Forensic Science: DNA Unit

Name: _____

Date	Classwork	Homework
Thurs. 3/16	Blood Unit Assessment Watch Bill Nye: Genes (p.1-2) Notes: DNA (p.3-4)	
Fri. 3/17	CSI NY "Open & Shut" Gel Electrophoresis Simulation & Assessment (p.5-7)	
Mon 3/20	DNA Case Study (p.8-12) 60 Minutes: A Not So Perfect Match (p.13)	
Tues. 3/21	Romanov Webquest (p.14-20)	
Wed. 3/22	Logic Puzzle Catching Killers: DNA Profiling & Questions (p.21-22) Begin GATTACA (p.23)	
Thurs. 3/23	Finish GATTACA (p.24-26)	
Fri. 3/24	Who ate the Cheese?--Unit Assessment Bones "The Bikini in the Soup"	

Name _____ Date _____

"Bill Nye: *Genes*" Video Worksheet

1. Where do your genes come from?

2. What is inside every cell in your body?

3. What does DNA stand for?

4. What did Bill climb to get out of the Nye Lab?

5. How long is the DNA string model of science?

6. How many times longer is DNA than it is wide?

7. How does Bill define a Gene?

8. Why is the white blood cell dark on the computer screen?

9. What does the nucleus of the cell contain?

10. What can you do with DNA after you take it out of an organism?
    a.
    b.

11. What 2 organisms were combined to create the message to Bill in the petri dish?

12. What do genes do?

13. Mom tells Richie: Genes are the set of _____ _____ that get passed down from _____to child. In the process, of course, the genetic material is _____ in new ways, which is why people bear resemblance to their _____ and _____without looking like any one relative in particular.

14. What analogy does Bill use to describe the human set of chromosomes?

15. What is each chapter analogous to?

Name _____ Date _____

16. How many genes to humans have?

17. What do cells in the body not need to do? _____

18. Most species have fewer than _____chromosomes but thousands and thousands of genes

19. Bill calls the babies "bundles of _____"

20. The reproductive cell that a mother donates to her child is called the _____
21. The reproductive cell that a father donates to his child is called the _____

22. The number of cells needed to make a baby is: _____

23. DNA is the _____ print for the future

24. Earlobes can be _____or _____

25. A _____is a piece of the _____ molecule

26. The four chemicals of DNA are
    a.
    b.
    c.
    d.

27. The number of chromosomes that a mule foal has is _____
28. The number of chromosomes that a horse has is _____
29. The number of chromosomes that a donkey has is _____

30. In the demonstration, the _____ gene for rolling your tongue is represented by the letter "R"
31. In the demonstration, the _____ gene for rolling your tongue is represented by the letter "r"
32. If a person has the pattern RR, then the person _____ roll their tongue
33. If a person has the pattern Rr, then the person _____ roll their tongue
34. If a person has the pattern rr, then the person _____ roll their tongue
35. What is special about the turtle in this movie?

DNA Evidence Name _____

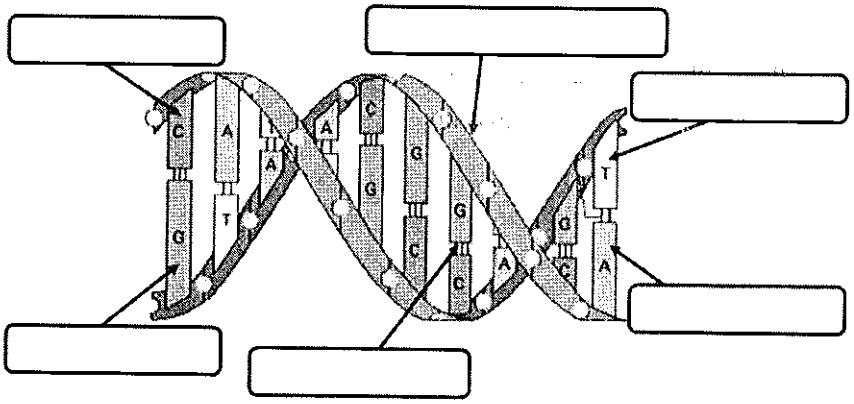
1. What is DNA?

