READING

2. Match terms with their definitions.

1. active medium	a. something that precedes and indicates the approach of something or someone.
2. convergence	b. energized laser medium.
3. dispersion	c. a photographic film or plate containing interference patterns created by the coherence of laser light.
4. divergence	d. the bending of light rays toward each other, as by a positive (convex) lens.
5. fiber optics	e. the full angle of the beam spread measured between those points which include laser energy.
6. hologram	f. a system of flexible quarts or glass fibers with internal reflective surfaces.
7. nanotechnology	g. process of joining separate pieces of metal in a continuous metallic bond.
8. precursor	h. the spreading of white light into its full spectrum of wavelengths.
9. pumped medium	i. collections of atoms or molecules capable of undergoing stimulated emission at a given wavelength.
10. welding	j. a field of science that focuses on extremely small devices and structures.

READING

3. Read the text paying attention to the subheadings which can be used as an outline for your oral presentation of this topic.

Incredible Uses of Laser Technology

A little more than 50 years after Nikolay Basov and others were awarded the Nobel Prize in Physics for their work developing the direct precursor of the laser, the maser, laser technology continues to have an almost unlimited number of applications. Without lasers, so much of what we've grown accustomed to in the past 50 years wouldn't be possible. From the accidental cat toy to end all cat toys to the invention of LiDAR, to the inauguration of a whole new field of astronomy, lasers are indispensable tools in every area of our lives.

Barcode Readers

While it might feel like an eye-rolling example of this extraordinary technology, taking a look back at commerce before barcodes and after barcodes tells us otherwise. Before barcodes, inventories had to be recorded manually or in a non-standardized way across industries and even

within the same warehouse. The idea of a universal means of identifying an item isn't new, but until the development of laser barcode readers, there was no way to process these codes automatically. The laser made that possible, and was as revolutionary to commercial logistics as the interstate highway system or the railroads.

LiDAR (Light Identification, Detection, and Ranging)

Laser range-finding technology itself is a remarkable advance, but one of its most remarkable applications is in LiDAR, a technology that is essentially RADAR except with light. The applications of LiDAR are numerous and have given us everything from the laser rangefinder you can find in your local hardware store to recording the distance to the Moon, thanks to the reflective mirrors astronauts left on the Moon when they traveled there in 1971. What's more, LiDAR from orbiting satellites is responsible for most of the high-resolution maps we use today and are significantly more precise than anything that came before it.

Optical Tweezers

How can you move around a single molecule, or even a single atom? Obviously, no physical tool could do the job, but thanks to laser technology, individual molecules can be manipulated and turned, and single atoms can be isolated and trapped. This kind of precision opens the door to all kinds of nano-technology, from chemistry and medicine to engineering and physics.

Laser Scalpel

Sometimes, you need a scalpel instead of a hacksaw, and then sometimes you need a laser scalpel. Traditional scalpels are incredibly sharp at the macro level. However, at the cellular level, there is still a considerable amount of damage to the surrounding tissue that may be okay for some surgeries, but become a danger when working on organs like the brain, where an unintended incision can have drastic consequences for the patient. With a laser scalpel, more delicate operations can be performed than would be possible otherwise.

Laser Cutters

Metal cutting has been an important driver of innovation since metal was first used by humans millennia ago. Lasers have increased the precision of these cuts considerably and have become an industry standard way of cutting complex shapes and pieces from metal sheets in a way that grinders and other mechanical cutters can't easily match.

Laser Welding

Welding has been a crucial industrial technique for centuries, but only in the 20th century did welding go beyond the hammering of molten metal pieces into a single shape. With the advent of laser-welding, precise, controlled joints could be made with different metals that were physically impossible before and was instrumental in developing automated assembly lines that have revolutionized manufacturing around the world.

Fiber Optics

The introduction of fiber optic cables built the Internet we have today. The rapid transmission of information that lasers provide through fiber optic cables allows for extremely fast download and upload speeds, which anyone alive during the dial-up era of the Internet can appreciate, and makes streaming content possible. Considering how this alone is disrupting entire industries is evidence enough of the kind of power lasers can have.

3D Scanners

Before 3D scanners, modeling a physical object for study, testing, or other practical purposes was expensive and limited to those who had the skill to do so, or money enough to pay someone who could. With 3D Scanners, which use lasers to take the dimensions of a scanned object and

turn them into digital representations, a physical object can be scanned and sent to a scanner to reproduce the exact item anywhere in the world in minutes. This technology is only just beginning to take off, but is set to revolutionize manufacturing around the world.

Ultra-Fast Photography

The shutter speeds of many cameras have advanced to the point where the fastest phenomena were slowed down enough to become visible. However, the real advance in this technology came when laser pulses are used to flash illuminate the subject in rapid sequence, creating a strobing effect that can appear to stop the subject entirely at every frame of the shot. This technique leads to much higher resolution imaging of an incredibly fast moving object than otherwise possible.

https://interestingengineering.com/science/11-incredible-uses-of-laser-technology

VOCABULARY

4. Insert the correct word in each of the following sentences as it is given in the text.

1. While it might feel like an … example of this extraordinary technology, taking a look back at commerce before barcodes and after barcodes tells us otherwise.

a. eye-catcher b. eye-rolling c. eye-spotted

2. Sometimes, you need a scalpel instead of a … , and then sometimes you need a laser scalpel.

a. chainsaw b. jigsaw c. hacksaw

3. There is still a considerable amount of damage to the surrounding tissue that become a danger when working on organs like the brain, where an unintended … can have drastic consequences for the patient.

a. placket b. incision c. lesion

4. Lasers have become an industry standard way of cutting complex shapes and pieces from metal sheets in a way that … and other mechanical cutters can't easily match.

a. choppers b. mincers c. grinders

5. With the … of laser-welding precise, controlled joints could be made with different metals that were physically impossible before.

a. advent b. onset c. arrival

6. The … speeds of many cameras have advanced to the point where the fastest phenomena were slowed down enough to become visible.

a. latch b. shutter c. clamper

7. Laser pulses are used to flash illuminate the subject in rapid sequence, creating a … effect.

a. strobing b. fixing c. striking

8. LiDAR from orbiting satellites is responsible for most of the high-resolution maps we use today and are significantly more … than anything that came before it.

a. precise b. certain c. specific

9. Without lasers, so much of what we've grown … to in the past 50 years wouldn't be possible.

a. habitual b. usual c. accustomed

10. Nowadays lasers are … tools in every area of our life.

a. abiding b. mandatory c. indispensable

5. Choose the correct phrase to complete the sentence in each of these statements.

1. Nikolay Basov and others were awarded the Nobel Prize in Physics for their …

a. discovery of graphene.

b. work developing the direct precursor of the laser.
c. participation in an international project.

2. Laser range-finding technology itself is a remarkable advance, but one of its most remarkable applications is in LiDAR, a technology that …

a. makes it possible for us to create anything you can imagine, virtually.
b. allows you to improve and develop new areas of activity in the service sector.
c. is essentially RADAR except with light.

3. Thanks to laser technology, individual molecules can be manipulated and turned, and single atoms can …

a. be isolated and trapped.
b. can form clusters.
c. can be connected to each other.

4. …, there is still a considerable amount of damage to the surrounding tissue that becomes a danger when working on organs like the brain.

a. At the quantum level
b. At the molecular-genetic level
c. At the cellular level

5. … has been an important driver of innovation since metal was first used by humans millennia ago.

a. Metalworking
b. Metal cutting
c. Timber processing

6. This technique leads to much higher resolution imaging of … than otherwise possible.

a. an incredibly fast moving object
b. distant galaxies and stars
c. internal organs

7. With 3D scanners, a physical object can be scanned and sent to a scanner to reproduce the exact item … .

a. for special purposes.
b. in a certain place at a certain time.
c. anywhere in the world in minutes.

8. This technology is only just beginning to take off, but is set to revolutionize … .

a. numerous areas of our life.
b. manufacturing around the world.
c. the way we use lasers.

9. The shutter speeds of many cameras have advanced to the point where … to become visible.

a. the important processes were slowed down
b. radioactive isotopes of certain stable elements were created
c. the fastest phenomena were slowed down enough

10. The rapid transmission of information that lasers provide through … allows for extremely fast download and upload speeds.

a. mobile broadband
b. fiber optic cables
c. satellites

6. Complete each sentence by matching it with the appropriate ending.

1. The research presents a one-step laser synthesis method that …	a. to manipulate, fabricate and process nano/micro structures on semiconductors with unique advantages of high precision.
2. The conductive laminates that were fabricated by laser technique show …	b. to convert the beam into a circularly polarized optical vortex.
3. Researchers have developed a laser-based sampling system for studying …	c. acoustic oscillators, also known as sasers.
4. Lasers are an excellent tool …	d. enables spontaneous conversion of PBI ink to 3D nanostructured graphene.
5. One of the major hurdles is that increasing the width of the laser waveguide can …	e. inefficient due to its slow growth speed, making mass production challenging.
6. The new approach allows for a selective pump of the fundamental optical mode …	f. material processing and micro-material processing.
7. The team shined a laser beam on a spatial light modulator and through a quarter-wave plate …	g. remarkably uniform sheet resistance distribution.
8. Lasers have tremendous applications with new extension of the concept across domains such as …	h. leading to lasing in the single-mode regime.
9. Quantum dot laser diodes were produced using Molecular Beam Epitaxy, but this method was …	i. the composition of ice cores taken from glaciers.
10. Industrial laser applications can be divided into two categories depending on the power of the laser: …	j. lead to degraded beam quality due to the emergence of high-order modes.

POST READING

7. Answer the following questions.

1. Why is laser welding the best choice for automotive applications?
2. What are the application areas of laser cutting machines?
3. Do you know which technology relies on the use of lasers for transmitting information?
4. Are there any possible military applications of lasers?
5. What is the potential of lasers in nuclear fusion technology?
6. What is the primary purpose of using lasers in medicine?
7. What is the advantage of using lasers in surgery?
8. What is a medical application of lasers in ophthalmology?
9. What is the impact of laser energy on biological tissue?
10. Why are holographic images and products widely used in the commercial world?

