Lulu the Lioness: A Heroine's Story

Based on a true story of parentage, genetics, and direct animal observations.

DATA SET 1: Behavioral Observation Data

Excerpts from Research Field Notes: 1992 Africa Expedition, Etosha National Park
Will work on pedigree with new genetics data that has just come back. New cub 713 sighted. Samples taken.

Excerpts from Research Field Notes: 1992 Africa Expedition, Etosha National Park

Date: *March 20th* Location: *Rietfontein Pride, Namibia*

Male 633 present along with females 628, 630, 664, 670, and 687. Male oldest animal in pride currently.
Male limping?
Male 633 awake and moving ok.
628 and 630 may be sisters as they appear to be same age. Either of these two may be mother of 664, 670, or 687.
Observed 664 and 670 which is a reminder that these females have been difficult to sample. Unsuccessful attempts have been made.

Date: *June 12th* Location: *Rietfontein Pride, Namibia*

Male 633 missing. 2 new males present, 631 and 695. Female 630 missing. Cubs 709, 710, 711, 712 also missing, presumed dead? Other females still present, mating observed between 631 and 628.

Males 631 and 695 seem to wander over a large area (nomadic?). Have been seen with Gemsbock females and the Obad females. These two males seemed to have settled in the Rietfontein area.

Date: *June 15th* Location: *Homob Pride, Namibia*

630 found in neighboring pride! Cubs 709, 710, 711, 712 all accounted for in new pride also. Sending blood samples from each to determine parentage. Cubs were trapped and checked by field vet. Blood samples taken for genetic analysis to be performed later. 630 presumed mother, locals calling her Lulu.

Date: *August 1st* Location: *Homob Pride, Namibia*

630 still a part of this pride. Cubs 709, 710, 711, 712 all accounted for and doing well. 709 appears to be male and other siblings appear to be female.

Excerpts from Research Field Notes: 1993 Africa Expedition, Etosha National Park

Date: *March 15th* Location: *Rietfontein Pride, Namibia*

630 seen back as part of this pride with new cubs. Cubs 709, 710, 711, 712 not present. 631 and 695 still patriarchs of pride.

Date: *March 30th* Location: *Homob Pride, Namibia*

710, 711, 712 present. 709 missing, presumably to another pride. Will work on pedigree with new genetics data that has just come back. New cub 713 sighted. Samples taken.

Name: _____

The big question to consider as you work: How do we determine parentage?

Supporting questions to consider as you work:
How can we determine who the mother is?
How can we determine who the father is?
Why does knowing the parents matter?

What will we do?
We will identify individuals and form hypotheses regarding their relationships.

Procedure:

1. Read the field notes on the other side of this sheet.
2. Consider possible family relationships that exist among members of the pride.
3. Discuss with your group who the probable parents are of the cubs.
4. Formulate a hypothesis for parentage based on observation data.

Making sense:

1. Summarize what seems to have happened in the pride during the period of observation.

2. What ideas do you have about who fathered the cubs?

   2a. What evidence supports this idea?

3. What ideas do you have about who mothered the cubs?

   3a. What evidence supports this idea?

Hypotheses:

Based on evidence, the mother of the cubs is _____.

Based on evidence, the father of the cubs is _____.

DATA SET 2: Geographical Observation Data

Lion ID	Gender	Birth Year	Status	Origin	Residing Now?
628	F	1984	Alive	Rietfontein	Rietfontein
630	F	1984	Alive	Rietfontein	Rietfontein
664	F	1989	Alive	Rietfontein	Rietfontein
670	F	1989	Alive	Rietfontein	Rietfontein
687	F	1989	Alive	Rietfontein	Rietfontein

Lion ID	Gender	Birth Year	Status	Origin	Residing Now?
633	M	1983	Dead? (1992)	Unknown	N/A
631	M	1984	Alive	Goas	Rietfontein
695	M	1985	Alive	Unknown	Rietfontein
657	M	1989	Alive	Rietfontein	Unknown
668	M	1988	Alive	Rietfontein	S. African Reserve

Cubs born into Rietfontein pride:

Lion ID	Gender	Birth Year	Status	Origin	Residing Now?
709	F	1992	Alive	Rietfontein	Homob
710	F	1992	Alive	Rietfontein	Homob
711	F	1992	Alive	Rietfontein	Homob
712	F	1992	Alive	Rietfontein	Homob
713	F	1993	Alive	Rietfontein	Rietfontein

Etosha National Park, Namibia

Key:	Colors and/or Symbols used		Colors and/or Symbols used
628		657	
630		668	
664		709	
670		710	
687		711	
633		712	
631		713	
695			

Name: _____

On the map below, label where each lion in the tables above originated, then drawing arrows for each to show where they traveled. Use a different color for each lion. If the lion died or is no longer around, put a single line through its ID number. Be sure to fill in the key below the map to show each lion's color.

The big question to consider as you work: How do we determine parentage?

Supporting questions to consider as you work:

How can we determine who the mother is?
How can we determine who the father is?
Why does knowing the parents matter?

What will we do?
We will determine the locations of individuals and reassess our hypotheses regarding their relationships

Procedure:

1. Using the field notes from Data Set 1 and Geographical Observation Data Set 2 on the back of this sheet, determine where individuals were sighted.
2. Consider possible family relationships that exist among members of the pride based on this combined data.
3. Discuss with your group who the probable parents are of the cubs.
4. Determine whether your hypotheses for parentage changed based on this new data.

Making sense:

1. Identify the three (3) most significant observations from the data provided.

o

o

o

2. Did this new data set change your hypotheses about the parents? _____

If it changed, what evidence caused this change? If it did not change, what evidence supported your hypotheses?

3. What data would be helpful in testing your hypotheses?

Name: _____

Research: African Lion

The big question to consider as you work: How do we determine parentage?

Supporting questions to consider as you work: ***How can we determine who the mother is?***
How can we determine who the father is?
Why does knowing the parents matter?

What will we do?
We will research the African lion species to help us better understand their relationships.

Procedure:

1. Using Internet resources, you will research this species to answer the following questions.
2. You will cite your resources, being sure to only use reliable resources.
   a. Reliable resources are typically published by professional organizations, institutions, universities, scientific societies, and other reputable sources.
3. Discuss with your group how pride structure increases fitness/survival.
4. Reassess your hypothesis for parentage based on your research.

Making sense:

1. What is this species' scientific name? _____

Resource: _____

2. Briefly describe what roles males and females play in the pride.

Resource: _____

Resource: _____

3. What niche do lions fill in their habitat? _____

3a. Why is this niche critical to maintain a healthy community?

Resource: _____

3b. Which sex is mainly responsible for this niche?