- DNA stands for _____ _____ and contains _____ information.
- It is found on _____ located in the nucleus of our cells.

2. What makes up a DNA molecule?

- The sides or _____ of the DNA molecule are made up of _____ (deoxyribose) and _____ molecules.
- The rungs that form the middle of the molecule are made up of pairs of _____ or nitrogen bases. _____ (A) pairs with _____ (T), while _____ (G) always pairs with _____ (C).
- The _____ of the bases determines the genetic _____.
- Label the diagram using the words listed below.

Backbone
Nitrogen Bonds
Adenine
Thymine
Cytosine
Guanine



3. How can DNA be used as evidence?

- Each person's DNA is _____ from other people (except identical twins).
- DNA collected from a crime scene can either link a _____ to the evidence or _____ a suspect, similar to the use of fingerprints.
- DNA can identify a victim through DNA from _____, even when no body can be found.
- DNA can _____ crime scenes together by linking the same perpetrator to different scenes.
- DNA can place an _____ at a crime scene, in a home, or in a room where the suspect claimed not to have been.
- DNA can _____ a claim of self-defense and put a _____ in the suspect's hand.
- It can change a story from an _____ to one of _____.

4. What factors can affect DNA evidence?

Environmental factors (e.g., _____, sunlight, _____, _____, and mold) can affect DNA. Therefore, not all DNA evidence will result in a usable DNA profile. Further, DNA testing cannot identify _____ the suspect was at the crime scene or for _____ _____.

5. What is CODIS?

CODIS stands for _____ _____ _____ _____, which is an electronic _____ of DNA profiles that can identify suspects.

6. DNA Matching

A. Who done it? _____ B. Whose your daddy? _____ C. Identical or not? _____

7. Which three statements below are true?

_____ 1. The DNA in a man's blood is the same as the DNA in his skin cells and saliva.

_____ 2. Each person's DNA is different from every other individual's.

_____ 3. DNA can be found in all the cells in our bodies except the blood cells.

_____ 4. DNA can have forensic value even if it is decades old.

_____ 5. DNA evidence was first used to get a conviction in a trial in 1987.

8. The Killer's Trail – Watch the video and then choose the best answer for each question.

1. Who was the victim?
A. Marilyn Sheppard B. Sam Sheppard C. Sam Sheppard, Jr.

2. What are the keys to DNA fingerprinting?
A.Chromosomes B. Alleles C. Nitrogen bases

3. Where did the scientist get the sample of DNA for Marilyn Sheppard?
A. Hair B. Skin C. Fingernail

4. Whose blood was found in the blood trail?
A. Marilyn Sheppard B. Sam Sheppard C. Neither

Gel Electrophoresis: DNA Analysis

Simulation #1: Go to the website below, follow directions and answer the questions below on your own paper:

http://tinyurl.com/c8z3m7

1. How can DNA strands be sorted by size?

2. What is a gel?

3. How are the strands pushed across the gel?

4. Which strands move more quickly?

5. How do they make the DNA visible?

6. What are the 5 steps to running a gel? Provide a **detailed** description of each.

7. What is the charge of DNA?

8. Why does the DNA move down the gel?

9. What is the chemical name for the staining solution?

10. How many base pairs are in the top most band? The one in the middle? The last one?

Simulation #2: Now it's time for you to solve a crime using this method. There is a slight variation to the procedure you just performed, but it's good to see a variety of ways to run the same test.

http://tinyurl.com/cuk4huc (Click on VIEW button next to blue box)

Part 1. It takes a lickin'

1. What happened to Jimmy?

2. Who are the suspects?

Part 2.

