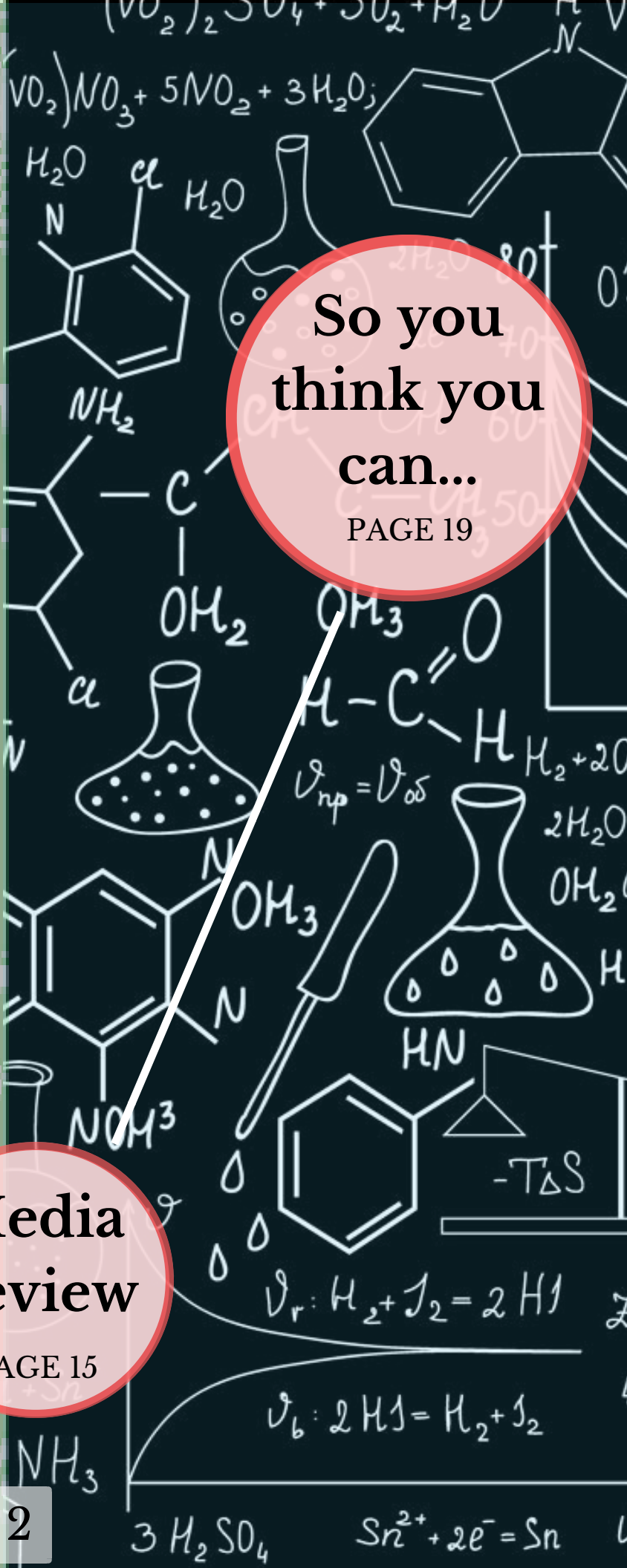
Vol. 1 No.1
David Cho
April 2018

Practical Science

The Monthly Journal of Biotech

Content

Outline



The Editorial

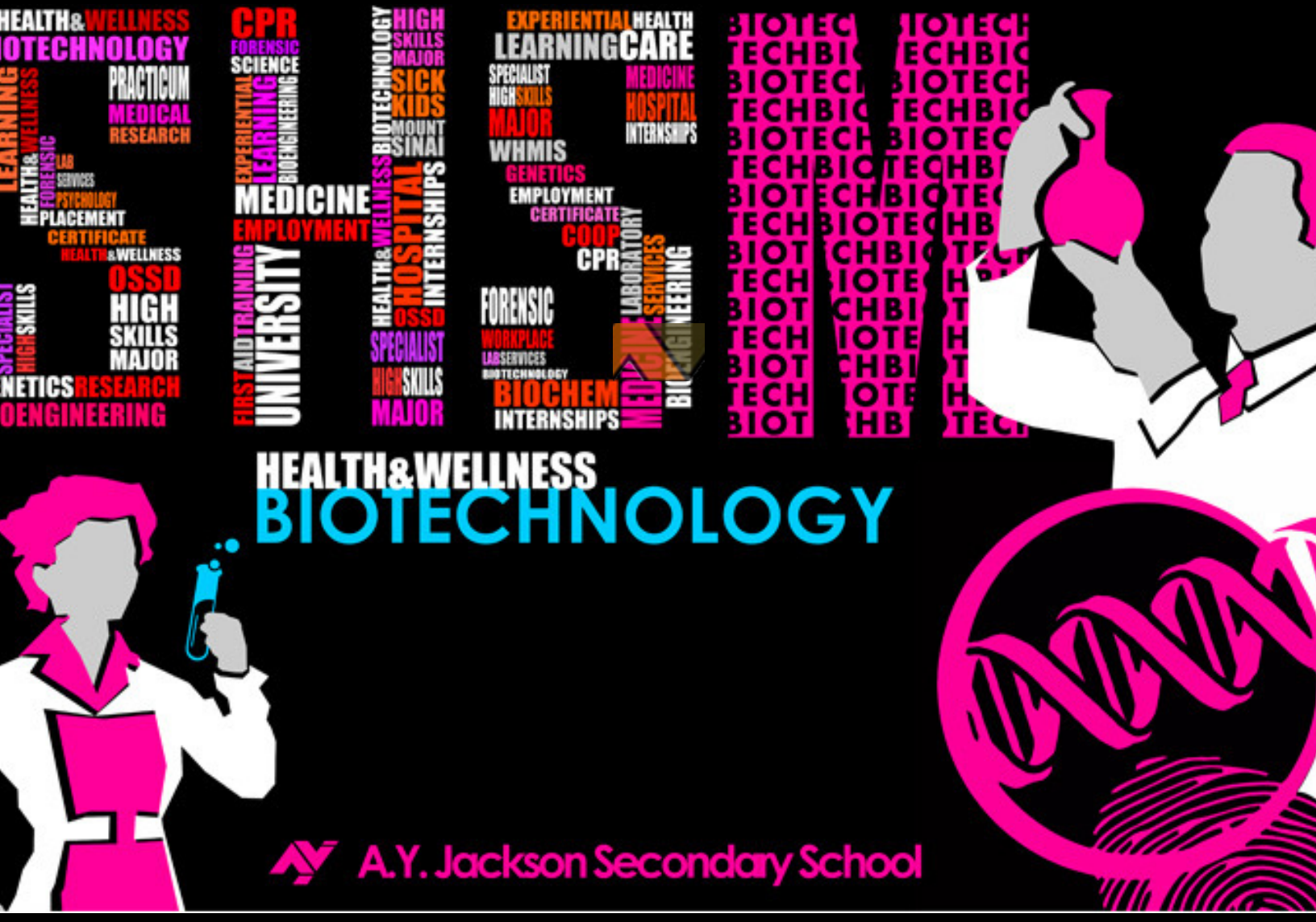
Over the past month, I have been given the privilege of bringing together the first volume of Practical Science. Practical Science is a magazine that is recommended to all science admirers. The first issue covers the topic of Molecular Biology, Evolution, Forensics, and Genetic Cloning. We managed to bring together notable featuring of Barry Allen and Hikaru Katsurou. We hope that these individuals and activities within the magazine will help further your interest in science. Best wishes

