Step One: What is the minimum distance a bighorn sheep would have to travel from the Cady Mountains population to find a mate in a different population?

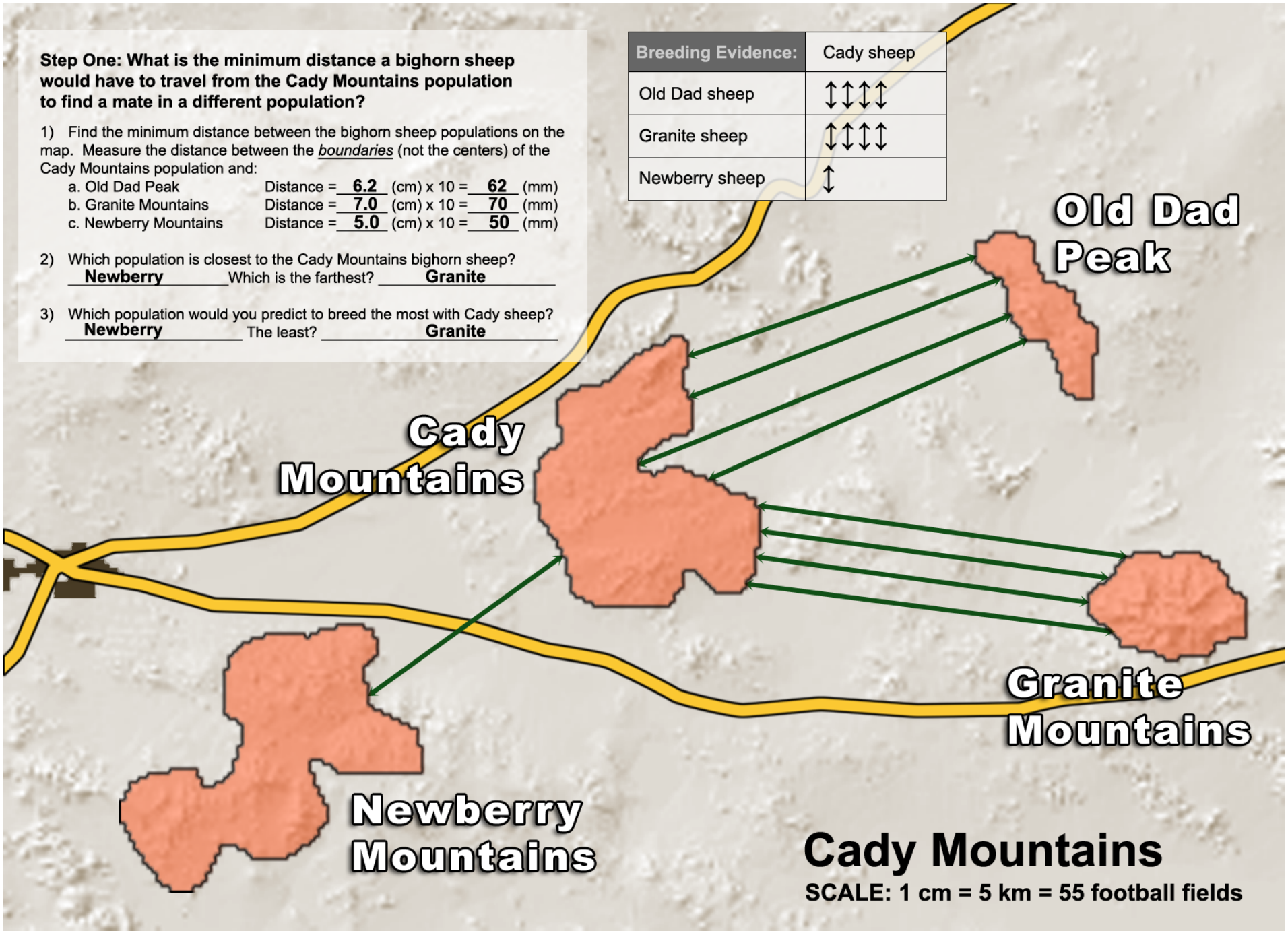
1) Find the minimum distance between the bighorn sheep populations on the map. Measure the distance between the *boundaries* (not the centers) of the Cady Mountains population and:

a. Old Dad Peak Distance = **6.2** (cm) x 10 = **62** (mm)
b. Granite Mountains Distance = **7.0** (cm) x 10 = **70** (mm)
c. Newberry Mountains Distance = **5.0** (cm) x 10 = **50** (mm)

2) Which population is closest to the Cady Mountains bighorn sheep? **Newberry** Which is the farthest? **Granite**

3) Which population would you predict to breed the most with Cady sheep? **Newberry** The least? **Granite**

Breeding Evidence:	Cady sheep
Old Dad sheep	↕↕↕↕
Granite sheep	↕↕↕↕
Newberry sheep	↕



CADY MOUNTAINS

Step 2: How much mating is taking place between sheep populations on neighboring mountains?