1. What is different about this procedure than the last?

2. What is the purpose of the restriction enzymes?

3. What is the purpose of the probes?

4. In what direction does DNA travel across the gel? Why must that be?

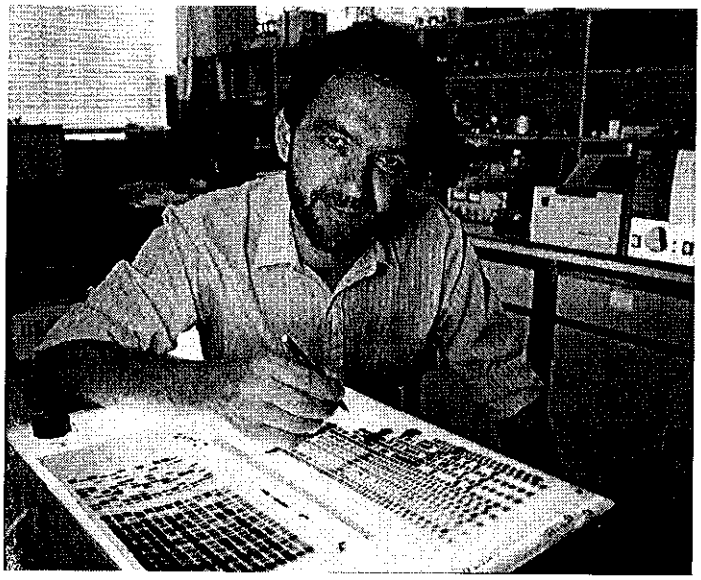
5. Who licked Jimmy lollypop?

Gel Electrophoresis Assessment

gel electrophoresis	wells	micropipette	faster
blood	salt water	negative	restriction enzymes
skin	electric field	gel	closer
hair	positive	smaller	stain
ultraviolet	larger	farther	slower

(1)_____ _____ is a method of separating DNA based on their length. Scientists first extract DNA from sources such as (2)_____, (3)_____, or (4)_____. The (5)_____ is the filter, which is the same consistency as jell-o. The buffer is made of (6)_____ _____ because it is an electrolyte and helps the electricity flow through the gel. Scientists use (7)_____ _____ to split the DNA strands into manageable pieces. The DNA is inserted in the (8)_____ at one end of the gel using a (9)_____. By adding an (10)_____ _____ we can make the DNA strands move down the gel because DNA has a slightly (11)_____ charge, which is why the end of the gel with the wells has a (12)_____ charge and the opposite end has a (13)_____ charge. As the DNA travels through the gel, the (14)_____ pieces move (15)_____ than the larger ones. Therefore the small pieces are found (16)_____ to the positive end of the gel. Scientists use (17)_____ to make it easier to see the bands that form on the gel. They may also put the gel on a (18)_____ light to make it easier to read.

CASE #1



Alec Jeffreys and the Pitchfork murder case: the origins of DNA profiling

British geneticist Alec Jeffreys began working in 1977 on a technique that could identify individuals through samples of their DNA. In 1984, he and colleagues devised a way to use a newly discovered property of DNA, isolated areas of great variability between individuals called restriction fragment length polymorphisms (RFLP), for forensic identification—the original DNA fingerprint.

In 1986, police asked Jeffreys for help in finding a man who had raped and killed two girls. DNA tests exonerated the primary suspect. Through a genetic dragnet, police found the perpetrator, Colin Pitchfork, who gave himself away when he asked a friend for a substitute blood sample.

Within a year, genetic fingerprinting was making the unique molecular structures of victims and suspects visible in criminal investigations around the world. Today, RFLP-based DNA analysis is being supplanted by newer techniques of genetic identification.

CASE #2

Michael Blassie unknown no more

We want the truth, we want to bring him home.

—Jean Blassie, mother of 1st Lt. Michael Blassie, 1998

It may be that forensic science has reached the point where there will be no other unknowns in any war.

—William S. Cohen, U.S. Secretary of Defense, 1998

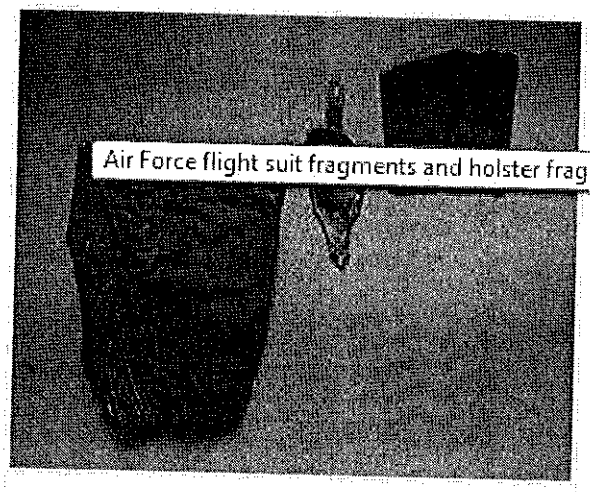
On Memorial Day 1984, the remains of a soldier killed during the Vietnam War were laid to rest in the Tomb of the Unknown at Arlington National