-David Cho

Contributions

- Mr Chung
- A.Y. Jackson Secondary School
- Biotechnology SHSM
- Google
- Peers of Biotechnology class
- TDSB

IMMERSE IN SCIENCE THROUGH BIOTECHNOLOGY SHSM



FIND MORE INFORMATION AT
HTTP://SHSM.AYJSCIENCE.CA/

Feature Article

DATE March 19, 2018

AUTHOR David Cho

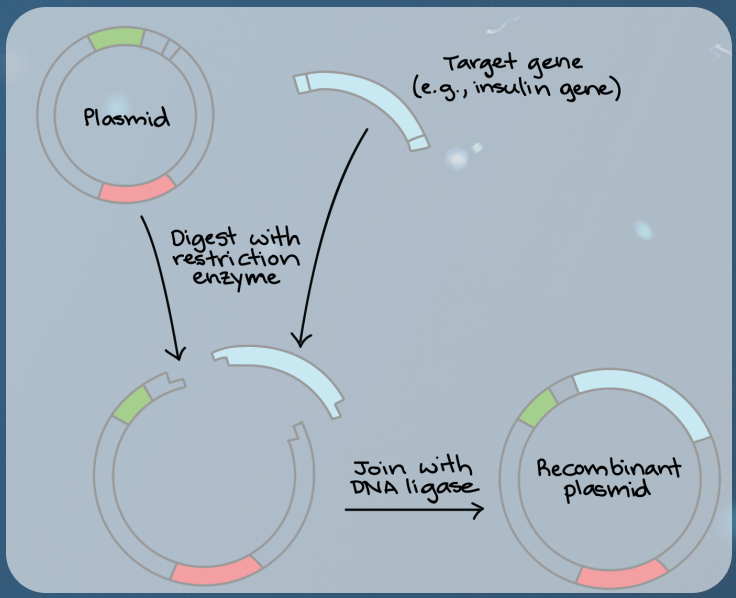
"Understanding Gene Cloning"

WHAT IS GENE CLONING?

Cloning is a technique in molecular biology that involves in producing identical copies of genes. There are several techniques in cloning, and one of the most typical methods is vector cloning. In this procedure, the gene of interest is separated from the donor cell and inserted as a foreign gene into a plasmid. The process of insertion is completed by enzymes which form a recombinant DNA. Restriction enzymes are responsible for cutting at the specific target sequence. Then, the cut sequence of DNA will be added to the plasmid. The sequences of DNA will then be sealed together through the enzyme, DNA ligase. When the process is completed, a recombinant plasmid is formed. The plasmid is then reintroduced as a vector into the bacteria. The process of where the plasmid is reintroduced is called transformation.

During transformation, the cells are put into different conditions such as high temperature, which helps the cell to take up that foreign genetic information. Within cloning, different types of genes can be introduced such as an antibiotic resistance gene. If an antibiotic resistance gene is introduced into the foreign gene, cells with the recombinant plasmids are put onto different plates containing antibiotic. Cells without the plasmid and the gene of interest will die and contrarily, cells that contain the gene of interest will live and reproduce.

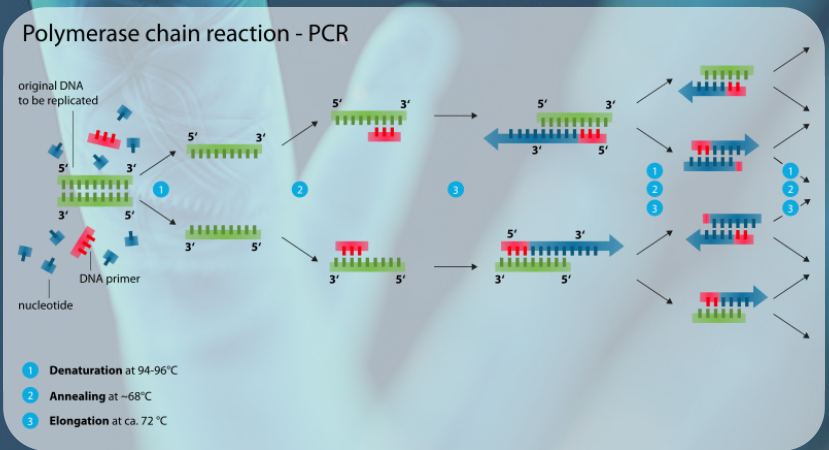
One of the biggest misconceptions behind cloning is that cloning with a result of carbon copies of the originals. The misconception is often brought up by the cloning of animals, such as Dolly the sheep. Clones are not carbon copies, but genetically identical copies of organisms. For example, through a method called somatic cell nuclear transplant, a nucleus of a somatic cell is used in place of the nucleus of an egg. The nucleus of the somatic cell is then stimulated to form a blastocyst, a structure formed in the development of embryos. The somatic cell contains the genetic material and is replicated by means of cloning. While the donor and the clone will have the same genotype, they will not necessarily have the same phenotype. Cloning cannot also transfer memories or experiences. Cloning will still result in distinct individuals that only contain the same genotype.