Resource: _____

4. Who is responsible for controlling the pride's territory? _____

Resource: _____

5. If the pride is taken over by new individuals, what happens to the…

a. females? _____

Resource: _____

b. males? _____

Resource: _____

c. cubs? _____

Resource: _____

6. How are cubs raised within the pride?

Resource: _____

7. How do the roles filled by the females increase the survival of the species?

Resource: _____

8. How do the roles filled by the males increase the survival of the species?

Resource: _____

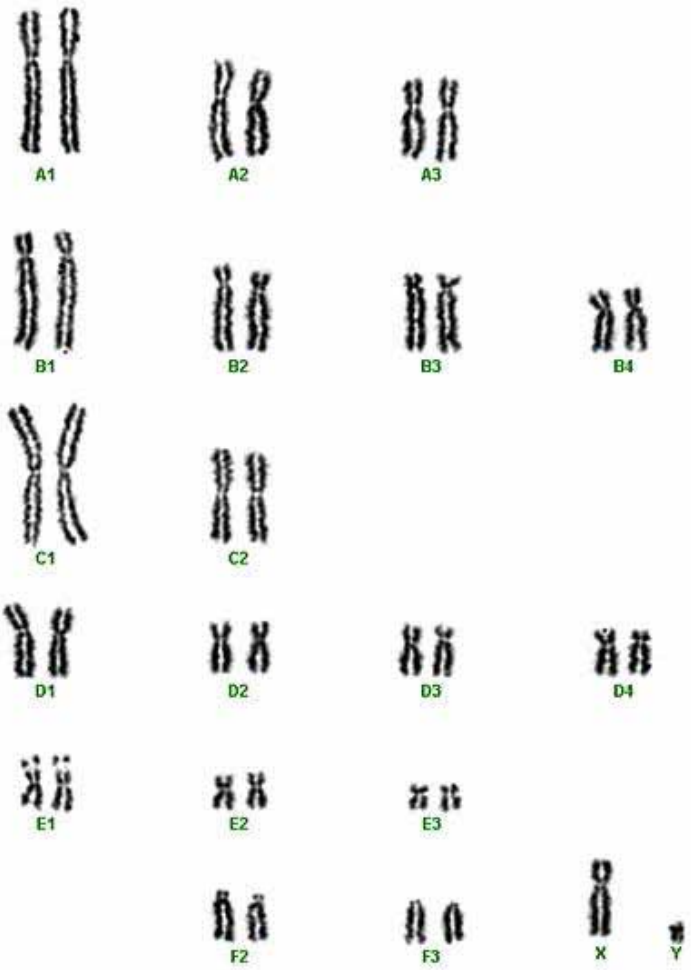
9. Explain how living in a group like these lions increases the fitness of a species.

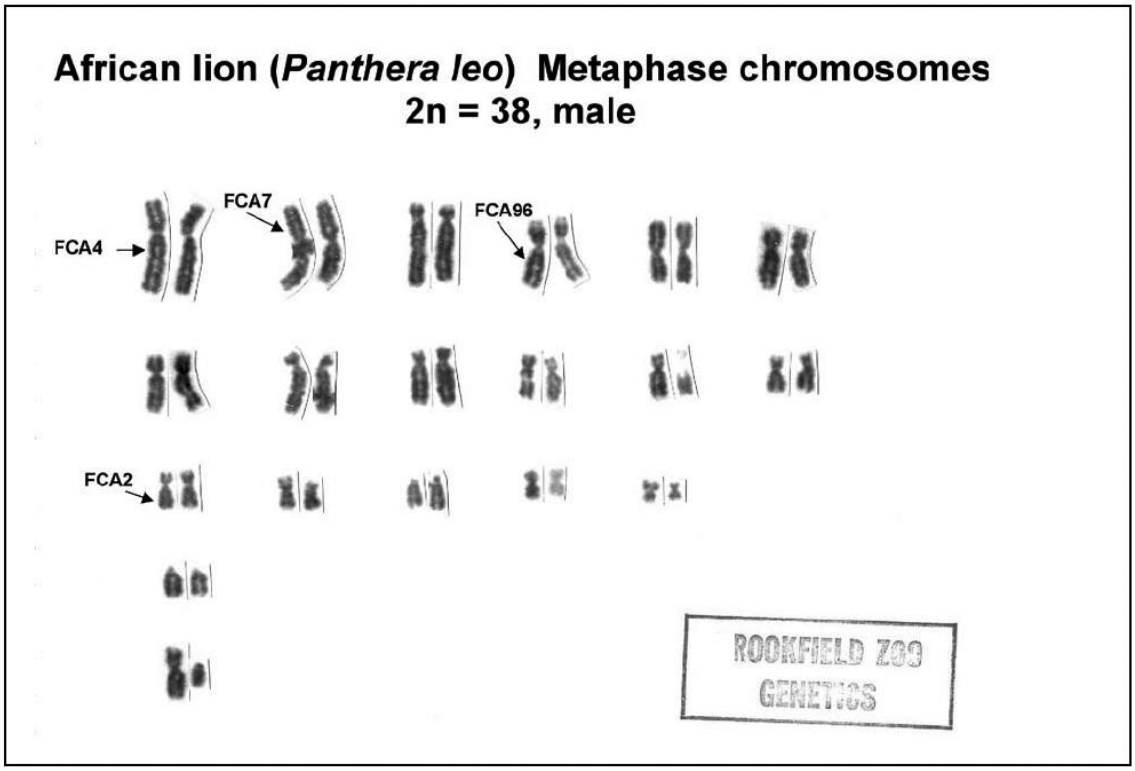
10. Does this research support your hypothesis? YES NO NOT ENOUGH INFO

Explain how this information either supports your hypothesis or made you rethink it.