Cemetery. A decade later, however, questions began to arise about the identity of this unknown soldier.

First Lieutenant Michael Joseph Blassie, 24, was shot down over South Vietnam in 1972 and presumed dead. When family members received word that his remains might be buried in the Tomb of the Unknown, they petitioned the Department of Defense to open the site and conduct previously unavailable DNA testing. In 1998 the Tomb of the Unknown was opened and the remains of the Vietnam Unknown—identified as X-26—were removed.

Forensic anthropologists took the aged and damaged samples of bone for mitochondrial DNA (mtDNA) testing. Because mtDNA is passed along the maternal line, scientists compared the Unknown Soldier's DNA against two samples submitted by First Lieutenant Blassie's mother and sister and found a match.

On July 11, 1998, 1st Lt. Michael Blassie was buried with full military honors in Jefferson National Cemetery, Missouri, near his hometown, in the same cemetery as his father.



Air Force flight suit fragments and holster fragment found with Michael Blassie
Courtesy of the Blassie Family

Going further: Lt. Blassie and the unknown soldier

Michael Joseph Blassie, the oldest of five children of a St. Louis meat cutter, entered the Air Force Academy in 1966 and received his officer's commission in June 1970. During a tour of Vietnam, he served as a member of the 8th Special Operations Squadron. On May 11, 1972, at age 24, his A-37B Dragonfly aircraft was shot down near An Loc, about 60 miles north of Saigon.

Immediate recovery attempts were launched, but Blassie had crashed in an area controlled by enemy forces so it was impossible to examine the crash site. Five months later, during a sweep of the area, a South Vietnamese Army patrol recovered a pelvis, an upper arm bone, and some ribs, as well as the remnants of a flight suit, a life raft, pieces of a parachute, and part of a USAF holster. The remains and associated materials were eventually turned over to the U.S. Army Central Identification Laboratory, Hawaii for analysis and identification. They were initially classified as belonging to Lt. Blassie. However, analysis at the time suggested that the remains were not a compelling match to Blassie's age and height. With the conflicting information between the forensic analysis and the physical evidence, the remains were designated as "Unknown" and assigned the number "X-26."

The timely and accurate identification of men and women who die while serving in the armed forces has long been a priority for the United States government. The Armed Forces have adopted the latest advances in fingerprint and dental identification, and forensic anthropology and radiology. But not all remains can be

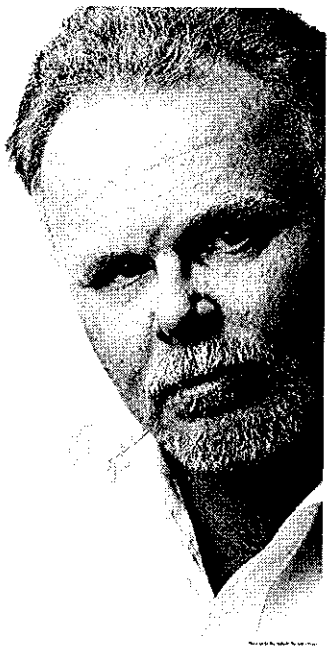
identified with such methods. Records can get damaged or destroyed, and post-mortem materials can be affected by decomposition, body fragmentation and exposure to heat.

With the invention of the polymerase chain reaction in 1985, DNA analysis moved to the forefront of forensic technologies. In 1991 the Department of Defense founded the Armed Forces DNA Identification Laboratory (AFDIL). AFDIL has used DNA analysis to identify the remains of at least 150 military personnel from Vietnam, Korea, and World War 2, and assisted in the identification of victims from high profile disasters, both natural and man-made. Now that DNA samples are taken from everyone who joins the U.S. Armed Forces, there may never be another American "unknown soldier."