After a bacterial colony with the gene of interest is formed, a chemical signal can be used to make protein. The bacteria would transcribe the gene of interest and translate the mRNA to produce the protein with the gene of interest. Once the protein is translated, it can be separated and purified. Once separated and purified, that protein containing the gene of interest can be used in experiments or can be administered as medicine.

There are other techniques of DNA cloning that can be faster and more efficient than vector cloning. Within vector cloning, time and precision are required as there are many different types of vectors. There are 6 major types of vectors. These vectors are plasmids, phages, cosmids, bacterial artificial chromosomes, human artificial chromosomes, and yeast artificial chromosomes. Another technique of DNA cloning is polymerase chain reaction (PCR).

PCR is a method that was conceptualized in 1983 by Kary Mullis. PCR uses a machine that can amplify a single copy of a gene into millions of copies. PCR revolves around DNA amplification which is a process of producing large quantities of DNA from a sample. Unlike vector cloning, PCR does not rely on the production of recombinant DNA. In the process of amplification, the temperature is raised at certain points for different purposes. At first, the temperature is raised to 55 degrees Celsius. At this temperature, the DNA is denatured into single strands. The DNA is cooled for the primers to be annealed to the denatured strands. The temperature is then raised to 72 degrees Celsius for Taq Polymerase to synthesize the DNA strand by adding free nucleotides from the ends of the primers. Then the cycle is repeated and more copies and made.



There are many purposes in DNA cloning, which include experimental purposes and medicinal purposes as mentioned earlier. Within the industry of DNA cloning, three main purpose involves biopharmaceutics, gene therapy, and gene analysis. As biopharmaceutics, DNA cloning makes proteins that can be administered to patients that lack that gene of interest. As gene therapy, genes of interest aid with patients that lack properly functioning forms of the gene. The final purpose is gene analysis, which involves research and analysis of genes and recombinant versions of it.

When Dolly the Sheep was first cloned in 1997, the focus turned to the prospect of human cloning. The possibility of human cloning could open up to research, reproductive, and organ farming purposes. Cloning and biotechnology introduced new controversial arguments which assisted in the bioethics of cloning. The obvious ethical issue on human cloning includes the safety of the procedure and the effects. Advocates of human cloning believe that therapeutic cloning could open up to medicines for regeneration and drugs to trigger immune systems. Research and developments could also treat serious diseases and aid in skin treatments. However, there are ethical objections present to human therapeutic cloning. From Article 11 of UNESCO's Universal Declaration on the Human Genome and Human Rights, it states that reproductive cloning opposes human dignity and there is a possibility that cloned individuals would be flawed or damaged. Even though there are set regulations and ethics, technology and science will continue to advance for a greater possibility of safe and ethical therapeutic cloning.

Reference:
Cloning. (n.d.). Retrieved March 20, 2018, from https://cbhd.org/category/issues/cloning

Cloning & Transgenesis. (n.d.). Retrieved March 20, 2018, from https://www.omicsonline.org/scholarly/gene-cloning-dna-cloning-journals-articles-ppts-list.php

Khan, S. (n.d.). Overview: DNA cloning. Retrieved March 20, 2018, from https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/a/overview-dna-cloning

Khan, S. (n.d.). Polymerase chain reaction (PCR). Retrieved March 20, 2018, from https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-sequencing-pcr-electrophoresis/a/polymerase-chain-reaction-pcr

Murnaghan, I. (n.d.). Therapeutic Cloning. Retrieved March 20, 2018, from http://www.explorestemcells.co.uk/therapeuticcloning.html

Pierce, J., et.al. (2018, March 09). Cloning. Retrieved March 20, 2018, from https://www.nytimes.com/topic/subject/cloning

Phillips, T. (2017, October 16). Learn How Vectors Are Used in Gene Cloning to Create GMOs. Retrieved March 20, 2018, from https://www.thebalance.com/gene-cloning-and-vectors-definition-and-major-types-375681

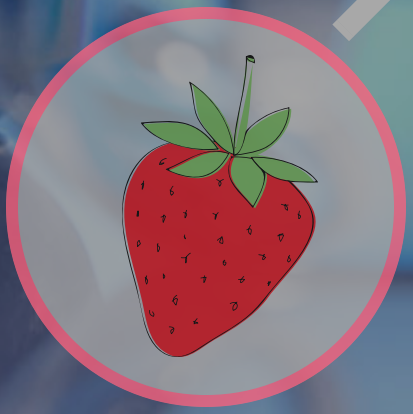
DIY Mini Lab

Strawberry DNA Extraction

MATERIALS

- Strawberry
- Detergent (10 ml)
- Table Salt (¼ teaspoon)
- Coffee filter
- Water (90 ml)
- Zip-lock bag (x1)
- Beaker (x2)
- Isopropyl alcohol (5 ml)

PROCEDURE



Put a strawberry into a zip-lock bag and seal it. Crush and mash the strawberry into strawberry pulp.

Collect 90 ml of water into a beaker
Add 10 ml of detergent into the water
Stir one-fourth teaspoon of salt into the beaker containing the water and detergent. This is now called the extraction solution.
Add the extraction solution into the zip-lock bag and mix it with the strawberry pulp.

Add 5 ml of isopropyl alcohol to the beaker.

Observe and wait for the DNA precipitate.

Then pour the mixed solution into a beaker through a coffee filter. Wait for the liquid to settle into the beaker.