DATA SET 3: Karyotype Data

These are karyotypes, or organized pictures of chromosomes, from two of the lion cubs. All lions have the same basic karyotype. Each chromosome contains genes, some of which are labeled below.





Name: _____

The big question to consider as you work: How do we determine parentage?

Supporting questions to consider as you work:
How can we determine who the mother is?
How can we determine who the father is?
Why does knowing the parents matter?

What will we do?
We will make observations of karyotypes and reassess our hypotheses regarding their relationships.

Procedure:

1. After carefully making observations of the karyotypes, determine whether patterns exist.

2. Discuss with your group what patterns exist.

3. Discuss with your group if the karyotypes help determine the probable parents are of the cubs.

4. Determine whether your hypotheses for parentage changed based on this new data.

Making sense:

1. What observations did you make when viewing the karyotypes? What did they have in common?

2. Why are the chromosomes paired? What does this tell you?

3. From where do lion cubs get their chromosomes? How does this happen to produce the pattern you see in the karyotype?

4. How can your answer from question 3 help us prove who the parents are?

5. Does this karyotype help you determine the parentage of the cubs? _____

5a. What other information would be helpful to answer your question?

DATA SET 4: Female Lion & Cub Genotype Data

Section A – Alleles				
Locus	**FCA26**	**FCA45**	**FCA77**	**FCA96**
Alleles	A	M	S	D
	B	N	T	E
	C	O	U	F
				G
				H

Section B – Genotype Data				
Females	**FCA26**	**FCA45**	**FCA77**	**FCA96**
628	A/B	M/N	S/S	D/D
630	B/B	M/N	S/U	E/H
687	C/C	M/N	T/U	D/G

Cubs	**FCA26**	**FCA45**	**FCA77**	**FCA96**
709	A/C	M/M	S/S	D/D
710	A/B	M/N	S/U	D/D
711	B/B	M/O	S/T	E/H
712	C/C	M/O	S/U	E/G
713	A/B	M/O	S/S	D/F

The data above is for all female lions sighted with the cubs during the observation period. A genotype is the combination of alleles that each individual organism has, one from each parent.

The blood samples that were collected as referenced by the field notes in Data Set 1 were sent to the genetics lab for analysis. The data above was the result.

Patterns emerge when using genotypes so you should make observations in order to use these patterns to determine the parentage of the cubs.

Name: _____

The big question to consider as you work: How do we determine parentage?

Supporting questions to consider as you work:
How can we determine who the mother is?
How can we determine who the father is?
Why does knowing the parents matter?

What will we do?
We will identify patterns among the genotypes of the female individuals, comparing them to the cubs, in order to reassess our hypotheses regarding their relationships.

Procedure:

1. Using the genotype data from Data Set 4 on the back of this sheet, look for patterns among individuals.
2. Consider possible family relationships that exist among members of the pride based on this combined data.
3. Discuss with your group how this data could be used to definitely determine who the mother is of the cubs.
4. Determine whether your hypotheses for parentage was proven true or false, citing evidence.

Making sense:

1. What observations did you make when viewing the genotypes?
2. Discuss with your group how you can make sense of this genotype data and how it can be used to determine parentage.

Write the procedural steps here, adding more steps if needed:

Step 1:

Step 2:

Step 3:

3. Did this data prove your hypotheses? Why or Why not?

4. Cite your evidence here:

5. What other information do you need to determine parentage?

DATA SET 5: Complete Pride Genotype Data

Section A – Alleles				
Locus	**FCA26**	**FCA45**	**FCA77**	**FCA96**
Alleles	A	M	S	D
	B	N	T	E
	C	O	U	F
				G
				H