Mitochondrial DNA testing

Human beings have copies of DNA from each biological parent, stored in the nucleus of every cell. DNA is also stored in tiny, energy-producing structures in the cells, called mitochondria. Mitochondrial DNA (mtDNA) differs from nuclear DNA because human beings inherit mtDNA solely from the mother and share this information with siblings and maternal relatives. Unlike nuclear DNA, each cell carries more than a hundred copies of mtDNA, since each cell contains many mitochondria but only one nucleus. The ability to match mtDNA between related individuals, and the fact that it does not degrade as rapidly as nuclear DNA, makes it a valuable tool in the identification of human remains.

CASE #3

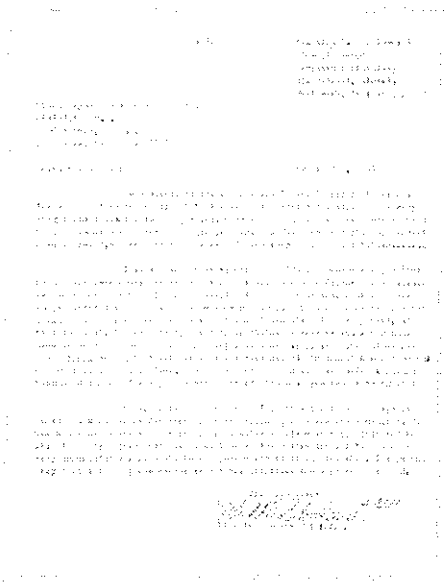


Rescued from death row: Kirk Bloodsworth and the Innocence Project

After an anonymous tip and eyewitness testimony placed him near the crime scene, Kirk Bloodsworth was sentenced to death in Maryland for the 1984 sexual assault, murder, and mutilation of 9-year-old Dawn Hamilton. Bloodsworth insisted on his innocence and no physical evidence linked him to the killing. In prison he learned about DNA profiling. Eventually his attorney, Bob Morin, with support from the Innocence Project, a nonprofit legal clinic formed to promote the use of DNA analysis to exonerate innocent prisoners, persuaded officials to compare Bloodsworth's DNA with the DNA of dried sperm found on the victim. The results exonerated Bloodsworth. He was freed from prison in June 1993—the first death-row prisoner to be exonerated by post-conviction DNA testing.

In 2003, after much prodding from Bloodsworth and Innocence Project lawyers, Maryland authorities finally searched their DNA database for a "cold hit" match of the evidence in the

Dawn Hamilton case. The search turned up Kimberley Shay Ruffner, a convicted rapist who Bloodsworth had known in prison, who was then tried and found guilty of the 1984 murder.



A. I. M. Letter, December 8, 1987
While in prison, Bloodsworth launched a letter-writing campaign to protest his innocence, always signing his letters "A. I. M." ("An Innocent Man").
Jayne Miller, WBAL-TV

Bloodsworth's story shows the promise of DNA testing for clearing the innocent and identifying the guilty. In 2003, Congress passed the "The Kirk Bloodsworth Post-Conviction Federal Grant Testing Program," creating a federal DNA testing program. Today, over 30 state and regional innocence projects are at work. By August 2004, 144 prisoners, some on death row, had been exonerated by DNA testing.

Bloodsworth currently works with the Justice Project, a non-profit group that campaigns for legislation to correct flaws in the American criminal justice system that result in the conviction of innocent men and women on death row for crimes they did not commit.

DNA Worksheet

Name:_____ Date:_____

1. Provide a Case Summary in the table below:

Cases	*Colin Pitchfork*	*Michael Blassie*	*Kirk Bloodsworth*
Case summary:			
What was the outcome using DNA analysis?			
What is the significance of this case?			

2. What type of DNA testing should be used? Why?

3. Who may want the DNA information? Why?

4. What are some examples of ethical and unethical uses of DNA information? Why?

5. What are possible benefits and problems that may occur by establishing a National DNA database for people living in the United States?