8. Read the following text and fill in the gaps with suitable words.

accuracy	*circuits*	*emission*	*frequency*	*impetus*
microchip	*strategy*	*reconciled*	*releasing*	*waves*

Scientists Use Laser Fields to Precisely Measure and Control Electron Emission of Metals

By superimposing two laser fields of different strengths and (1) _____, the electron emission of metals can be measured and controlled precisely to a few attoseconds. German physicists have shown that this is the case. The findings could lead to new quantum-mechanical insights and enable electronic (2) _____ that are a million times faster than today.

Light is capable of (3) _____ electrons from metal surfaces. Since the photoelectric effect could not be (4) _____ with the light wave theory, Albert Einstein came to the conclusion that light must consist not only of (5) _____, but also of particles.

With the development of laser technology, research into the photoelectric effect has gained a new (6) _____. So far, scientists have only been able to determine laser-induced electron dynamics precisely in gases – with an (7) ____ of a few attoseconds. Quantum dynamics and emission time windows have not yet been measured on solids. This is exactly what the researchers have now succeeded in doing for the first time. They used a special (8) _____ for this: instead of just a strong laser pulse, which emits the electrons a pointy tungsten tip, they also used a second weaker laser with twice the frequency.

In the experiment, the researchers were able to determine the duration of the electron flow to 30 attoseconds—thirty billionths of a billionth of a second. This ultra-precise limitation of the (9) _____ time window could advance basic and application-related research in equal measure.

The most important field of application is light-field-driven electronics: with the proposed two-color method, the laser light can be modulated in such a way that an exactly defined sequence of electron pulses and thus of electrical signals could be generated. Scientists believe, it will be possible to integrate the components of their test setup (light sources, metal tip, electron detector) into a (10) _____. Complex circuits with bandwidths up to the petahertz range are then conceivable, that would be almost a million times faster than current electronics.

https://phys.org/news/2023-04-scientists-laser-fields-precisely-electron.html

SPEAKING

9. Extended discussion.

Formulate basic rules and safety measures to protect personnel from laser radiation.

10. Search for necessary information and prepare for oral repots:

a. Laser technology in nuclear energy.
b. Laser technology in industry.
c. Laser technology in the medical field.
d. Laser technology in communication, information processing, and data storage.

LISTENING

11. Watch the video «New Research: Laser Guided Lightning» and answer the questions below.

1. For how long have conventional lightning rods been used?
2. What does the new method of guiding the lightning strikes published in *Nature Photonics* employ?
3. What is the yearly fatalities count of lightning incidents?
4. When was the method of launching a rocket to trigger the lightning strikes published?
5. How many lightning strikes were generated and how many lasers were used in the experiment back in 1999?
6. Where was the laser mounted in the new experiment reported in the video?
7. According to the researchers, what could laser filamentation be used for?
8. How does laser filamentation work?
9. What does a laser filament contain?
10. How many successful guided lightning strikes were recorded by the research team?

12. Watch the video and choose if the following statements are true or false:

1. Worldwide, the lightning raises no safety concerns at large facilities like airports.
2. The research on initiating the lightning strikes with lasers begun at the end of the 20^{th} century.
3. The first successful attempt of triggering the lightning with lasers was made by Germans.
4. In the new experiment a laser was set-up at the height of 300 m.
5. The telecommunications tower used in the experiments is located in Poland.
6. Laser filamentation is suitable for sending laser pulses into the clouds.
7. Superheating of air is one of the steps in the lightning-triggering process.
8. The method can be used for guiding lightning strikes to occur away from the important infrastructure.
9. Using the laser, the researchers were able to guide several lightning strikes in the summer 2021.
10. Despite its high potential this method cannot be used for lightning protection of planes and rockets.

13. Read the following text and discuss the future and technological advancements of laser surgery. How can lasers transform modern surgery?

Replacing Bone Saws with Smart Lasers

Using lasers rather than scalpels and saws has many benefits in surgery. Yet they are only used in isolated cases. But that could be about to change: laser systems are getting smarter and better all the time, as a research team from the University of Basel demonstrates.

Even back in 1957, when Gordon Gould coined the term «laser», he was already imagining the possibilities for its use in medicine. Surgeons would be able to make precise incisions without even touching the patient. Before that could happen, however, there were—and still are—many hurdles to overcome. Manually controlled light sources have been superseded by mechanical and computer-controlled systems to reduce injuries caused by clumsy handling. Switching from continuous beams to pulsed lasers, which turn themselves rapidly on and off, has reduced the heat they produce. Technical advances allowed lasers to enter the world of ophthalmology in the early 1990s. Since then, the technology has moved on in other areas of medicine, too, but only in relatively few applications has it replaced the scalpel and the bone saw.

Safety concerns are the most important hurdle: how can we prevent injury to the surrounding tissue? How closely can the cutting depth be controlled so that deeper layers of tissue are not accidentally damaged? Researchers at the University of Basel have just made an important contribution to the safe and precise use of lasers with their recent publication in the journal Lasers in Surgery and Medicine. The research team has developed a system that combines three functions: it cuts bones, controls the cutting depth and differentiates between different tissues.

https://phys.org/news/2023-12-bone-smart-lasers.html

14. Find the words in the text which match the definition.

1. a group of related cells that forms larger parts of animals and plants
2. to replace something, especially something older or more old-fashioned
3. to stop something from happening or someone from doing something
4. to invent or be the first to use a new word or expression
5. awkward in movement or manner
6. to harm or spoil something
7. a problem that you have to deal with before you can make progress
8. physical harm or damage done to a living thing
9. an opening that is made in something with a sharp tool
10. a tool with a blade or sharp cutting points, used for cutting hard materials

MINI GRAMMAR

The inverted word order

The inverted word order is the replacement of the predicate or part of the predicate before the subject. English usually requires an inverted word order for questions. A different word order is required if a «negative» word is used to open a sentence. Inversion can be provoked by some conjunctions and adverbs:

not only, not only ... but, no sooner ... when, hardly ... when, little, scarcely ... when, , never, never before, nowhere, nobody, nor, neither, neither nor, only, so, etc. e.g.

Not only has the author presented some valuable new information, he has also presented it in a clear and coherent manner.

In no case do the authors provide any statistical information about their results.

Notice how the auxiliary verb precedes the subject, as in a question. Now look at this statement, first inverted, and then in normal word order.

Particularly prominent were functional strategies … .

Functional strategies … were particularly prominent.

In certain conditional sentences, subjects and verbs may also be inverted. This can be done if the auxiliary verbs are *should*, *were*, and *had*. Inversion in conditional sentences and the connector *if* is omitted.

If you should get a letter from your scientific advisor, let me know.

Should you get a letter from your scientific advisor, let me know.

If I were you, I wouldn't start the experiment.

Were I you, I wouldn't start the experiment.

If I had known, I would have performed many careful tests.

Had I known, I would have performed many careful tests.

Inversion is a strong highlighting device and should only be used for special emphasis, as when we want to single out one result/fault/problem/virtue from many others.

15. Translate the following sentences into Russian paying attention to the emphatic word order.

1. Not only does CNN allow manipulating content and style but it also provides way to create new images.
2. Little did we imagine the immense possibilities that would arise from delving into the realm of metamaterials for counting and sequential information processing.
3. Only through careful observation and analysis can this theory be understood.
4. Never before had the concept of relativity revolutionized our understanding of the universe.
5. Only when the experiment was completed did they realize the significance of their findings.
6. Nor does it reveal much about the properties of the supposed material.
7. Not until the experiment is conducted can the hypothesis be confirmed.
8. Under no circumstances should you look directly into the reflection.
9. Nowhere did scientists use the gold nanoplates except for these experiments.
10. Nor do the laws of nature change depending on the direction in which you look.

16. Complete the following inversions.

Example: *Particularly interesting …*

Particularly interesting was the way in which he introduced sociological ideas about the influence of older scientists on younger scientists.

1. Especially notable …

2. Much less expected …

3. Especially noteworthy …

4. Of greater concern …

5. Under no circumstances …

6. No sooner …

7. In no other way …

8. At no time …

9. Nowhere …

10. Only when ….

17. Fill in the gaps with the words and phrases from the list.

at no time	*had ...studied*	*hardly ... when,*	*little*	*not only ... but*
only	*nowhere*	*should*	*such*	*were*

1. Perhaps _____ have been achieved better results as in this field of science.
2. _____ in this case can we find a similar construction.
3. _____ he _____ hard, he would not have failed in the examination.
4. _____ can you use my new equipment.
5. _____ was the experiment conducted _____ they installed a new device.
6. _____ did I know I've spent all this time working alongside the greatest scientist.
7. _____ you need any assistance, please, don't hesitate to contact the dean's office.
8. _____ did our team overcome these challenges, _____ they also set a new industry standard.
9. _____ I in your position, I would accept the offer.
10. _____ was his influence that everyone followed his advice.

18. Translate from Russian into English using emphatic structures.

1. Размеры сенсорных устройств действительно варьируются от молекулярных систем до километровых установок.
2. Неорганические полупроводники на самом деле обладают координационной структурой, т.е. в их пространственных решетках отсутствуют молекулы.
3. Только в 1981 году ученые создали сканирующий туннельный микроскоп, что дало возможность не только получать изображения отдельных атомов, но и манипулировать ими.
4. Только в середине 80-х – начале 90-х годов XX века произошло открытие наноструктур углерода – фулеренов и углеродных нанотрубок.
5. Кто бы ни возражал, я все-таки буду утверждать, что сегодня нейросети не могут создавать полноценную интеллектуальную систему.
6. Именно физические закономерности положены в основу принципа работы тепловых преобразователей.
7. Графен не только очень быстро и эффективно передает тепло, но и обладает полной оптической прозрачностью.
8. Плохо они понимают, как наночастицы будут воздействовать на здоровье человека и окружающую среду.