Ask the Expert

Hikaru Katsurou: DNA

Get to know Hikaru Katsurou: Katsurou was born in Kyoto, Japan. From an early age, Katsurou was different from his peers as he found fun during his leisure by observing different colourization of flowers and butterflies. In his early youth, Katsurou spent a lot of time in his mother's laboratory, where he continued to hone his interest in the study of life. Katsurou also travelled to many wonders of the world with his father and noted that this helped him further his love for biology. Soon after excelling his high school education, he continued his education at the prestige University of Tokyo. He then got his PhD, doctoral degree of genetics and genomics at Harvard University. Very shortly after, Katsurou started teaching his own class at Massachusetts Institute of Technology. Currently, Katsurou and his Japan-based research team are now researching on cancer cells.

Q. What is the difference between transcription and translation? What are their processes?

A. To start off with, transcription and translation are both processes in which the DNA genetic code is converted into protein. However, transcription and translation have different roles in the overall process that can be very distinguishable.

Transcription, in summary, is the first process of where the genetic information which is stored in the DNA, is copied and synthesized onto the mRNA or the messenger RNA. In transcription, there are 3 stages. These three stages are called, 'Initiation, Elongation, and Termination'. Before transcription occurs, an enzyme called RNA polymerase II, first separates DNA strands and bonds RNA nucleotides with appropriate base pairs along the DNA template. Transcription then occurs starting off with the Initiation Stage. In the Initiation Stage, the promoter sequence is the binding site of RNA polymerase and the site where transcription begins. The promoter binds to additional transcription factors to create RNA polymerase II. The entire process creates the Transcription Initiation Complex. Within the RNA polymerase, Elongation takes place. As RNA polymerase unwinds the double helix, nucleotides are added to the DNA template, and the double helix reforms while the RNA molecule is peeled away. Transcription ends as the RNA polymerase reaches the terminator sequence.

In translation, the mRNA molecules formed are then decoded by the ribosome. Before translation occurs, the mRNA strands exit the nucleus through pores. The ribosomes then read the RNA code and synthesize polypeptide chains, which are sequences of amino acids. The polypeptide can then be formed into different levels of the structure of the protein. The tertiary or quaternary protein structures are the final product of protein.

Q. What information from the history of genetics is still very applicable?

A. It is very important to look back at the works of Gregor Mendel and recognize that his efforts have that brought us to where we are. Through Mendel, patterns of genetic inheritance was understood and helped future investigations. This made biologists realize that there was more to the idea of inheritance. This soon led to the age of DNA and the age of the genome, where elements like the structure of the double helix was discovered by James Watson, Francis Crick, and Rosalind Franklin. I believe one of the turning points in molecular biology and genomics is through the study of Hershey and Chase. Hershey and Chase performed an experiment using bacteriophage and bacteria. They realized that when bacteriophages, which are made up of DNA and protein, infects and takes over bacteria, only DNA traces, with no protein were found within the host bacteria. However, even to this current age, there are still many unanswered questions concerning genetics. As technology advances, we hope that the knowledge of science can be more deeply understood.

Q. Could you give us some insight on the origins of DNA?

A. As I said previously, there are many unanswered questions and this is an example of one of them. One theory behind the origin of DNA is that RNA was the molecule that was first formed around 4 billion years ago. Then through its first structures, evolved into RNA and DNA molecules.

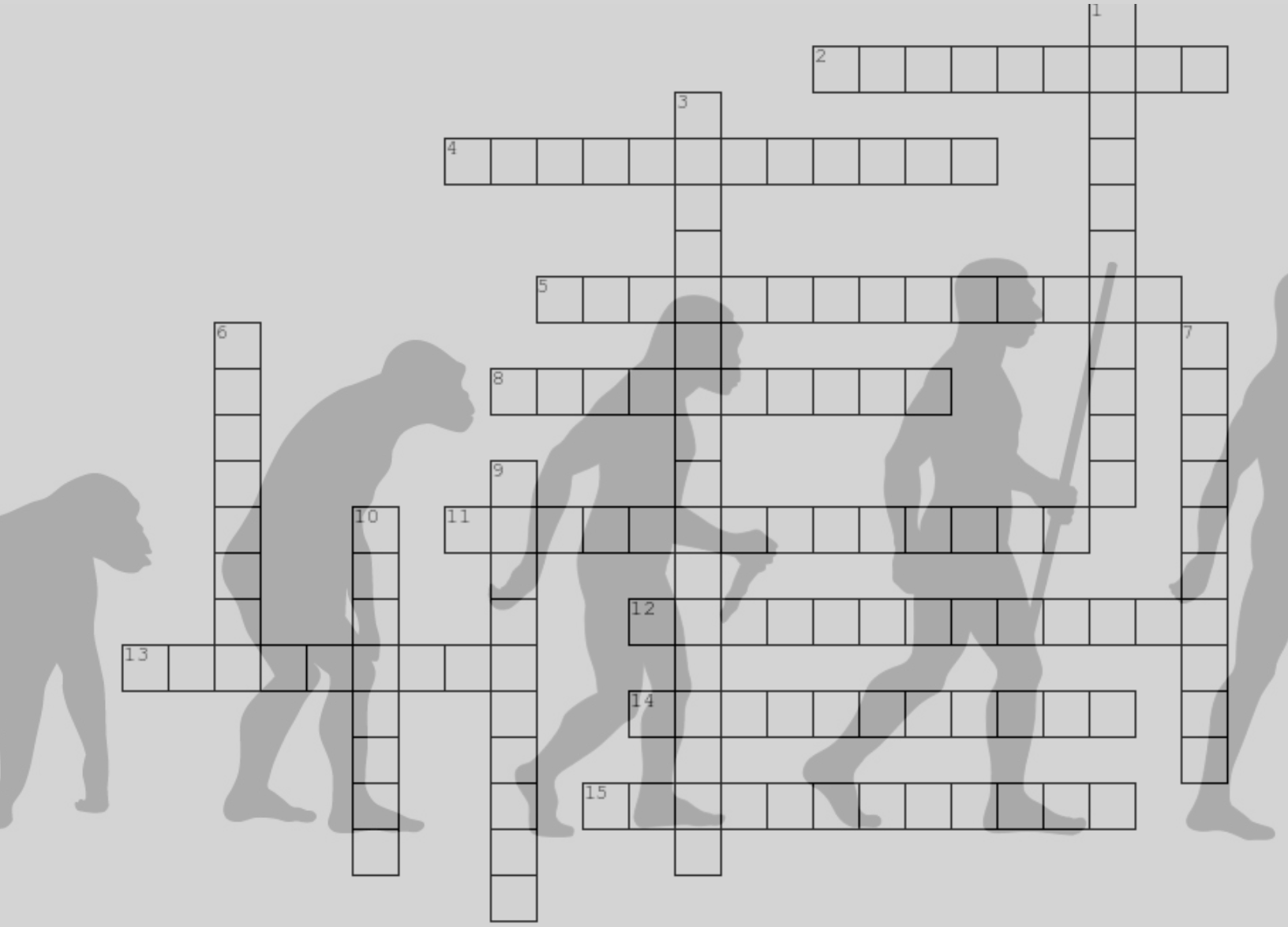
Q. What makes the structure of Amino Acids so significant?
Why are Amino Acids called the building blocks of life?

