

RAFT IDEAS

Topics: Genetics, Ancient Cultures, Archaeology

Materials List

- ✓ Copies of DNA barcode sheet on cardstock (Optional: laminate for increased durability)
- ✓ Copies of student sheet with empty family tree and hints
- ✓ Scissors

This activity can be used to teach:

- Genetic material and reproduction (CA Science Standards: Grade 7, 2.b and 2.e; HS Biology, 5.a and 3.a)

Who's Your Mummy?

Using DNA Fingerprinting to Reconstruct an Ancient Family Tree



Students apply their knowledge of DNA fingerprinting and play the role of archaeologist in this activity that unravels to reveal a complex Egyptian family tree.

To Do and Notice

1. Examine the mummy DNA fingerprints (barcodes) on the following page.
2. Each column models the DNA fingerprint (barcode) of a mummified individual. The first line notes the mummy's number designation, the second line notes gender (male or female), and the third line notes the age at time of death. The remaining 30 lines contain the DNA information.
3. Follow the instructions on pages 3 and 4 of this activity, and use the barcodes to fill-in the mummy family tree.

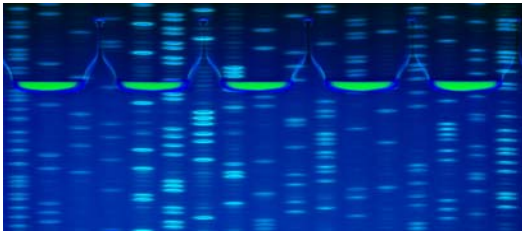
Teacher suggestions:

- Do this activity after the RAFT Idea *Who is the Daddy?* which provides students an opportunity to practice Paternity Testing in a simpler scenario.
- Solve this activity personally before presenting it in a classroom situation.
- Students can either use pre-cut strips or cut the barcode strips themselves.
- If using pre-cut strips, review DNA fingerprinting with students and guide them through the examples presented on the barcode page.
- Direct students to work in groups of 2 or 3 to fill in the family tree. Each student, however, should have a set of barcodes.

The Content Behind the Activity

DNA fingerprinting utilizes the highly variable, noncoding pieces of an individual's genetic code (minisatellites) to create a "barcode". Through the electrophoresis process, long and short minisatellites travel varying distances in a gel. All genetic material comes from a combination of both parents, so all genetic material that did not come from the mother must come from the father, and visa versa. Unlike actual fingerprints that only identify an individual, DNA fingerprinting also can identify an individual's parents.

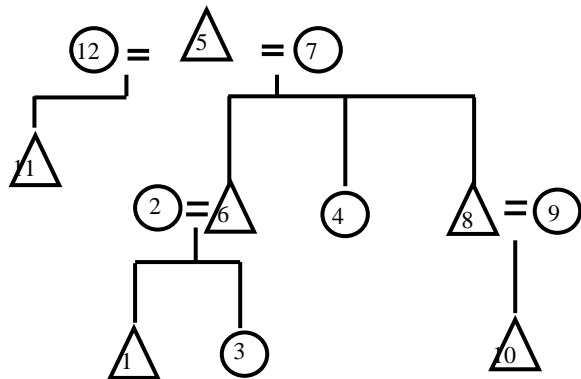
This simplified model illustrates the process of identifying relationships through DNA fingerprinting. In each case, a fictitious barcode contains 12 "bars" in 30 possible spaces, with exactly 6 "bars" coming from each parent. Students should be clear that reality is significantly more complicated, illustrated by the actual image of DNA fingerprints on page 2. Information about an individual determined by DNA analyses increases with improved technology and our knowledge of DNA structure.



Professionals use DNA testing to verify identities, establish relationships, and solve mysteries. When biologists developed and refined DNA fingerprinting processes, anthropologists immediately saw applications, such as identifying mummified individuals, as modeled in the scenario. When piecing together ancient cultures, archaeologists often face challenges presented by broken or damaged artifacts. Every scientific process available is utilized to gather as much data as possible for stronger conclusions. Mummified individuals are X-rayed and scanned to produce MRIs. Increased medical technology provides archaeologists with an array of less invasive procedures that preserve delicate artifacts. Archaeologists use a small amount of mummy tooth dentin as the genetic testing material of choice because it provides better results than flesh samples.

Although this activity models a fictitious family, the results are consistent with Ancient Egyptian family relationships. The family patriarch married twice; polygamy, re-marriage after the death of a female partner, and divorce were common in Ancient Egypt. Egyptian women had little say regarding their future husbands as parents arranged marriages after puberty, generally at age 12 or 13. Mummy 12 was relatively young when she died (age 16-20). This woman may have died in childbirth or from illness, or possibly been the victim of jealous stepchildren from a first marriage (as seen in the historic “Letters of Hekanakhte”). The other “DNA surprise” involves mummies 9 and 10. Mummy 10 is not the biological offspring of mummy 8. This could point to infidelity, but also might reveal an adoption (a common practice among the Ancient Egyptians).

The correct answer in this model is:



Note: Students should find that mummy 8 is not the genetic father of mummy 10, but placement of this individual on the family tree is by default. Teachers can share that adoptions were common in Ancient Egypt, and this situation may reflect an adoption. Students may also offer other explanations. Advancements in genetic testing in the past couple of decades have solved many mysteries, but in some cases, questions are still left unanswered.

Taking it Further

- To make this activity easier, guide students through the process step by step.
- To make this activity extremely challenging for advanced students, have the students create the family tree on their own, using only the clues, barcodes, and gender and age data. In this case, students should conclude that mummies 9 and 10 have no direct link to the rest of the family tree. Allow students to use any plausible explanation for these mummy appearances in this tomb as a hypothesis (distant relatives, adoption, attendants).