9. Ученые и не подозревали, что черная дыра начнет выбрасывать потоки позитронов, которые затем можно собрать в виде энергии.
10. Ни при каких обстоятельствах экспериментаторам не разрешалось увеличивать размер молекулярного кластера.

Unit 4 The role of scientists in society

Part 1. What makes a good scientist?

Ex.1 **Give nouns that correspond to the following areas and discuss the questions.**

Area	**person**
1. Science -	*scientist*
2. physics-	
3. chemistry –	
4. biology –	
5. mathematics -	
6. research –	
7. analytics –	
8. programming -	
9. astronomy –	
10. experimentation -	1) experimentalist 2)
11. organization –	
12. exploration –	

1. What kind of knowledge and skills do physicists need?
2. Apart from physics what fields of science should they be good at?
3. Does it depend on their specific area of interest? (astrophysicists, particle physicists, biophysicists, engineering physicists and etc.)
4. Do you think that physics is one of the most exciting and challenging areas of human activity? Why?

Ex.2a **Read a short description of scientists and check you understand the words in bold**.

A scientist engages in systematic and methodical **inquiry** to expand our understanding of the natural world. Scientists can specialize in various fields such as physics, chemistry, biology, astronomy, and more, each contributing to the collective body of scientific knowledge. Their work often involves a **commitment to** objectivity, **rigorous** methodology, and the **pursuit** of evidence-based explanations. Scientists may work in academic institutions, research laboratories, or private industries, and their discoveries contribute not only to theoretical understanding but also to technological advancements and practical applications that benefit society.

Ex.2b **Complete the sentences with the words in bold using each one twice**.

1. As development advances, it will naturally intersect to an increasing degree with efforts in the _____of 'virtual reality'.
2. _____ comparisons among the various studies are difficult.

3. The questions of what constitutes civil society and how it relates to the state and the market have long been the focus of academic _____.
4. A career as a physicist requires one hundred per cent _____.
5. It is an area of _____that in itself deserves to be pursued more intensively in future research.
6. Their participation is based purely on their _____ to the development of science in the subregion.
7. In this work, no _____ attempt to calculate the optimal number and locations, and control gains has been made by the authors.
8. They are not afraid to risk in the _____ of true representation.

Speaking

Ex.3 **Look at the list of requirements below. Work in pairs and decide whether they might or might not be necessary for a good scientist. What would you add to the list?**

• knowledge of any foreign language
• publications in the field of study
• experience in teaching
• international projects
• a strong track record in research
• awareness of cultural differences
• the ability to be open to other cultures

• a PhD

• advanced technological skills
•

•

Reading and vocabulary

Ex.4a **Read the sentences and check you understand the words in bold.**

1. The road to a fruitful career in science may seem **hazy**.
2. Achieving success can seem impossible and **daunting**.
3. After **encountering** many obstacles, it becomes easy to focus on failures.
4. The early stages of a scientific career are **fraught** with many hardships.
5. Becoming an **accomplished** scientist is even more challenging.
6. Emerging scientists should **strive for** a way to be of value.
7. Be **genuine** and nice when networking.
8. You don't want to become so **overwhelmed** that your research progress is **hindered**.
9. Don't ever give up on your dreams because with **perseverance** they will become a reality.
10. Accomplished scientists shared the tactics used to overcome **adversity**.

4b **Match the words in bold with the definitions a)-n)**

a) very good at a particular thing; having a lot of skills
b) the quality of continuing to try to achieve a particular aim despite difficulties
c) not clear because of a lack of memory, understanding or detail
d) frightening in a way which makes a person feel less confident
e) made difficult
f) try very hard to achieve something
g) swamped, overloaded
h) filled with something unpleasant
i) meeting something new, unusual or unexpected
j) sincere and honest
k) a difficult or unpleasant situation

Ex.5 **a) You are going to read an article about the key qualities of a successful scientist. Look at the title of the article. What do you think the winning formula of a successful scientist could be?**

b) Read the first part of the article and check your ideas.

Part 1

Successful Scientist: What's the Winning Formula?

by J. Stull and Eric D. Ciappio
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The early stages of a scientific career are fraught with many hardships, and achieving success can seem impossible and daunting. After encountering many obstacles, it becomes easy to focus on failures and lose sight of career goals. At times, the road to a fruitful career in science may seem hazy to an emerging scientist who has spent countless hours conducting experiments that fail, writing manuscripts and grants that are rejected, and generating research ideas that never come to fruition. Young scientists must realize they are not alone and that even accomplished scientists have also experienced similar hardships during the early stages of their careers.

Most young scientists are eager to know how to become successful, the key qualities of a successful scientist, and the secret formula for success. There are a few tactics that can help to overcome adversity.

Part 1. Journey to Success: What Does It Take?
Enjoy your work. Great scientists enjoy what they are doing and their happiness is the key to their successful and long-lasting careers. Aiming for success is the wrong goal. Instead, emerging scientists should strive for a way to be of value and enjoy what they are doing. If you truly love your job, then you will be successful because it is very difficult to perform poorly at something you enjoy. You should find a job you like so much that you would do it for free.
Take risks. Successful scientists not only work hard, but they take a lot of risks that magnify their impact. When successful scientists see a great opportunity, they pursue it. Don't be afraid to step outside of your comfort zone and if 'plan A' doesn't work then the alphabet has 25 more letters. Be open-minded to new ventures and untraditional paths. Risk taking is where most of the big discoveries and opportunities in science lie.

Network. Be genuine and nice when networking, and try to think of ways you can help others succeed rather than always looking for a handout. People will remember those who helped them succeed in the past.
Don't overcommit. Budget your time very carefully. If you are doing your share of administrative work in your department as a junior faculty member, do not hesitate to decline a request to serve on another committee. In the early years, focus your committee member responsibilities, speaking engagements, and grant and manuscript reviews to tasks related to your research area. You don't want to become so overwhelmed that your research progress is hindered. Devote your time to activities that you want to contribute to.
Step away from science. Becoming a great scientist requires countless hours of hard work. However, working too hard can be counterproductive. It is critical to balance hard work with other activities to help the mind and body de-stress. Find activities that can recharge you emotionally, mentally, and physically.
Embrace failure. There will be a number of setbacks encountered early in your career. There is nothing shameful about being wrong, especially if you learn from your mistakes. Moving forward is important for success. If the study didn't work, find out why and try it again. Learning from your failures can turn what others view as problems or disappointments into opportunities. Failure teaches us, reveals our abilities, makes us stronger, inspires us and others, builds courage, and leaves us open to better opportunities. Don't ever give up on your dreams because with perseverance they will become a reality.

Ex.5a **Discussion. Answer the questions.**

1. Why are the early stages of a scientific career fraught with many hardships?
2. What should an inexperienced scientist strive for?
3. What does "think outside the box" mean?
4. What adversities might young scientists encounter?
5. Why are good communication and presentation skills important?
6. What advice do you consider the most valuable? Why?
7. What advice would you give to junior students who are about to start their study/research/experiment for the first time?

Part 2. What Are the Key Qualities of a Successful Scientist?

Ex. 6 **Read the second part of the article and explain to your partner what each quality involves, give examples; then answer the question in the discussion section below**.

Although there are many key qualities that define successful scientists, there were identified 10 of the most important ones. The top 10 key qualities of a successful scientist are as follows:
1. Passionate about their career.
2. Resilient.
3. Detail-oriented but yet visionary.
4. A creative thinker.
5. Determined.
6. Knowledgeable (an expert).
7. A team player.
8. Self-motivated.
9. An effective communicator.
10. Capable of thinking "outside the box".

Ex. 6a **Discussion.** Work in pairs. Do you think it is necessary/ possible to possess all of these qualities? If not, choose the most important ones and explain your choice.

Part 3 Conclusions: What's in the Winning Formula?

Ex.7 Write 5 sentences that could make a possible conclusion of the article, read your conclusion to your partner then go to the end of part 1 and read the authors' conclusion. Were you close?

Grammar. **Articles. Uncountable nouns**

Ex. 8 a. **The word 'advice' in Ex.6 is an uncountable noun.**
How to make it countable? What uncountable nouns do you remember?
Which articles are used with uncountable nouns?

Ex. 8 b **Look at the countable and uncountable nouns in the box. Combine them into the following pairs: an *uncountable noun – a countable synonym*. For example, *evidence -a fact.***

Equipment, advice, sugar molecule, dollar, knowledge, software, information, literature, research, study, evidence, thermometer, machinery, train, computer program, sugar, a piece of data, money, progress, book, the ability to understand, fact, suggestion, advance

Ex.8c **Match the uncountable nouns from the box with the words below to form collocations. Sometimes several variants are possible.**

1. to advance *knowledge*
2. to provide
3. to do
4. brand new
5. to review
6. complex
7. convincing
8. to dissolve
9. to install
10. constructive
11. invest
12. to make good

Listening

Ex9a **In the video "What makes a good researcher?" scientists speak about their profession. Watch the video and answer the following question: Are your views similar to those of the speakers? Why not?**

Ex. 9b **Choose the correct variant to complete the following sentences, then watch the video again from 0:02 to 1:30 and check.**

1. We are trying to push the boundaries of what *conventional/common* wisdom says is possible.
2. I *think /don't think* there is one specific personality type that necessarily makes a good researcher.
3. We are dealing with ever changing problems. We have to be open to *tackling/handling* these new challenges.
4. You don't go with a *biased /preconceived* notion of how you want your research to come *up/out.*
5. If you want to do anything of significance, you're gonna have to be *stubborn/tenacious.*
6. A researcher has to really be *willing/eager* to push forward with solving hard problems. You have to be willing to try another solution.
7. You have to be *content/willing* to fail spectacularly.