A. Before making any reference to amino acids, it is very important to note that the structure of any molecules relate to their function as well. To start off, the basic structure or an amino acid contains a central carbon, a carboxyl group, an amine group and a side chain. At the side chains, different functional groups can be added, forming different structures. These various structures create codons from the amino acids. Amino acids with different structural groups can be categorized based on their functions. Some of their functions include: the ability to catalyze chemical reactions, structural support, transporting, contractions, regulating hormones, and protectivity. Then the 20 different types of amino acids form a chain into a primary polypeptide structure through dehydration synthesis. With all this said, it is now easier to explain why amino acids are called the building blocks of life. As we can see, proteins are completely made up of amino acids, and proteins maintain almost all reactions that occur in the body. These include neurotransmitters, hormones, and heart and muscles, which are all mostly composed of amino acids. Finally, both DNA and RNA must have amino acids for it to function properly.

Q. Why is DNA isolation important? What are the processes in DNA extraction?

A. To be able to extract DNA gives many opportunities for the advancement of science, ranging from the development of medication to the study of pathology. It also helps with studies for curing genetic diseases, sequencing genomes, and identifying virus and bacteria. In eukaryotic cells, DNA is arranged as chromosomes in the nucleus. What DNA isolation does, is it extracts the DNA from the cell and separates it from other fluids and proteins. In DNA extraction, there are three basic processes: Lysis, Precipitation, and Purification. In the Lysis step, DNA is released from the broken nucleus. This can be done through mechanical means by using a tissue homogenizer or a mortar and pestle. It also can be done using enzymes that dissolve proteins to separate the DNA. After lysis is completed, DNA will be assorted with different cell parts. Using precipitation, DNA can be separated. Through the final step, purification, DNA can be rinsed and purified with alcohol to remove debris and unwanted wastes.

EVOLUTION CROSSWORD



Across

2. first principle of evolution
4. second principle of evolution
5. originator of the theory of evolution
8. structures anatomically similar to common ancestors
11. when small population settles away from rest of the population
12. change in allele frequency by random chance
13. set of genetic information
14. selection that favours both extremes
15. an isolation of difference in location which prevents reproduction

Down

1. selection that favours only one extreme
3. key mechanism in evolution
6. changes in DNA sequence
7. selection that favours the average
9. when a population is reduced in size to at least one generation
10. an isolation of difference in season which prevents reproduction

ANSWERS ON PG 13

Mission Statement

The mission of HOSA Canada is to enable secondary and postsecondary students to **become leaders in the healthcare industry** by providing future health professionals with knowledge, technical training and leadership development.

Why Join HOSA

Networking

National and international conferences give students the opportunity to network with like-minded individuals as well as a variety of medical professionals

Relevant Skills

HOSA members gain hands-on experience performing the same procedures carried out by health professionals on a daily basis

Experience

Our fondest high school memories are seldom of us sitting in class. There's nothing like the feeling of being on stage in front of thousands of your peers

Career Exploration

HOSA Canada offers 41 health science events, each focusing on a different area of health science, ranging from medical photography to pharmacology