Section B – Genotype Data				
Females	**FCA26**	**FCA45**	**FCA77**	**FCA96**
628	A/B	M/N	S/S	D/D
630	B/B	M/N	S/U	E/H
687	C/C	M/N	T/U	D/G
Males	**FCA26**	**FCA45**	**FCA77**	**FCA96**
633	B/C	N/O	S/T	D/E
631	A/A	M/O	S/S	F/H
695	B/C	N/O	T/T	D/F
668	B/C	M/O	S/U	D/D
657	C/C	M/M	S/T	H/G
Cubs	**FCA26**	**FCA45**	**FCA77**	**FCA96**
709	A/C	M/M	S/S	D/D
710	A/B	M/N	S/U	D/D
711	B/B	M/O	S/T	E/H
712	C/C	M/O	S/U	E/G
713	A/B	M/O	S/S	D/F

The data above is for all lions sighted during the observation period. A genotype is the combination of alleles that each individual organism has, one from each parent.

The blood samples that were collected as referenced by the field notes in Data Set 1 were sent to the genetics lab for analysis. The data above was the result.

Patterns emerge when using genotypes so you should make observations in order to use these patterns to determine the parentage of the cubs.

Name: _____

The big question to consider as you work: How do we determine parentage?

Supporting questions to consider as you work: ***How can we determine who the mother is?***
How can we determine who the father is?
Why does knowing the parents matter?

What will we do?

We will identify patterns among the genotypes of all pride individuals and reassess our hypotheses regarding their relationships.

Procedure:

1. Using the genotype data from Data Set 5 on the back of this sheet, look for patterns among individuals.
2. Consider possible family relationships that exist among members of the pride based on this combined data.
3. Discuss with your group how this data could be used to definitely determine who the mother is of the cubs.
4. Determine whether your hypotheses for parentage was proven true or false, citing evidence.

Making sense:

1. What observations did you make when viewing the genotypes?
2. Discuss with your group how you can make sense of this genotype data and how it can be used to determine parentage. Write the procedural steps here, adding more steps if needed:

Step 1:

Step 2:

Step 3:

3. How was this procedure different now that the male genotypes are available?

4. Did this data prove your hypotheses? Cite your evidence here:

5. Below, determine a way to represent your data and findings. Tables should be done using pencil and a straight edge and should be designed to make sense to another reader.

Do the mother side first, then look for Dad.

Section C – Data Analysis										
		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	709	A/C	M/M	S/S	D/D	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	710	A/B	M/N	S/U	D/D	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	711	B/B	M/O	S/T	E/H	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	712	C/C	M/O	S/U	E/G	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	713	A/B	M/O	S/S	D/F	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

Final Report – Lion Parentage Investigation

Name: _____

1. What line of evidence was most important in determining parentage? _____

   1a. Why was this case? _____

_____

2. How did this line of evidence change things for your group's initial claim? _____

_____

_____

3. All of this data is from an actual research project that is ongoing in Africa in conjunction with researchers here in the area.

   Why do you think the researchers were surprised by these findings? _____

_____

_____

4. Describe why genetics is now required to study species like these lions. _____

_____

_____

5. Was Lulu (#630) the mother of all cubs? (Circle one) YES NO NOT ENOUGH INFO

Explain: _____

_____

_____

6. Was Lulu related to the cubs? (Circle one) YES NO NOT ENOUGH INFO

Cite three (3) pieces of specific evidence here to support your answer: _____

_____

_____

_____

7. Was there a benefit for Lulu (#630) to raise these cubs? (Circle one) YES NO NOT ENOUGH INFO

Explain: _____

_____

_____

Turn this sheet over to continue your final report.

8. Based on your experience with this data from Africa, how is it advantageous for some species like lions to live in a social group? _____

_____

_____

9. Do you think lions in this pride are related to lions in other prides? (Circle one) YES NO NOT ENOUGH INFO

Where would you look to find evidence to support this claim? _____

_____

_____

10. Do you think all African lions are the same species? (Circle one) YES NO NOT ENOUGH INFO

What kind of data would you need to research this? _____

_____

How would you use this data to test this? _____

_____

_____

Individual Self-Assessment: The final supporting question you saw throughout this lab activity asks why knowing parentage is important. How could this knowledge help wild populations of endangered species? How could it also help with zoo populations? After considering the discussions you had with your group to answer the questions above, compose a well-written and thoughtful conclusion here:

_____

_____

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