Ex. 9c **Watch the rest of the video from 1:30-to the end and tick the phrases that the speakers mentioned. Do you remember why these ideas were mentioned? There are four extra ones.**

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take a step beyond	the goals of society	the ideas of the past	sceptics
laboratory equipment	inquisitive	career opportunities	to have that spirit
eyes can light up	a modicum of disrespect	it's just engineering	a little bit of friction
be daunted	the next mega computer	job positions	

Grammar and writing a brief analysis of research.

Ex.10a **In the article "Non-cognitive skills: The hidden key to academic success" the author describes new research that reveals the growing importance of emotional intelligence in shaping educational outcomes. Look at the terms below, match them with their definitions and say what the noun "attribute" means.**

non-cognitive abilities, cognitive skills, hard skills, soft skills,

1. a set of mental abilities related to the way our brain deals with the information about the world including memory, problem-solving abilities, making predictions and etc.
2. refer to socioemotional abilities such as perseverance, motivation, self-discipline, goal-setting, organization.
3. personal attributes; an umbrella term for people skills and personal career attributes including time management, teamwork and leadership.
4. industry-specific abilities acquired and enhanced through education and experience to perform job- specific tasks.

Ex.10b **Match the following words with their synonyms in bold:**

Irresistible, belief, results, teach, perseverance

1. educational **outcomes**
2. to **foster** non-cognitive skills
3. the long-held **assumption**
4. **compelling** evidence
5. such as **grit**

Ex. 10c **Read the article (470 words) and do the exercises.**

Non-cognitive skills: The hidden key to academic success

New research reveals the growing importance of emotional intelligence in shaping educational outcomes.

Margherita Malanchini, Andrea G. Allegrini, Michel G. Nivard

A new study, jointly led by Dr Margherita Malanchini at Queen Mary University of London and Dr Andrea Allegrini at University College London, has revealed that non-cognitive skills, such as motivation and self-regulation, are as important as intelligence in determining academic success. These skills in addition to diligence and engagement, reflecting the importance of attributes such as a positive attitude towards learning, a strong work ethic, enthusiasm for a subject, dedication and effort, become increasingly influential throughout a child's education, with genetic factors playing a significant role. The research, conducted in collaboration with an international team of experts, suggests that fostering non-cognitive skills alongside cognitive abilities could significantly improve educational outcomes.

"Our research challenges the long-held assumption that intelligence is the primary driver of academic achievement," says Dr Malanchini, Senior Lecturer in Psychology at Queen Mary University of London. "We've found compelling evidence that non-cognitive skills -- such as grit, perseverance, positive and confident outlook, academic interest, and value attributed to learning -- are not only significant predictors of success but that their influence grows stronger over time."

The study, which followed over 10,000 children from age 7 to 16 in England and Wales, employed a combination of twin studies and DNA-based analyses to examine the complex interplay between genes, environment, and academic performance.

The power of non-cognitive genetics

"We discovered that genetic effects associated with non-cognitive skills become increasingly predictive of academic achievement over the school years, in fact their effect nearly doubles between the ages of 7 and 16" explained Dr Allegrini, Research Fellow at University College London. "By the end of compulsory education, genetic dispositions towards non-cognitive skills were equally as important as those related to cognitive abilities in predicting academic success."

This finding challenges the traditional view of educational achievement as determined largely by intelligence. Instead, the study suggests that a child's emotional and behavioural makeup, influenced by both genes and environment, plays a crucial role in their educational journey.

Implications for education

The findings of this study have profound implications for education. By recognising the critical role of non-cognitive skills, schools can develop targeted interventions to support students' emotional and social development alongside their academic learning.

"Our education system has traditionally focused on cognitive development," said Dr Malanchini. "It's time to rebalance that focus and give equal importance to nurturing non-cognitive skills. By doing so, we can create a more inclusive and effective learning environment for all students."

The study also highlights the need for further research into the complex interplay between genes, environment, and education. By understanding these factors, educators and policymakers can develop more effective strategies to support students' overall development and achieve better educational outcomes.

The study was a collaborative effort involving researchers from multiple institutions across six countries.

> Margherita Malanchini, Andrea G. Allegrini, Michel G. Nivard, Pietro Biroli, Kaili Rimfeld, **Genetic associations between non-cognitive skills and academic achievement over development**. *Nature Human Behaviour*, 2024;

Ex.11 **Answer the question:**

1. What examples of non-cognitive skills are mentioned in the text?
2. What can influence academic performance according to the article?
3. What research questions or hypotheses are being addressed in the article? Are the questions relevant?
4. What kind of evidence (method, experiment) was collected to explore the research questions? Is there any evidence that could or should have been collected and included but was not? How good is the evidence? How well does the evidence support the conclusions?
5. What age groups were involved in the study?
6. What does the research lack?
7. Are the author's conclusions valid or plausible based on the evidence? Why or why not? (Significance and ramifications of the findings).

Ex.12 **Reporting Verbs**
Reporting verbs describe what people say, think, feel or want. Study the patterns for some common verbs provided in the table below. Which patterns are not possible for *suggest* **and** *claim***?**

Complements of common reporting verbs in the active voice				
	Noun phrase	**Noun clause**	**-ing clause**	**to infinitive clause**
suggest	He suggested a solution.	He suggested that we do it.	He suggested doing something.	
recommend	I recommend the book.	I recommend that you buy the book.	I recommend buying the book.	I recommend you to buy the book.
claim	We claim victory.	We claim that we have succeeded.		We claim to have succeeded.
show	Table 1 shows the result.	Table 1 shows that the results are significant.	The picture shows the researcher conducting the test.	Table 1 shows the results to be significant.

Ex.13 **Check whether you remember the verb patterns for** *allow* **by choosing the correct alternative in the sentences below.**

1. This will allow *to make/us to make* much progress.
2. We don't allow *to smoke/smoking* in the lab.
3. The paper shows the results of an approach that *allows to extrapolate the data* / *means the data can be extrapolated* more easily than with other methods.
4. The new equipment allowed *to finish/ them to finish* the job on time.
5. It is important that scientists record their procedures carefully, allowing *others to reproduce/to reproduce* and verify the experimental data and results
6. This system allows *to save* / *researchers to save* a lot of money.
7. This kind of behavior is not *allowed / enabled*.
8. The formulation of this new theory *allows to* / *means we can* obtain a more general expression of the overall transfer function.
9. We have to allow *for/-* the possibility of the project being delayed.

Ex.14 **Write several sentences using the reporting verbs from the table above to say what the research described in the article "Non-cognitive skills: The hidden key to academic success"** *shows/ claims/allows/suggests***, and give your** *recommendations/suggestions* **for further research based on the investigation. Express your ideas with various compliments for verbs shown in the table above.**

Grammar **Prepositions**

Ex.15. **Put the following expressions into the correct column depending on their prepositions.**

the end of
the beginning of
a distance of 5m
the verge of
the atmosphere
length
common
the internet
a nutshell
the site
detail
demand (2)
a temperature of 20^0C
other words
the expense of
risk
the field
the last 5 years
the picture/figure
work
fact
a right angle
average
detail
advance
next year/month
a speed of 60 km/h
width
a certain frequency
random
purpose
a large scale
last year/month
the long term/run
the slide
the graph
the contrary
doubt
the whole

at	on	in	no preposition

Ex.16 **Fill in the gaps with the correct prepositions.**

1. The vast majority of robots do have several qualities ____ common.
2. Muons are passing through you and everything around you___ a speed close to that of light.
3. Like electricity, sound energy travels through substances in waves, which "excites" the substance's particles and causes them to vibrate ___ a certain frequency.
4. Perpendicular lines cross over - or "intersect" -one another ___ a right angle.
5. Evolution doesn't do things ___ purpose.
6. Welders and carpenters use all sorts of tools to set things ____ perfect 90-degree angles. Many doorframes have corners set ___ right angles.
7. The train was going ___ a rate of fifty miles an hour.
8. The food industry uses this food-preserving process ____ a large scale.
9. This is a graph of temperature _____ time.
10. Another popular language ____ the internet is Spanish, whose users have also shown a steady increase ____ growth _____the last ten years.
11. The box is two feet ___ length.
12. The pressure ___ the bottom of the deepest part of the Pacific Ocean is 16,380 pounds per square inch.
13. Some researchers claim to be ___ the verge of discovering the cause ___ some forms of cancer.
14. Hydrogen boils ___ a temperature ___ -252.87^0C.
15. We change the colour of the solution ___ means of acid.
16. Spectroscopy takes advantage ___the fact that all atoms and molecules absorb and emit light ____certain wavelengths.
17. Atoms can be in different states of excitation. ____ other words, they can have different energies.
18. Divers breathing a mixture ___helium and oxygen can work ____a depth ____ 100 meters.
19. ____ a nutshell, this was the problem of control.

* Part 3 Conclusions: What's in the Winning Formula? (Ex.7)

Conclusions: What's in the Winning Formula?
Unfortunately, all of the symposium speakers concurred that there is not a simple formula that will lead you to a path of excellence. There are many different paths to success; you just have to find your own that you are passionate about and that keeps you motivated and excited about your career. A young scientist must always remember that, although the end is important, the journey must be fun. So, enjoy the journey to becoming a successful scientist because you are in the exciting process of discovery!

Part 2 Job responsibilities of scientists

Ex.1. **Answer the following questions:**

1. What kinds of responsibilities do scientists have? Think of several levels at which they might have responsibilities: the science itself, their field, their individual science and laboratory.
2. Can discoveries be divided into useful and harmful ones? Explain your viewpoint with examples.
3. Are scientists responsible for their discoveries? Why? Why not?