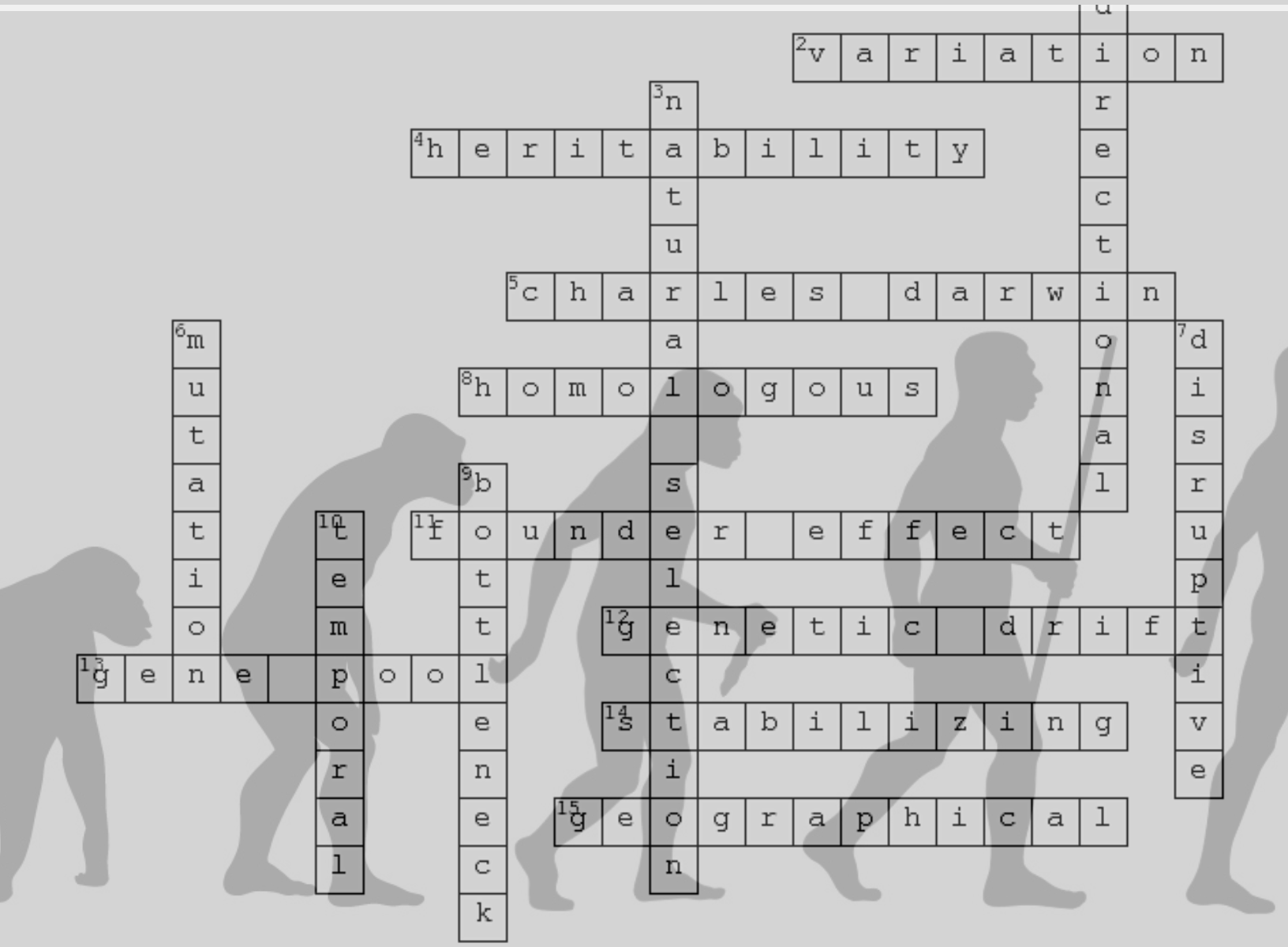
Personal Development

Immersed in a highly competitive environment, students learn first hand the value of preparation, hard work and time management

Extracurricular Involvement

Students want more than just good marks. They want to make a difference in their community and know that they are making a difference in the world

CROSSWORD ANSWERS



Across

2. first principle of evolution (**variation**)
4. second principle of evolution (**heritability**)
5. originator of the theory of evolution (**charles darwin**)
8. structures anatomically similar to common ancestors (**homologous**)
11. when small population settles away from rest of the population (**founder effect**)
12. change in allele frequency by random chance (**genetic drift**)
13. set of genetic information (**gene pool**)
14. selection that favours both extremes (**stabilizing**)
15. an isolation of difference in location which prevents reproduction (**geographical**)

Down

1. selection that favours only one extreme (**directional**)
3. key mechanism in evolution (**natural selection**)
6. changes in DNA sequence (**mutation**)
7. selection that favours the average (**disruptive**)
9. when a population is reduced in size to at least one generation (**bottleneck**)
10. an isolation of difference in season which prevents reproduction (**temporal**)

Robust, sensitive, and fast real-time results under any conditions.

That's **enzymagic**.

Introducing SsoAdvanced™ SYBR® Green supermix — designed to deliver superior gene expression results faster, without compromising on sensitivity or reliability. With increased resistance to a broad range of PCR inhibitors, this supermix provides high sensitivity of detection, even from your most challenging samples.

- **Better performance** — a robust formulation provides quality data consistently with either standard or fast cycling
- **More tolerance** — predeveloped qPCR assays work in a range of reaction conditions, primer concentrations, and temperature ranges
- **Reliable efficiency** — instant polymerase activation and rapid polymerization kinetics decrease run times and time to results, without compromise

Speed isn't everything, but combine it with this kind of reliability, sensitivity, and performance, and that's really something. Learn more at **www.bio-rad.com/ad/Ssoadvanced** or contact your Bio-Rad representative.

Research. Together.

Media Review

Mankind Rising - Where do Humans Come From

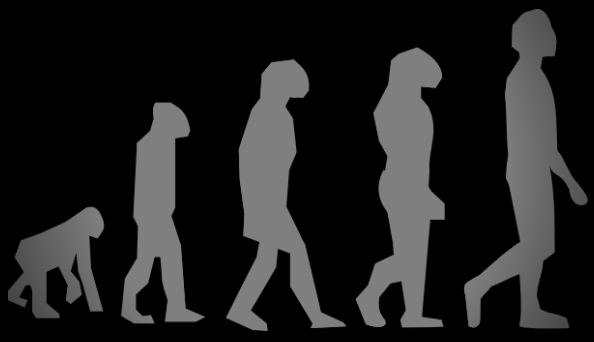
Mankind Rising is a computer animation documentary on the evolution of humanity. Beginning with the genetic makeup of a single cell to the current species of mankind. Mankind Rising illustrates an evolutionary timeline with much depth. With voice-over storytelling, history is created with a climatic narrative. It walks the audience through the history of challenges that were overcome through the journey of evolution.

Starting from over 3.5 billion years, the ancestors of mankind were first introduced as a simple single-celled organism. Through mutation and the luck of natural selection, a lightning struck the chemicals within the waters at a precise location and time to form the first single-celled organisms. Through natural selection and adaptation to the environment, the single-celled ancestors evolved to the underwater worm. Through evolution, the ability of slight gave a critical advantage on survival and reproduction. To make sense of the slight, nerve cells cluster together to form a small brain. However, natural selection did not only favored the ancestors of mankind as there were other species that preyed on the small fish-like creatures. Then the creature evolved to form hard scales and jaws with teeth in defence. However, that was not enough as they were not the superior species. This made the fish like ancestors to flee to the tide where oxygen was not sufficient. Most died while some adapted by the evolution of the lungs. These evolved species became known as the reptiles.