Web Resources (Visit www.raft.net/more for how-to videos and more ideas!)

For detailed information of how DNA Fingerprints are made and used in legal situations, visit “How Stuff Works” at: <http://www.howstuffworks.com/dna-evidence.htm>

See the following websites for more information about Ancient Egypt:

<http://www.egyptianmuseum.org>

<http://www.watson.org/~leigh/egypt.html>

<http://www.rom.on.ca/egypt/hiero/hiero.html>

Who's Your Mummy?

Unraveling an Ancient Family Tree

Archaeologists have made an incredible new find: an Egyptian family tomb from the new kingdom containing remains of 12 individuals! Unfortunately, thieves have ransacked the tomb in search of treasures. Each mummy was found removed from its sarcophagus and unwrapped. Burial chamber contents were also damaged. Scientists have used tooth material to create DNA fingerprints (barcodes) from each mummy in an effort to recreate the family tree.

The Task:

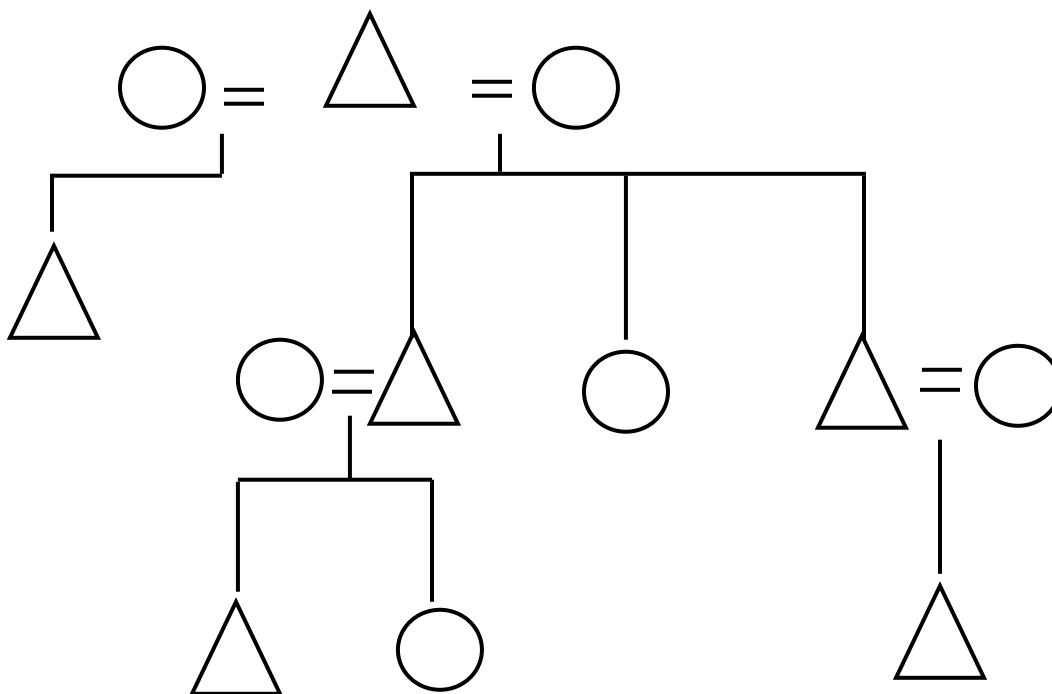
Use the DNA fingerprints (barcodes) provided and the hints to fill-in the family tree.

The Hints:

- Archaeologists created the family tree based on writings from each sarcophagus and other notations inside the tomb. Each mummy has a place on the family tree.
- Mummy 5 is the male head of the family.
- Mummy 6 is the son of mummy 5 and mummy 7.
- Mummy 6 had 2 children.

Notes on reading a family tree:

- Triangles represent males
- Circles represent females
- "Equals" symbols represent a union (marriage)



Mummy DNA Fingerprints (barcodes)

Mummy 1	Mummy 2	Mummy 3	Mummy 4	Mummy 5	Mummy 6	Mummy 7	Mummy 8	Mummy 9	Mummy 10	Mummy 11	Mummy 12
M	F	F	F	M	M	F	M	F	M	M	F
Age 1-2	Adult	Adult	Age 4-6	Adult	Adult	Adult	Adult	Adult	Adult	Adult	16-20
1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29	29	29	29	29
30	30	30	30	30	30	30	30	30	30	30	30

1. Each column models the DNA fingerprint (barcode) of a mummified individual. The first line notes the mummy's number designation, the second line notes gender (male or female), and the third line notes the age at time of death. The remaining 30 lines contain the DNA information.
2. Notice that each mummy barcode contains 12 colored bands. The dark bands represent the presence of genetic material coming from a combination of both parents. For example, if a child has a dark band in location 3 on the barcode, then at least 1 parent **must** also have a dark band in location 3 on their barcode. When comparing a child with 2 possible parents, the child's barcode must share **every** dark band with at least 1 parent. Close does not count! Even 1 dark band not shared with a potential parent will rule out the possibility. Matching dark bands is the key; light bands do not matter.
3. Example: Could 11 be the offspring of 10 and 12? Mummy 11's first dark band (band 4) also appears in the barcodes of 10 and 12. The next dark band (band 6), however, does not appear in either mummy 10's or mummy 12's barcode. The absence of dark band 6 in either potential parent rules out the possibility.
4. Cut the paper DNA fingerprint models (barcodes) into column strips.
5. Use the barcodes to fill-in the mummy family tree.