Vocabulary

Ex2a **Read the phrases and check you understand the words in bold.**

1. **assess** the significance
2. **peer-reviewed** journals
3. **disseminate** knowledge
4. **address** complex problems
5. **outline** the research objectives
6. the project's **merit**
7. research **endeavors**
8. **adhere to** ethical standards in
9. **stay abreast** of

2b **Complete the following sentences with the phrases from Ex 2a.**

1. Scientists _____ their research.

2. This involves developing proposals that _____, methodology, and expected outcomes to convince funding agencies of _____.

3. They draw meaningful conclusions from data, _____ of their findings, and contribute to the body of knowledge in their field.

4. Effective communication skills are crucial to _____.

5. Scientific fields evolve, and scientists must _____ new developments.

6. Scientists publish their research findings in _____.

7. They may also mentor graduate students or junior researchers, guiding them in their own _____.

8. Scientists often work in interdisciplinary teams, pooling their expertise to _____

Reading

Ex.3 **Read a text about scientists' work responsibilities and do the tasks.**

What does a scientist do?

Duties and Responsibilities

The duties and responsibilities of a scientist can vary depending on their specific field of expertise, whether it's in physics, chemistry, biology, or any other scientific discipline. However, there are some common core responsibilities that scientists typically share:

- *Research and Experimentation*: Scientists design, plan, and conduct experiments or investigations to test hypotheses and expand knowledge in their field. This involves carefully documenting procedures, collecting and analyzing data, and drawing conclusions based on evidence.
- *Hypothesis Formulation*: Scientists propose hypotheses or theories based on existing knowledge or observations. They formulate these hypotheses to guide their research and to make predictions that can be tested through experimentation.
- *Literature Review*: Staying current with existing research is essential. Scientists regularly review scientific literature to understand the state of their field, identify gaps in knowledge, and build upon or challenge existing theories.
- *Data Analysis and Interpretation*: Scientists use statistical methods and analytical tools to interpret experimental results. They draw meaningful conclusions from data, assess the significance of their findings, and contribute to the body of knowledge in their field.
- *Publication and Communication*: Scientists publish their research findings in peer-reviewed journals to share their discoveries with the scientific community. Effective communication skills are crucial, as scientists often present their work at conferences, collaborate with colleagues, and engage with the public to disseminate knowledge.
- *Collaboration*: Collaboration is common in scientific research. Scientists often work in interdisciplinary teams, pooling their expertise to address complex problems.
- *Grant Writing*: Many scientists secure funding for their research through grant applications. This involves developing proposals that outline the research objectives, methodology, and expected outcomes to convince funding agencies of the project's merit.
- *Teaching and Mentoring*: In academic settings, scientists may have teaching responsibilities, educating students at various levels. They may also mentor graduate students or junior researchers, guiding them in their own research endeavors.
- *Ethical Considerations*: Scientists adhere to ethical standards in their research, ensuring the humane treatment of research subjects, accurate representation of data, and responsible use of resources.
- *Continuous Learning*: Scientific fields evolve, and scientists must stay abreast of new developments. Continuous learning through attending conferences, workshops, and engaging with the scientific community is crucial for professional growth.

https://www.careerexplorer.com/careers/scientist/

Ex.4 **Talk about your practical training in the research institute. What activities mentioned in the text above have you been involved in? (What exactly did you do?) Which ones haven't you done yet but would like to try?**

Ex.5 Scientists work across a broad spectrum of industries, contributing their expertise to advance knowledge, solve complex problems, and drive innovation. **You are going to look at various industries where scientists play pivotal (i.e. of great importance) roles**. **Outline what they do and give examples of their work in each industry as it is done for *Pharmaceuticals and Biotechnology*:**

- Pharmaceuticals and Biotechnology: *Scientists in this industry research and develop new drugs and therapies. They may be involved in clinical trials, studying the efficacy and safety of medications. For instance, pharmaceutical scientists at a company like Pfizer work on the development of vaccines and medications for various medical conditions.*
- Healthcare and Medicine:
- Agriculture and Food Science:
- Environmental Science and Conservation:
- Technology and IT:
- Energy and Renewable Resources:
- Space Exploration and Aerospace:
- Chemical and Materials Science:
- Academic Research and Education:

Listening 1

Ex.6a.**In the video " Friendly feuds. Experimental physicists versus Theoretical physicists" two scientists speak about their profession. Look at the statements the speakers use for justifying their position in the table below, then watch the video and tick the statements in the correct column.**

statements	theorist	experimentalist
I started graduate school thinking that I'll be a theorist.		
I like playing with toys.		
We're like dwarves and they're the elves.		
Theorists often try and think about not just the way the world is but the way of the world could be. Experimentalists, their job is to go out and figure out which of these ideas is actually right.		
The famous physicists, for the most part ,who get all the glory are usually the theorists: Albert Einstein, Richard Feynman, Isaac Newton.		
I don't know why there are no famous experimentalists. Maybe because we're more modest.		
A theorist has the luxury of coming out with 20 different theories. It's very cheap, it's very fast.		
We are bound by laws of nature.		
So we try to have a "No Theorist" sign on the on the door.		
Without them we have no idea what we're doing.		
It's a friendly feud, and we're well aware that we do not exist apart from each other.		

Ex.6b **Work in pairs. Choose the position of either** *Experimental physicists* **or** *Theoretical physicists* **described in the video. Watch the clip for the second time paying particular attention to the speech of the chosen role and take notes. Role play the conversation in pairs adding your own ideas.**

Ex.7a **What do you know about the scientific method? Do you always follow its steps? Read the text and answer the questions using your experience in doing research.**

Reading

"Doing" Science

Adapted by: Christine Miller

Science is as much about doing as knowing. Scientists are always trying to learn more and gain a better understanding of the natural world using basic methods of gaining knowledge that are common to all of science. At the heart of science is the scientific investigation, which can be observational or experimental.

The flow chart below shows the typical steps followed in an experimental scientific investigation. The series of steps shown in the flow chart is frequently referred to as the scientific method**.** This is an oversimplification of how science is actually done, but it does highlight the basic plan and purpose of an experimental scientific investigation: testing ideas with evidence.

Science is actually a complex endeavor that cannot be reduced to a single, linear sequence of steps. Real science is nonlinear, iterative (repetitive), creative, unpredictable, and exciting. Scientists often undertake the steps of an investigation in a different sequence, or they repeat the same steps many times as they gain more information and develop new ideas. Scientific investigations often raise new questions as old ones are answered or may address the same questions, but at ever deeper levels. Alternatively, an investigation might lead to an unexpected observation that sparks a new question and takes the research in a completely different direction.

https://humanbiology.pressbooks.tru.ca/chapter/1-4

Ex.7b **Answer the following questions:**

1. Can you explain the difference between an observational and experimental scientific investigation? Give examples.

2. What are the easiest and hardest steps presented in the chart of the experimental scientific investigation in your opinion? Explain your viewpoint.

3. The scientific investigation is not always conducted in the order given above. What can be different?

4. Do you need to do background research before formulating a hypothesis?

5. What was the sequence of steps of your scientific investigation last year? Did anything go in an unpredictable way? If so, what did you do?

6. An observation is anything that is detected through human senses or with instruments or measuring devices that enhance human senses. We usually think of observations as things we see with our eyes, but we can also make observations with our sense of touch, smell, taste, or hearing. What are the examples of instruments and measuring devices enhancing human senses that scientists use for observation?

7. One of the most important observations was made by Scottish biologist Alexander Fleming in the 1920s. What did he observe? What scientific discovery did Fleming make?

8. What is a hypothesis? What must it be based on?

9. Once scientists have made a hypothesis, they'll test it by designing and carrying out an experiment. To do this it's important to identify the variables of the experiment. There are usually three different kinds of variables: independent variables, dependent variables and controlled variables. Explain the difference with examples.

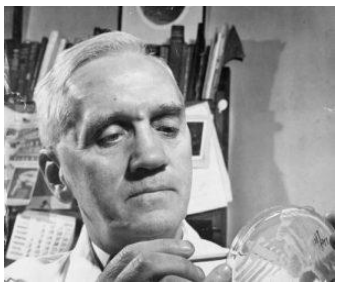
10. Testing a hypothesis involves using the data to answer two basic questions. What could be the two possible questions?

11. What can you do if direct experimentation to test your hypothesis is not possible?

12. The scientific method includes making observations, formulating a hypothesis, testing the hypothesis with new observations. What do scientists do if the new observations contradict the old hypothesis? If the new observations agree?

13. The final step of the scientific method is communicating results. What are the possible forms of sharing the results of your research?

14. When does a hypothesis become a theory?



Alexander Fleming examining bacterial growth.

Grammar and writing
Prepositions

Some words can be both nouns and verbs. For example, the verbs *influence* and *impact* do not need a preposition with their object, but when used as a noun, they must be followed by a prepositional phrase.

The environment can **influence** a mental illness diagnosis.
The environment can **have an influence on** a mental illness diagnosis.

Ex.8 **These collocations are frequently used in academic writing. Write sentences about you current research, using at least five of these phrases.**

a significant influence on
the start of
the nature of
the relationship between
with the exception of
shown in
in contrast to
similar to
on the basis of
the same way as
an increase/ decrease in

Grammar

Should have done or shouldn't have done (Should've done)

Should have +past participle is used to refer to something that you did not do, but it would have been better if you had done it. Use should have + past participle when you mean something (in the past) was a good idea, but you didn't do it.

Use shouldn't have + past participle when you mean something (in the past) wasn't a good idea, but you did it anyway.

For example:

We should have sent the abstract to the conference, then we could present our research. Now we can only go and watch.

Should (not) have + past participle is used to make strong recommendations. It's often found in conclusions when authors give their recommendations to other authors regarding possible directions for future work. In situations other than in papers, should is used to give friendly recommendations and to express opinions.