Those that adapted began to breathe in both water and land and eventually began to walk on land. On land, the mankind ancestors evolved into reptiles with hard skin. The reptiles began to reproduce by means of sex and adapted to lay hard-shelled eggs. Slowly, the size of the brain of our ancestors grew. After a volcanic eruption, the lizard-like ancestors evolved to a cat-sized creature covered in fur. However, our ancestors were on the bottom of the food chain due to dinosaurs. They eventually become smaller, into mouse-like creatures, in order to run away from their predators. These mouse-like creatures became nocturnal and had fur stand on end to trap heat as insulation. These were the first evolutions of the mammals.

The mouse-like creatures also adapted to have high qualities of sense, sight, and smell. In the brain, a new structure called the neocortex is formed. The neocortex enables analyzing situations and response. To protect offsprings from predators, the shrew-like creatures evolved to give birth to live young. Instead of leaving their young, they were taken care of by breastfeeding. The dinosaur era was over when an asteroid hits earth. The shrew-like ancestors survive by burrowing underground. Dinosaurs die out as their food source is insufficient. Our ancestors then involved to purgatorius, a bug-eating squirrel-like creature. As vegetation grows with fruits and nutrients on trees, the purgatorius evolves into primates to climb trees.

17 million years later, fewer trees were available, and primate ancestors stretched their arms across trees to travel. The newly evolved primates lost their tail and their arms grew longer. As mountain chains form from continental shifts, trees become less and the source of food decreases. Ardipithecus ramidus then starts to walk in search of food to survive. 3.2 years ago mankind ancestors were the Australopithecus. Then, 2.3 million years ago they evolved to homo habilisi which are also called the handyman. Working alone, eating whatever they could find, they learned to make use of tools and weapons. 1.8 million years ago, homo habilisi evolved into homo erectus or upright man. They were hunters and worked in groups. They were able to run long distances and learned to make use of fire. By working together, they found that family life would enable them to live longer. The Homo erectus also valued meat and learned that cooked meat was easier to consume. The molars retracted and the jaw muscles grew smaller while the brain grew larger. They also began to communicate 0.20 million years ago and natural selection made their tongue change shape and move down the larynx enabling them to make different sounds. 200000 years ago, homo sapiens, or wise men were evolved.

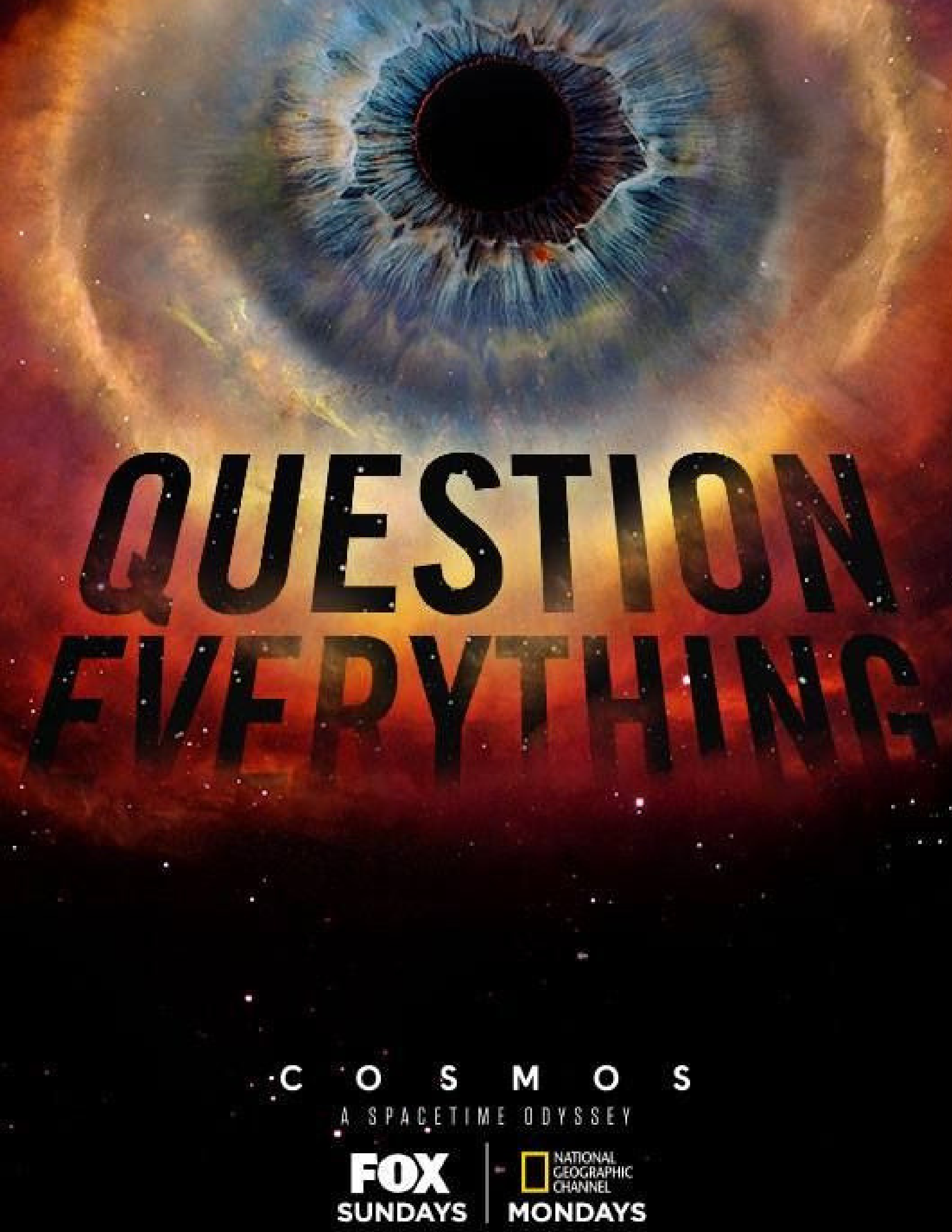


Creative rating system:

Creativity ⅘
Informative ⅘
Presentation ⅗
Likely to recommend ⅗
Enjoyable ⅗

Personal View:

The documentary was very informative with dates and name of species. The climatic walkthrough of the history from the perspective of the creatures captivated my attention. Good explanations of the scenarios helped with the clarity of what was going on. I personally found it very interesting as I obtained new information by watching this 40-minute long documentary. Through narrative history, it helped me have a better and more clear idea of the phylogenetic trees of the biology of evolution. I would not necessarily recommend on watching it as it is a bit time consuming to watch rather than to research this information. However, it was ever slightly enjoyable and captivating.