Name: _____ Date: _____ Class Pd.:_____

60 Minutes: A Not So Perfect Match

http://www.cbsnews.com/news/a-not-so-perfect-match/

1. What DNA is used for fingerprinting?

2. ____% of inmates has a family member who is incarcerated.

3. What are 3 pros to genetic surveillance?

4. What are 3 cons to genetics surveillance?

5. What is familial searching?

The Romanovs and DNA **Direction Sheet**
Forensic Science

Using this direction sheet to work through the activity and answer the questions on your answer sheet. Make sure you read all the info and follow the directions on each page in the modules that you go through!

Part A: The Romanov Family

Click on the link below to start:

http://www.dnai.org/d/index.html

At the bottom of the screen, click on the link to the module "Recovering the Romanovs."

Read the background information on the Romanov family on this screen, and the summaries of what you will investigate in each section.

At the top of the page, click on the link '***the Romanov Family***'. Once this link opens, you will see 10 numbered circles at the bottom of the page. Click on each numbered circle and answer the questions as you progress through the material. For **Part A**, the number of the circle corresponds to the numbered questions on the answer sheet. As you look at the pedigrees, the 'key' tab in the lower left explains the symbols used.

Part B: The Mystery of Anna Anderson

Click on the link below to start:

http://www.dnai.org/d/index.html

At the bottom of the screen, click on the link to the module "Recovering the Romanovs."

At the top of the page, click on the link '***the mystery of Anna Anderson***'. Once this link opens, you will see 6 numbered circles at the bottom of the page. Click on each numbered circle and answer the questions as you progress through the material. For **Part B**, the number of the circle corresponds to the numbered questions on the answer sheet.

Part C: Science Solves a Mystery

Click on the link below to start:

http://www.dnai.org/d/index.html

At the bottom of the screen, click on the link to the module "Recovering the Romanovs."

At the top of the page, click on the link '***science solves a mystery***.' Once this link opens, you will see 22 numbered circles at the bottom of the page. Click on each numbered circle and answer the questions as you progress through the material. For **Part C**, the number of the circle corresponds to the numbered questions on the answer sheet. Make sure you read every page and follow the indicated links!

The Romanovs and DNA
Forensic Science

Names: _____

_____

The House of Romanov was the second and last imperial dynasty to rule over Russia, reigning from 1613 to 1917. In 1918, the last ruling Romanov, Nicholas II, and his family were executed and buried in a mass grave in Siberia. When the grave was exhumed, two of the bodies were missing. In this activity, you will use forensic tools to solve the mystery of the missing Romanovs.

Using the direction sheet on Blackboard, work through the activity and answer the questions below.

Part A: Family Background

1) Refer to the pedigree of Tsar Nicholas II. What was his mother's maiden name? _____

2) Alexandria was born in what country? _____

3) Refer to the pedigree of Tsar Nicholas II's family:

a) How many daughters did he have? _____ Sons? _____

b) Who were his two youngest children? _____

4) Prince Alexei suffered from a blood disorder:

a) What was the name of the disorder? _____

b) What are the symptoms of this disorder?

c) From whom did Alexei inherit this genetic disorder? _____

5) What other family members of Alexandra also suffered from this disorder?

6) View the four movie clips of the Tsar's family (**no sound with these clips).

7) In what year did Nicholas II abdicate his throne? _____

8) During World War I, the leadership of Russia changed.

a) Who became the leader? _____

b) What was the political party? _____

c) What was the reason for the overthrow of the government?

9) **a)** What was the significance of the Ipatiev House?

b) What happened there in 1918?

10) **a)** In addition to the Tsar's family, who else was executed?

b) What was inserted into the corsets of the women that prevented some of the bullets from entering their bodies?

Part B:The Mystery of Anna Anderson

1) Who did "The Unknown Woman" claim to be? _____

2) List four characteristics the unknown woman had in common with Tsar Nicholas II's youngest daughter.