Ex.9 **Fill in the gaps with *should (not) have* + past participle and the words in brackets.**

1. You _____ (use) that new device.
2. You _____ (carefully consider) his suggestion.
3. The government _____ (think) about the problems that plague the world.
4. This line _____ (put) into operation long ago.
5. System problems that exist today _____ (solve) a year ago.
6. They _____ (determine) the structure of these molecules, but they haven't done that.
7. You _____ (bring up) new ideas or presented new facts in the conclusion of a research paper, but _____(stick) to the background information you had presented earlier.

8. Your research paper _____(be) more concise and succinct than your essay.
9. You _____(show) any emotions in the text of a scientific article.
10. Logical transitions and text connectivity _____ (facilitate) by such words as “on the other hand,” “consequently,” “in fact,” “certainly,”

Ex.10 **Recollect one of your scientific investigations and say how it could’ve been different using should have done or shouldn’t have done and the ideas below.**

1. A decision you shouldn’t have made
2. A person you should have asked
3. Something you shouldn’t have forgotten
4. Something you should have read about in more detail
5. Something you should have remembered
6. Something you shouldn’t have used
7. Something you should have changed
8. Something you should have anticipated

Listening

Ex.11a **In the video ‘A day in the life of engineering physicist Linda Bagby’ a scientist speaks about her work day. Watch the video and complete her sentences.**

1. I am….
2. I am responsible for…
3. I am passionate about…
4. The way that I approach that is…
5. I develop…
6. Each time we build a new experiment,..
7. We are hopeful that by the time we actually get to build DUNE…
8. The biggest challenge I have is that…
9. On moment I can be….
10. And then later in the afternoon I could be…

Ex.11b **Make up your own story ‘A day in the lab’ speaking about your practical training. Complete the phrases so that they were true for you.**

1. I am…
2. I am responsible for…
3. I am passionate about ...
4. The way that I approach that is ...
5. I develop ...
6. Each time we build a new experiment,..
7. I am hopeful that…
8. The biggest challenge I have is …
9. On moment I can be ...
10. And then later in the afternoon I could be ...

Extensive Reading

Ex.12 **You are going to read an excerpt from an article describing a robot scientist and its research. Pay particular attention to the steps of the scientific investigation mentioned.**

Rise of the Robo Scientists

By Ross D. King

My colleagues and I have spent a decade trying to build a robot scientist that can discover new scientific knowledge.

Robot scientists could make research more productive and cost-efficient. Some scientific problems are so complex they require a vast amount of research, and there are simply not enough human scientists to do it all. The goal for a robot scientist is to combine technologies to automate the entire scientific process: forming hypotheses, devising and carrying out experiments to test those hypotheses, interpreting the results and repeating the cycle until new knowledge is found.

Adam Takes on Yeast

Our robot, Adam, is not humanoid; it is a complex, automated lab that would fill a small office cubicle. The equipment includes a freezer, three liquid-handling robots, three robotic arms, three incubators, a centrifuge, and more, every piece of it automated. Of course, Adam also has a powerful computational brain—a computer that **does the reasoning** and controls the personal computers that operate the hardware.

Adam experiments on how microbes grow, by selecting microbial strains and growth media, then observing how the strains grow in the media over several days. The robot can initiate about 1,000 strain-media combinations a day all on its own. The first full study was on the yeast *Saccharomyces cerevisiae*—the organism used to make bread, beer, wine and whiskey. Adam focused on understanding the unsolved problem of how yeast uses enzymes—complex proteins that catalyze particular biochemical reactions—to convert its growth medium into more yeast and waste products.

To be able to discover some novel science, Adam needs to know a lot of existing science. We programmed Adam with extensive background knowledge about yeast metabolism and the functional genomics of yeast.

Reasoning about Genes

When scientists follow the scientific method, they form hypotheses and then experimentally test the deductive consequences of those hypotheses. In this manner, Adam first hypothesizes new facts about yeast biology, then deduces the experimental consequences of the facts using its model of metabolism. Next Adam experimentally tests the consequences to see if the hypothesized facts **are consistent with** the observations.

To test its hypotheses, Adam conducted numerous physical experiments. It grew certain yeast strains selected from a complete collection in its freezer, where each strain has a specific gene removed. The next step would be to experiment on the strains. To achieve this goal, Adam assumes that every hypothesis has a probability of being true. Most working scientists tacitly assume that certain types of hypotheses are more likely **to prove true** than others. For example, they generally follow the notion of "Occam's razor"—that all else being equal, a simpler hypothesis is more probable than a complex one.

Given a set of hypotheses with associated probabilities and a set of possible experiments with associated costs, the goal we set for Adam is to choose a series of experiments that minimizes the expected cost of **eliminating all but one hypothesis**. Pursuing this approach optimally is

computationally very difficult, but our analyses have shown that Adam's approximate strategy selects experiments that solve problems more cheaply and quickly than other strategies, such as simply choosing the cheapest experiment. In some cases, Adam can design one experiment that can **shed light on** many hypotheses. Human scientists struggle to do the same; they tend to consider one hypothesis at a time.

20 Hypotheses, 12 Novel

Once Adam's artificial-intelligence system homes in on the most promising experiments, Adam uses its robotics to carry them out and observe the results. Adam cannot directly observe genes or enzymes; its observations consist only of how much light shines through cultures of yeast. From these data, through a complicated chain of reasoning, Adam **infers** whether or not the evidence is consistent with hypotheses about genes and enzymes. Such chains of reasoning are typical of science; astronomers, for example, infer what is happening in distant galaxies from the radiation they observe in their instruments. Deciding on **the consistency of hypotheses** was one of the most difficult tasks for Adam. Adam generated and experimentally confirmed 20 hypotheses about which genes encode specific enzymes in yeast. We determined that seven of Adam's conclusions were already known, one appeared wrong and 12 were novel to science.

Is the Robot a Scientist?

Some people **object to** the term "robot scientist," pointing out, with some justification, that Adam resembles more of an assistant than an independent scientist. We cannot simply set up Adam and come back several weeks later to examine its conclusions. Adam is a prototype, and its hardware and software often break down, requiring a technician. Integrating Adam's software modules also needs to be improved so that they work together seamlessly without some human interaction. Adam's process of hypothesizing and experimentally confirming new knowledge, however, does not depend on human intellectual or physical effort.

How novel is Adam's science?

Some of the mappings between genes and enzyme functions in *S. cerevisiae* that Adam has hypothesized and experimentally confirmed are certainly novel. Although this **knowledge is modest**, it is not trivial. Of course, some of Adam's conclusions could be wrong; all scientific knowledge **is provisional.** Yet it seems unlikely that all the conclusions are wrong.

Another way of assessing whether Adam is a scientist is whether Adam's approach to generating novel hypotheses is generalizable. Once Adam was off running experiments, we began developing a second robot. Eve applies the same automated cycles of research to drug screening and design, an important medical and commercial pursuit. Eve's research is focused on malaria, sleeping sickness and Chagas disease. We are still developing Eve's software, but the robot has already found some interesting compounds that show promise of being active against malaria.

Human Partners

If we accept that robots can be scientists, we would like to know their limits. Comparing the task of automating science with automating chess is instructive. Automating chess is essentially a solved problem. Computers play chess as well or better than the best humans and make strikingly beautiful moves. Computer mastery is possible because chess is a bounded, abstract world: 64 squares, 32 pieces. Science shares much of the abstract nature of chess, but automating science will be harder because experimentation takes place in the physical world. However, developing robot scientists capable of performing quality science will probably be easier than developing artificial-intelligence systems that can socially interact with humans. In science it is safe to assume that the physical world is not trying to deceive you, whereas that is not true in society.

Whether these creations will ever be capable of paradigm-shifting insights or be limited to routine scientific inquiries is a key question about the future of science. Some leading scientists, such as physics Nobel laureate Philip Anderson, argue that paradigm-shifting science is so profound that it may not be accessible to automation. But another physics Nobel laureate, Frank Wilczek, has written that in 100 years the best physicist will be a machine. Time will tell who is correct.

Either way, I see a future where networks of human and robot scientists will collaborate. Scientific knowledge will be described using logic and **disseminated instantaneously** using the Web. The robots will gradually assume an ever greater role in the advancement of science.

Scientific American, January 1, 2011

Ex.13a **Answer the questions:**

1. What steps of the scientific investigation/method are presented in the article? Support your answer with the text.
2. What were the reasons for the experiment?
3. What does robot Adam look like?
4. What did Adam study?
5. How does Adam infer whether or not the evidence is consistent with the hypotheses about genes and enzymes?
6. What was the result of Adam's investigation?
7. Is it legitimate to claim that Adam autonomously discovered new scientific knowledge?
8. How novel is Adam's science?
9. Why is automating science harder than automating chess?
10. What are the points of view of leading scientists?
11. Which one do you support?
12. What is the author's conclusion?

Ex. 13b Explain the expressions in bold given in the text **Rise of the Robo Scientists**

Ex. 13c Do you know about any other Robo Scientists? Has progress been made since 2011? Use the Internet to find out.

Ex. 14 The -ing form can be used as the subject of a sentence. For example:

Understanding this phenomenon is important for many reasons.
Restoring devastated mangrove forests has proven difficult.

Reread the first paragraph of *'Human Partners'* in the article above and find all the cases of using the -ing form as the subject.

Grammar

Should in that-clauses; the present subjunctive

1. We can sometimes report advice, orders, requests, suggestions, etc. about things that need to be done or are desirable using a that-clause with should + bare infinitive:

Society demands that physicists should solve the problem of disposal of radioactive substances.
Stabilization of the Earth climate demands that emissions of greenhouse gases should be cut significantly.
We insist that the data should be available to all students.

2. In formal contexts, particularly in written English, we can often leave out should and use only the base form of the verb (that is, the form you would look up in a dictionary). This form is the present subjunctive:
Society demands that physicists solve the problem of disposal of radioactive substances.
Stabilization of the Earth climate demands that emissions of greenhouse gases be cut significantly.
We insist that the data be available to all students.
Other verbs used with the present subjunctive: advise, ask, beg, command, instruct, intend, order, prefer, recommend, request, require, suggest, urge, warn.