QUESTION
EVERYTHING
COSMOS
A SPACETIME ODYSSEY
FOX
SUNDAYS
NATIONAL GEOGRAPHIC CHANNEL
MONDAYS

Monthly Science Horoscopes

Aquarius: You're next experiment will be a complete success. Believe in yourself!

Pisces: You will play a leader-role in your lab group. Prepare to guide your lab mates!

Aries: You will perform very well on your next assessment. Be confident and relax!

Taurus: You will meet a new role model figure in your life.

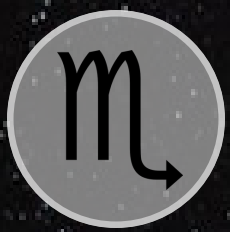
Gemini: Your research will be provided with bursaries.

Cancer: You will soon be promoted in your position. Continue to work hard!

Leo: You will make a ground-breaking discovery. Persevere in your research!

Virgo: There will be extra hands to your lab group. Prepare to receive some help!

Libra: Your family and peers will motivate you on a new research.

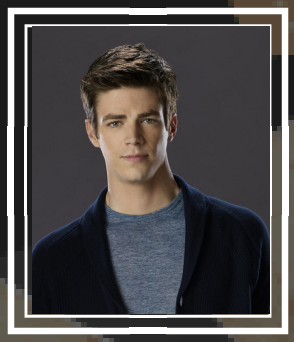


Scorpio: You have been working too hard recently. Take some time off and relax!

Sagittarius: An acceptance offer may come. Don't slack off!

Capricorn: You will get a raise. Spend it with the people you love!

So You Think you can be a Forensic Scientist?



Barry Allen, a scientist from the Criminal and Forensic Science Division, will explain the life of a forensic scientist. Barry Allen has been involved in the forensic investigation scene for around 5 years now.

Q. How did you become a forensic scientist? What was your education route?

A. In university, I studied forensic and finished with a bachelor's degree in forensic science. After that, I obtained my Master's degree. I believe other undergraduate programs involving biochemistry or toxicology will prepare you in this field as well. These bachelor's degree programs should help in criminal investigations, and law or court procedures. To have a higher chance of being employed, candidates tend to go for Master's degree or acquire a certification.

Q. Were there any other procedures in becoming a forensic scientist?

A. As a candidate, I had to pass a background check and a drug test. I also had to be clear of any criminal record, and I could not have any history of drug use. Internships really helped me stand out as a candidate. Employers want to see you experience in the labs. So I highly recommend landing internships while preparing to become a forensic scientist. As a crime scene investigator (CSI), I needed two letters of endorsement, and at least 75% on the exam presented by the International Association of Identification (IAI).

Q. Do I specifically have to set my courses to become a forensic scientist?

A. No, not at all. I have a friend who took a different undergraduate program. She planned on becoming a doctor, but eventually became a forensic scientist. In order to obtain a science degree to study medicine, she decided to study chemistry. While studying, she also enrolled in "Introduction to Forensics" class. She became more interested in the field of investigation, and thus became a forensic scientist.
However, you still need a science-related degree in order to pursue your career in forensics.

Q. How is the pay of a forensic scientist?

A. According to the Bureau of Labour Statistics (BLS), the average salary of a forensic scientist is around $50,000. Currently, I am making the average amount as a forensic scientist.

Q. How many jobs are available through forensics?

A. There are a lot of opportunities through forensics, ranging from specializing in fingerprints to footprints. Some of the careers include Forensic Toxicologist, Forensic Technician, Forensic Serologist, Forensic Psychologist, Forensic Nurse, Forensic Investigator, Forensic Hypnotist, Forensic Ballistics Analyst, and a Forensic Artist. I, personally specialize as a Crime Scene Investigator.

Q. What does a typical life of a forensic scientist look like?

A. I primarily gather evidence and conduct DNA analysis. At the crime scene, I also analyze bloodstain patterns and examine the surrounds to reconstruct the crime scene. I usually bring the evidence back to my own lab where I conduct research. Using gel electrophoresis and other lab techniques, I gather samples of the evidence. The process itself takes very long and is tiring at times. Once I gather all my samples, I provide consultation. I often worked with the police department and sometimes the FBI. I very rarely had to testify the evidence in the court.

Q. What are some responsibilities as a forensic scientist?

A. As a crime scene investigator, I have the responsibility of being able to gather evidence at crime scenes. I have to then properly store and analyze the evidence. I have to be very careful and responsible as evidence is crucial. Then, I have to be accountable for consulting and preparing a report of the findings.

Q. What are the job characteristics of a forensic scientist?

A.Unlike how media portrays forensic scientists of being fast and flashy, the actual investigations take a long time. As a forensic scientist, one must be detailed, precise, and organized. Forensic scientists must have good communication skills as they have to be efficient in their work while effectively analyzing the evidence. Some forensic analysts, also have to go to court to testify the evidence. Forensic scientists must also be honest with their mistakes and must also be serious about the confidentiality of the evidence.

Q. What is the work environment and hours of a forensic scientist?

A.Depending on the specialization, there are different work environments. Typically, most laboratories are well ventilated and clean due to fumes and chemicals. Within the laboratories, scientists have to wear protective clothing in order to prevent contaminating physical evidence. Sometimes, evidence has to be presented at the court. Usually, forensic scientists are on call, usually working around 40 hours a week. Some people work three days a week, on flexible hours.

Q. Any advice for future forensic scientists?

A.Many universities offer degrees in forensic science. However, I advise that students should obtain a degree in biology or chemistry. By studying biology or chemistry, more career options will be open. It is also very important to gain work experience within forensic laboratories. This is because laboratory work requires precise but efficient work ethics. You must also learn to be flexible with your time and be ready to receive constructive criticisms.

Scan QR Code
to subscribe

0 36000 29145 2