3) Did the ear tracing of Anna Anderson match Anastasia's? _____

4) Who did the royal family decide Anna Anderson really was? _____

5) **a)** Did Peter Kurth, who knew Anna Anderson very well, believe that she was born in a Prussian farmer village to beet farmers?

b) Give one piece of evidence he gives for his reasoning.

Part C: Science Solves a Mystery

1) In 1991, where was the supposed burial site of the Tsar and his family?

2) **a)** Why was the American team called in to help identify the bodies?

b) What type of information can they gain by studying the bones?

3) **a)** How many skeletons were recovered? _____

b) How many people died in the massacre? _____

4) What can be determined by the examination of:

a) Wisdom teeth

b) Vertebrae

c) Pelvic region

5) List the age (greater than ___) and sex for each skeleton.

Skeleton	Age	Sex
1		
2		
3		
4		
5		
6		
7		
8		
9		

6) What two people were determined to be missing from the gravesite?

7) The bodies were buried for over 75 years. What type of evidence was preserved that enabled scientists to determine who was buried in the grave?

8) Go through the modules on nuclear DNA and mitochondrial DNA. Use the 'next' button in the upper left to scroll through the modules.

9) Compare and contrast mitochondrial DNA (mtDNA) with nuclear DNA.

a) How are they alike?

b) How are they different?

10) From whom do we inherit our entire mitochondrial mDNA? _____

11) **a)** From whom did the Romanov children inherit their mDNA? _____

b) Where did the person in (a) get his or her mDNA? _____

c) Does Nicholas II have the same mDNA as his children? Explain.

12) On Tsarina's pedigree, find Nicholas II and Alexandria.

a) All mitochondrial DNA of the Tsar's children can be traced back to whom?

b) According to the pedigree, who is the relative still alive today that has the same mDNA as the Romanov children?

13) Go to the Bioserver Sequence Server and look through the differences (in yellow).

14) Whose skeleton was #9? _____

15) Why was James, Duke of Fife, selected to have his DNA examined?

16) Go to the Bioserver Sequence Server. Which of the male's skeletons matched with the mDNA of James, Duke of Fife?

17) It is believed the identity of the other male skeletons was:

18) Why was Anna Anderson's mDNA being compared to the mDNA of Prince Philip?

19) Why was Carl Maucher's mDNA being examined?

20) Watch the hair sample video. From where did Susan Burkhart obtain a sample of Anna Anderson Monahan's hair?

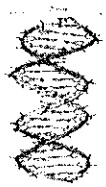
21) **a)** If Anna Anderson was cremated, then how did they obtain a sample of her cells?

b) Based on Michael Baden's and Syd Mandelbaum's findings, were Anna Anderson and Anastasia, the daughter of the royal family, the same person? Explain your answer.

c) What is believed to have happened to the bodies of the two youngest children, Anastasia and Alexei?

Name: _____ Date: _____ Class Pd: _____

Catching Killers: DNA Profiling



1. When was Vicky murdered?
2. What does BTK stand for?
3. What clue did BTK leave behind?
4. Did it help them determine his blood type?
5. What happened in the 1980s to BTK?
6. When was DNA determined to hand down genetic material?
7. What evidence was found in the semen at the Linda Mann crime scene?
8. What did they discover was similar in the evidence found in Dawn & Linda's crime scene?
9. How did they find a suspect?
10. Why might the DNA samples not be useful?
11. What property of DNA fragments are used to separate them?
12. Did the DNA support that Richard Buckland was the murderer?
13. Why is PCR helpful in DNA profiling?
14. What is the purpose of polymerase?
15. What is the name of the DNA database?
16. What happened to help the case in England?
17. Who killed Linda & Dawn?
18. What was his sentence?
19. How did the police get BTK to communicate with them?

20. How did they finally get a clue about who BTK might be?

21. Who is BTK?

22. Why did they want to be sure he was BTK?

23. How did they obtain a DNA sample?

24. Why were they able to use that sample to identify BTK?

25. What was his sentence?

Name:

Date:

Period:

GATTACA

Questions

1. What do you think Andrew Niccol (the director) is trying to say by using the quote from Ecclesiastes 7:13 and the quote by Willard Gaylin at the beginning of the film?