3. To make a negative form, we use **not** (not 'do not') before the verb:
We advised that the company not raise its prices.

4. We can also use should sometimes the subjunctive after it + be + adjective:
It is inappropriate that he (should) receive the award again.
Also: advisable, appropriate, crucial, essential, important, obligatory, (un)necessary, urgent, vital

Ex. 15 **Study the model and complete the sentences.**

Verbs: -require/ demand -propose/ suggest -desire/ wish -advise/ recommend -insist/ urge -order/ ask, etc. Adjectives: necessary important desirable advisable (im)probable possible urgent	that	sb sth	(should)	do/ be not do/ be be done have done

1.I suggest that they (have) a break. 2. In this letter to the President of the Academy Prof. Pavlov recommends that measures (take) to promote the applications of scientific results. 3. In the same letter he suggests that the number of specialized scientific journals (increase). 4. He also recommends that some newer scientific investigations (include) in the textbooks. 5. Modern research requires that a scientist should (inform) about the main investigations in adjacent fields. 6. Numerous applications of electronic devices demand that they (be) more easily maintained. 7. He insisted that the problem should (discuss) immediately. 8. They proposed that the new results (include) in the article. 9. There is an increasing demand that laboratory instruments (be) more reliable, more manageable and less costly. 10. Our suggestion is that representatives of all branches of science (invite) to work in the committee.

Ex.16 **Complete the sentences using *should*.**

1.It is essential that this matter (keep) secret. 2. It is not fair that he (award) for the results obtained. 3. It is necessary that a research institute (bring together) representatives of interrelated areas. 4. It is important that applied research (carry on) in cooperation with industrial engineers. 5. It is desirable that cooperation among research centers (encourage). 6. It is essential that fundamental research (receive) adequate attention. 7. It is essential that the beginner (introduce) to the fundamentals of science. 8. Many participants insist that this discussion (cover) all the points. 9. The experiment requires that the material (preheat).

10. The participants suggest that the reports left over from yesterday's session (deliver) today.

Ex. 17 **Read the following sentences without *should*.**

1. The demand is that all measurements should be made accurately.
2. Scientists insisted that the experiment with liquid fuel rockets should be continued.
3. We suggest that you should give another definition.
4. Lev Landau suggested that the theory of electromagnetic field should be stated in terms of variation principles for the latter formulations.
5. We will require that an element should always be a member of some set, and all sets under discussion should be subsets of some given set.
6. I request that you should look through the obtained data thoroughly.

Ex.18 **Imagine that you are writing a formal letter to the director of your institute. What would you suggest or recommend in order to improve the research process of students?**

Student 1: I suggest that the students' grants should be increased.

Student 2: I propose that measures should be taken to promote the publication of graduates' papers.

UNIT 5. Research institute

1. **Read the text and focus on the last sentence. How would you answer this question?**

Key attributes of successful research institutes

When scientists start working at a research institute, they quickly realize that they are not just inside the bubble of their own laboratory, but are part of a bigger ecosystem. In the words of John Donne, "no man is an island," and this rings true of scientists and research groups as well. The culture of a research institute, its scientific standards, its social cohesion, and its funding framework are critical to its research output. But what are the key ingredients for a thriving institute?

Research institutes across the globe have put considerable efforts into building environments that facilitate the conception and exploitation of novel scientific ideas. A critical aspect of these environments is educational: throughout their careers, scientists continuously learn from each other by emulation, discussion, collaboration, and competition. This reflects the proverb that states "it takes a village to raise a child." A research institute provides exactly this. It is the whole village—with all its constituent residents—in which scientists develop, formulate, and pursue their ideas, but also from which they emerge to join other scientific communities worldwide.

Research institutes occupy a specific niche in the larger research ecosystem. Their success can be measured by scientific contributions in the form of novel ideas, publication output, and grant funding. Furthermore, success is assessed not by shareholders but primarily by other scientists, both in a broad community sense and in terms of advisory boards, funding bodies, and so on. Other measures of success include the satisfaction levels of staff and trainees, their career development to go on to contribute to society in research or other venues, and commercial impact, for example.

Thus, a key question is how to incubate an inspirational research culture where productivity, ambition, and high-quality science are encouraged in a balanced, supportive, and inclusive way. While scientific output is generally perceived as the result of work by bench research scientists alone, there are multiple structures within a research institute involved in research delivery, and thus everyone in an institute is part of the research mission and should be recognized for their contributions. What are the ingredients required to craft a successful, collaborative, supportive, and thriving research environment?

Adapted from https://pmc.ncbi.nlm.nih.gov/articles/PMC10479891/#sec002

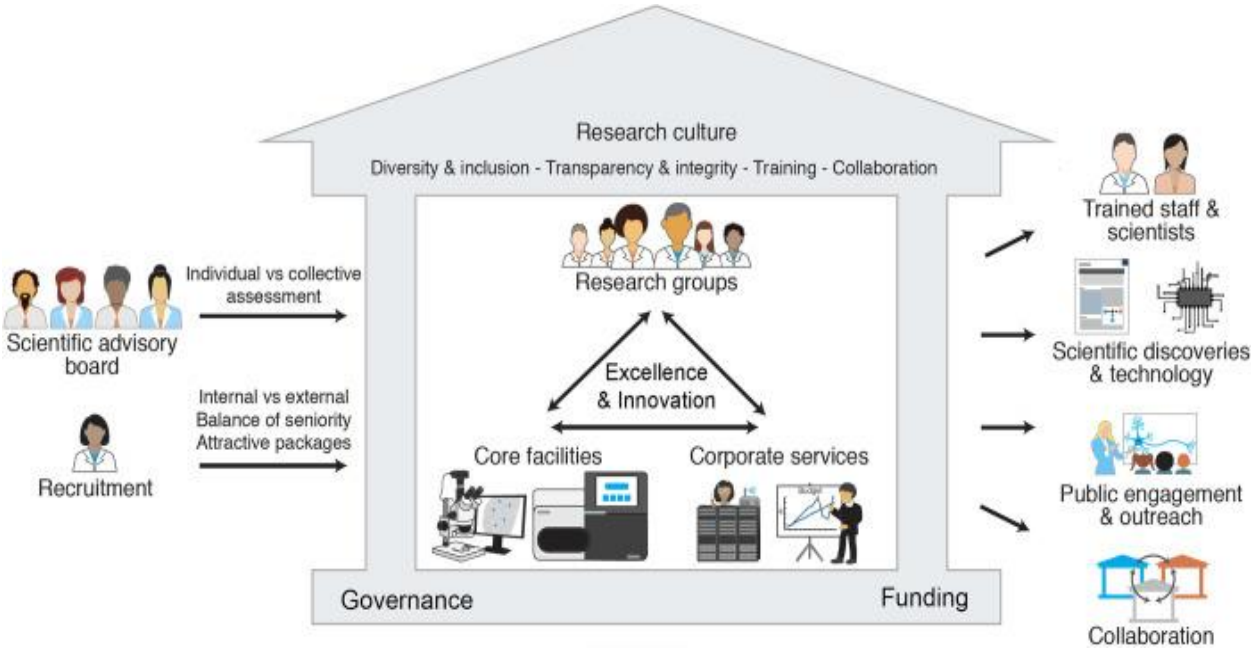
2. **The authors of the text suggest their own point of view on the key ingredients of a successful research institute. They present their ideas in the table. Some of the key points are mixed (in bold). Try to put them in the correct place.**

Organizational component	**Key ingredients**
Funding review process	• Individual principal investigator-based review or collective (e.g., departmental) reviews depending on the institute

	• A carefully appointed scientific advisory board • A transparent and clear process
Administration and corporate services	• Proactive service mindset, customer-friendly • Fast turnaround and agility • Transparency in performance • Buy in to the institute's vision • Clear two-way communication channels **• Culture of allowing mistakes**
Core facilities	• Proactive and transparent user data distribution **• Train scientists at all levels across the institute** • Rapid training • Equipment shared across the institute • Fair governance • Commitment to career pathways, acknowledgement in papers
Technology transfer and innovation teams	Management of intellectual property, external partnerships, and patents • Legal and business counsel • Promotion of entrepreneurship in researchers **• Review process designed to promote collaboration and interdisciplinarity**
Training	• Train scientists at all levels across the institute • Research methods and cutting edge techniques • Holistic skills: communication, research management, leadership, etc.
Faculty recruitment	• Transparency **• Promote collaboration and creativity by fostering an open research culture (e.g., open seminars with unpublished work, retreats, funding mechanisms that promote collaboration)** • Internal or external recruitment processes (and measures that counterbalance any potential negative consequences) • Attractive packages • Long-term versus short-term considerations • Distribution of experience
Institute culture	• Transparency in operations and management/governance, recruitment, packages, salary, space, and platform access • Provide training at all levels: scientific as well as communication and leadership

	• Enable people to call out bad behavior (e.g., bullying, scientific fraud), with clear escalation routes and consequences, even for highest levels of management • Build diversity in the workforce at all levels based on merit • Supporting needs of diverse groups (parents, religious groups, individuals with disabilities, etc.) in order to build truly inclusive environment • Senior leadership buy-in to demonstrate commitment from the top

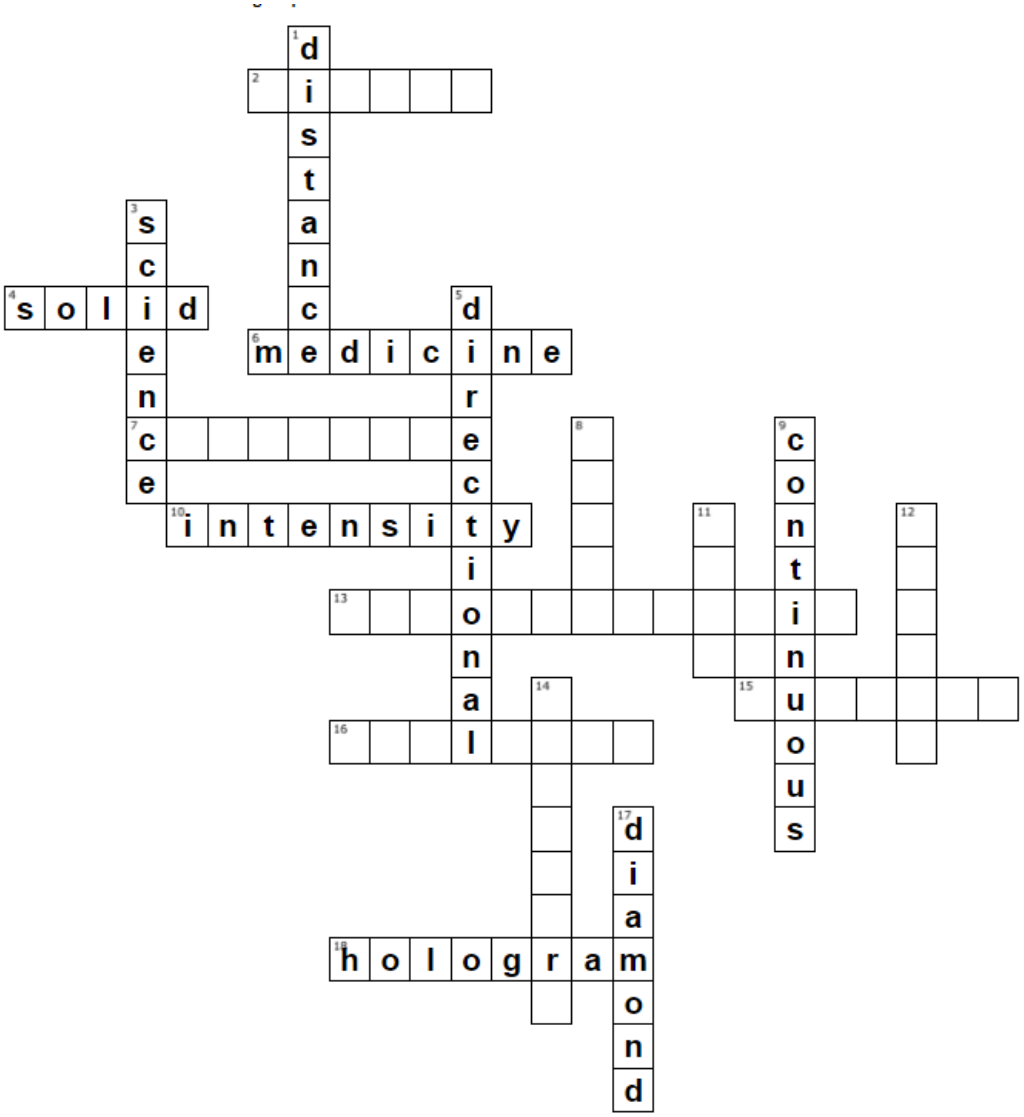
3. **Describe this scheme. Do you agree with what is presented in the picture? Why (not)? What would you change?**



Can you say the same things about your institute? Is there anything to improve?

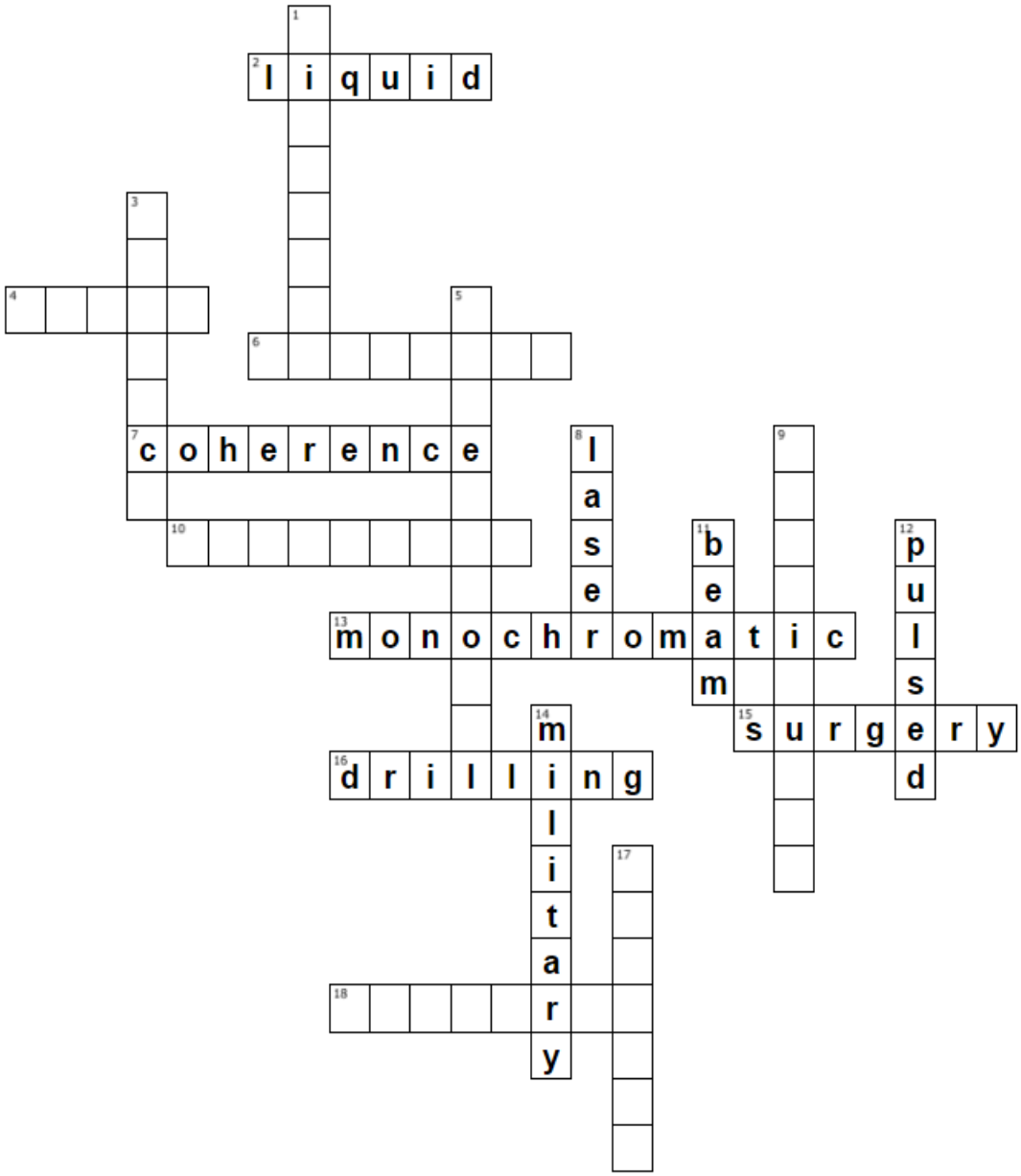
Appendix

Student A



Word List

Across		Down	
4. solid	**6.** medicine	**1.** distance	**3.** science
10. intensity	**18.** hologram	**5.** directional	**9.** continuous
		17. diamond	



Word List

Across		Down	
2. liquid	**7.** coherence	**8.** laser	**11.** beam
13. monochromatic	**15.** surgery	**12.** pulsed	**14.** military
16. drilling			

Student B

Supplementary material

Use the following plan to talk about the institute and laboratory where you have your practical training.

Research institute and laboratory.

1. Foundation date, the head
2. Location.
3. Scientific directions / the main research interests of the Institute.
4. Structure (departments, laboratories).
5. Research equipment available at your Institute.
6. Laboratory you work in (research subjects, lab equipment, the head of the lab, your supervisor, the staff).
7. Institute's main research achievements.
8. Institute's collaboration network.
9. Competitors of the Institute.
10. Publication activity.
11. Conferences, symposia, workshops organized by the Institute.
12. Position in the national and international rankings (citation, h-index of the institute according to WoS).
13. National and international reputation of the Institute.
14. Institute-supported start-ups.
15. Educational profile of the Institute (universities' chairs, supervision of bachelor's and master's degree projects, outreach activity).
16. Your motivation to join this Institute.

Current progress in my field of study.

Which three results impressed you the most, why?

Use the following ideas to compare three studies on the topic of your current scientific research.

1. **The title and research area.**
2. **The authors of the paper.** Which universities are the authors from? Are there any prominent scientists among the authors?
3. **A brief summary of the results.** How relevant are they to your scientific project?
4. **Key strengths of the paper.** Where does the value of the paper lie?
5. **Key weaknesses of the paper.** What would you do differently?

6. **The significance of the paper.** Does it demonstrate a fresh approach, new methods and innovative ideas? Does it describe a well-designed technology? Is it well-cited?

Requirements for the presentation

1. Maximum of 10 slides
2. Comparison tables (similarity, difference)
3. Minimum of 3 parameters to compare (e.g. methods, figures, theory, experimental parts, results, other parameters)
4. Conclusion slide

Writing in class

A brief analysis of research

1. The author, the title. What research questions or hypotheses are being addressed in the article? Are the questions relevant?
2. What kind of evidence (method, experiment) was collected to explore the research questions? Is there any evidence that could or should have been collected and included but was not? How good is the evidence? How well does the evidence support the conclusions? (Pluses and minuses). Are the author's conclusions valid or plausible based on the evidence? Why or why not?
3. Significance and ramifications of the findings. Recommendations for further research.

Requirements:

1. 200 words
2. No quotations, citations and rhetorical questions
3. No copies of either full sentences or parts of sentences
4. Style: either **highly formal** or somewhere **between formal and informal** (using *I have found, from my experience, I would argue, I can understand, I recommend, in my opinion* etc. ~~you, we~~)