2. What is an "in-valid"?

3. List two ways that the society portrayed in the movie routinely 'reads' a person's genetic profile.

4. What is one major surgery that Vincent had correct for his genetic "imperfections"?

5. List two things Vincent did on a daily basis to maintain his 'Jerome' identity.

6. Who is murdered in this film? Why?

7. What evidence pointed towards an 'in-valid' as the murderer? Who is the murderer?

8. Describe the different attitudes Vincent and Irene have toward their imperfections.

9. What would you say to a friend who believed themselves to be solely a product of their DNA and with no true freedom?

10. What ultimately happened to Anton (the brother)? What job did he end up doing?

11. How is the relationship between Vincent and his brother? How is it ultimately resolved?

12. What is the significance of the word "GATTACA"?

13. Why doesn't the actual Jerome enter the space program?

14. Does anyone ever find out that Vincent is not Jerome? If so, who?

15. Does Vincent ever get to fly into Space? What moon was Vincent training and planning for?

* Choose 3 * * Use 3-4 complete Sentences for each *

GATTACA

Reflection Questions

Answer the following questions based on your knowledge of the Living Environment, your personal opinions, and the movie "GATTACA".

1. Why do you think Vincent's father decided to name him "Vincent Anton" rather that "Anton"?

2. How was Vincent's childhood/family life affected by his genetic profile?

3. How was Vincent's adult life affected?

4. What qualities does Vincent possess that contribute to his success?

5. Does Jerome have any weak qualities? What are they?

6. Why do you think the writer/director chose the name "Gattaca" for this film, and for the place where Vincent worked?

7. Why do you think Lamar's son was a "big fan" of Vincent?

8. What are the positive and negative aspects of the GATTACA world?

9. "This child is you, simply the best of you. You could conceive a hundred times and never achieve the same result." Explain this statement using the terms: HOMOLOGOUS CHROMOSOMES and ALLELES.

10. What are "valids" and "in-valids" in the story? Explain in definition.

11. During the car search in the tunnel, Vincent (who is with Irene) tells the tester NOT to take a saliva sample (implying the sample might be "contaminated"), but rather, to take a blood sample. What did he mean by the saliva being "contaminated", and, what was the REAL reason Vincent did not want a saliva sample to be taken?

12. Is it true that you are more than the sum of your genes?

13. What evidence pointed towards an "in-valid" as the murderer?

14. What major surgery did Vincent have to enhance his genetic "imperfections?"

15. Discuss at least FOUR preparations Vincent had to do everyday to pass as Jerome Morrow at GATTACA. In each case, explain WHY he had to do each preparation.

16. "For one reason or another, when a member of the elite falls on hard times, their genetic identity becomes a valid commodity for the unscrupulous." What happened in this film to demonstrate what Vincent was talking about?

17. What does GATTACA say about DNA determining a person's potential?

18. The technology to do what was done in the movie is definitely possible within the next fifty years. Do you think that Vincent's world could eventually happen in America? Why?

19. Choose your favorite character from the film. Explain why you choose that person. Would you want to be that person? Why? Why not?

20. Why do you think Vincent left his family, tearing his picture out of the family photo, after winning the swimming race against his brother?

21. Wouldn't every parent want to ensure that their child was perfect and had the attributes of physical attractiveness, intelligence and athletic prowess to be able to do whatever he or she wanted in life? If so, why is the society portrayed in this film so devoid of happiness, vitality and fun?

22. Discuss the significance of the structure of the STAIRCASE in the home Vincent shared with Jerome in terms of the theme of this film.

23. It appears, in the society shown in the film, that one could have a potential romantic partner/love interest sequenced. Discuss the positive and negative aspects of having this technology available to prospective mates.

24. You are an employer and know from genetic testing that the most qualified applicant for the job has a 70% chance of developing Multiple Sclerosis in one year's time. Would you hire this person?

25. In one scene, Vincent states that "there is no gene for fate." What does this phrase mean? Much of this film deals with the human desire to control fate, versus the willingness to let fate run its course. List some examples of moments in the film where characters try to control their destiny, and moments where they accept fate.