By looking at the genes of different populations, scientists can tell how much breeding takes place between neighboring populations.
The genetic data below translated into arrows indicate breeding levels between sheep populations from different mountains:
Many arrows (↕↕↕↕↕↕) means that more breeding occurs between two populations
Few arrows (↕) means that less breeding occurs between populations – Inbreeding

Instructions:

1) Draw double-headed arrows on your map to connect the sheep populations from different mountains to one another.
2) Use the number of arrows indicated by the table below. For example, use four double-headed arrows to connect Old Dad sheep and Cady sheep.

Breeding Evidence of Cady Sheep	
	Cady Sheep
Old Dad Sheep	↕↕↕↕
Granite Sheep	↕↕↕↕
Newberry Sheep	↕

Step 3: Compare your predictions from step 1 with the data from step 2:

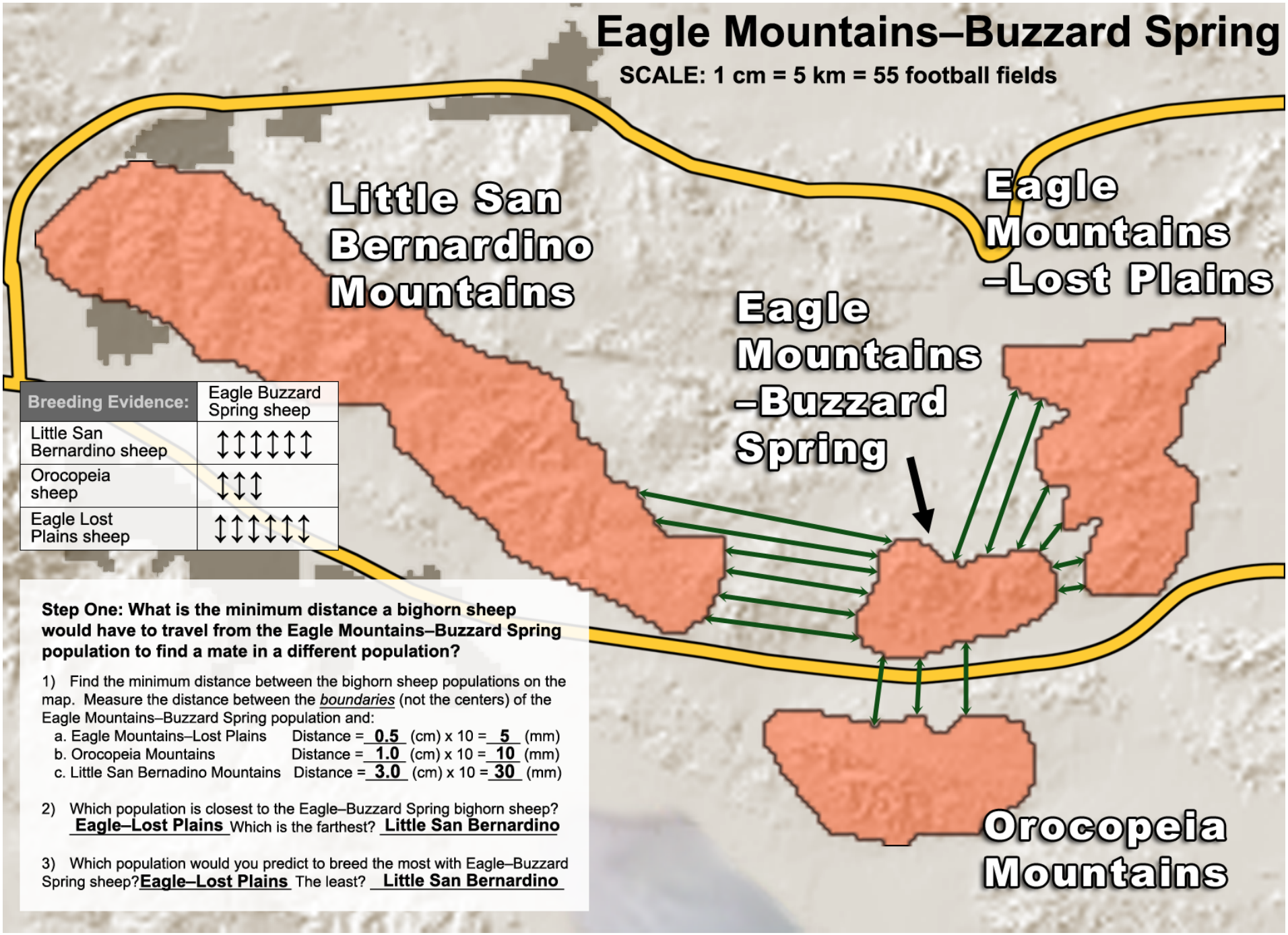
Instructions:

1) Answer questions below
2) Use your answers to the questions to make a prediction of where the highway is located. Draw the highway onto the map.

A. Based upon distance, what sheep population would you have expected Cady Mountain sheep to breed with most frequently?
Newberry Mountain sheep

B. What do the genetic data show? Which population do they breed with most frequently?
Granite Sheep

C. Where do you predict the highway lies amongst the mountain ranges? Draw your prediction on the map.
The highway must lie between Cady Mountain and Newberry Mountain.



Breeding Evidence:	Eagle Buzzard Spring sheep
Little San Bernardino sheep	↕↕↕↕↕↕
Orocopeia sheep	↕↕↕
Eagle Lost Plains sheep	↕↕↕↕↕↕

Step One: What is the minimum distance a bighorn sheep would have to travel from the Eagle Mountains–Buzzard Spring population to find a mate in a different population?

1) Find the minimum distance between the bighorn sheep populations on the map. Measure the distance between the *boundaries* (not the centers) of the Eagle Mountains–Buzzard Spring population and:

a. Eagle Mountains–Lost Plains Distance = **0.5** (cm) x 10 = **5** (mm)
b. Orocopeia Mountains Distance = **1.0** (cm) x 10 = **10** (mm)
c. Little San Bernadino Mountains Distance = **3.0** (cm) x 10 = **30** (mm)

2) Which population is closest to the Eagle–Buzzard Spring bighorn sheep? **Eagle–Lost Plains** Which is the farthest? **Little San Bernardino**

3) Which population would you predict to breed the most with Eagle–Buzzard Spring sheep? **Eagle–Lost Plains** The least? **Little San Bernardino**

EAGLE BUZZARD SPRING

Step 2: How much mating is taking place between sheep populations on neighboring mountains?

By looking at the genes of different populations, scientists can tell how much breeding takes place between neighboring populations.
The genetic data below translated into arrows indicate breeding levels between sheep populations from different mountains:
Many arrows (↕↕↕↕↕↕) means that more breeding occurs between two populations
Few arrows (↕) means that less breeding occurs between populations – Inbreeding

Instructions:

1) Draw double-headed arrows on your map to connect the sheep populations from different mountains to one another.
2) Use the number of arrows indicated by the table below. For example, use six double-headed arrows to connect Eagle-Buzzard Spring sheep and Little San Bernardino sheep.

Breeding Evidence of Eagle-Buzzard Spring Sheep	
	Eagle Buzzard Spring Sheep
Little San Bernardino Sheep	↕↕↕↕↕↕
Orocopeia Sheep	↕↕↕
Eagle Lost Plains Sheep	↕↕↕↕↕↕

Step 3: Compare your predictions from step 1 with the data from step 2:

Instructions:
1) Answer questions below
2) Use your answers to the questions to make a prediction of where the highway is located. Draw the highway onto the map.

A. Based upon distance, what sheep population would you expect Eagle-Buzzard Spring sheep to breed with least often?
Little San Bernardino sheep

B. What do the genetic data show? With what sheep population do they show the least signs of breeding?
Orocopeia

C. Where do you predict the highway lies amongst the mountain ranges? Draw your prediction on the map.
The highway must lie between Eagle Buzzard Spring and Orocopeia Mountains.

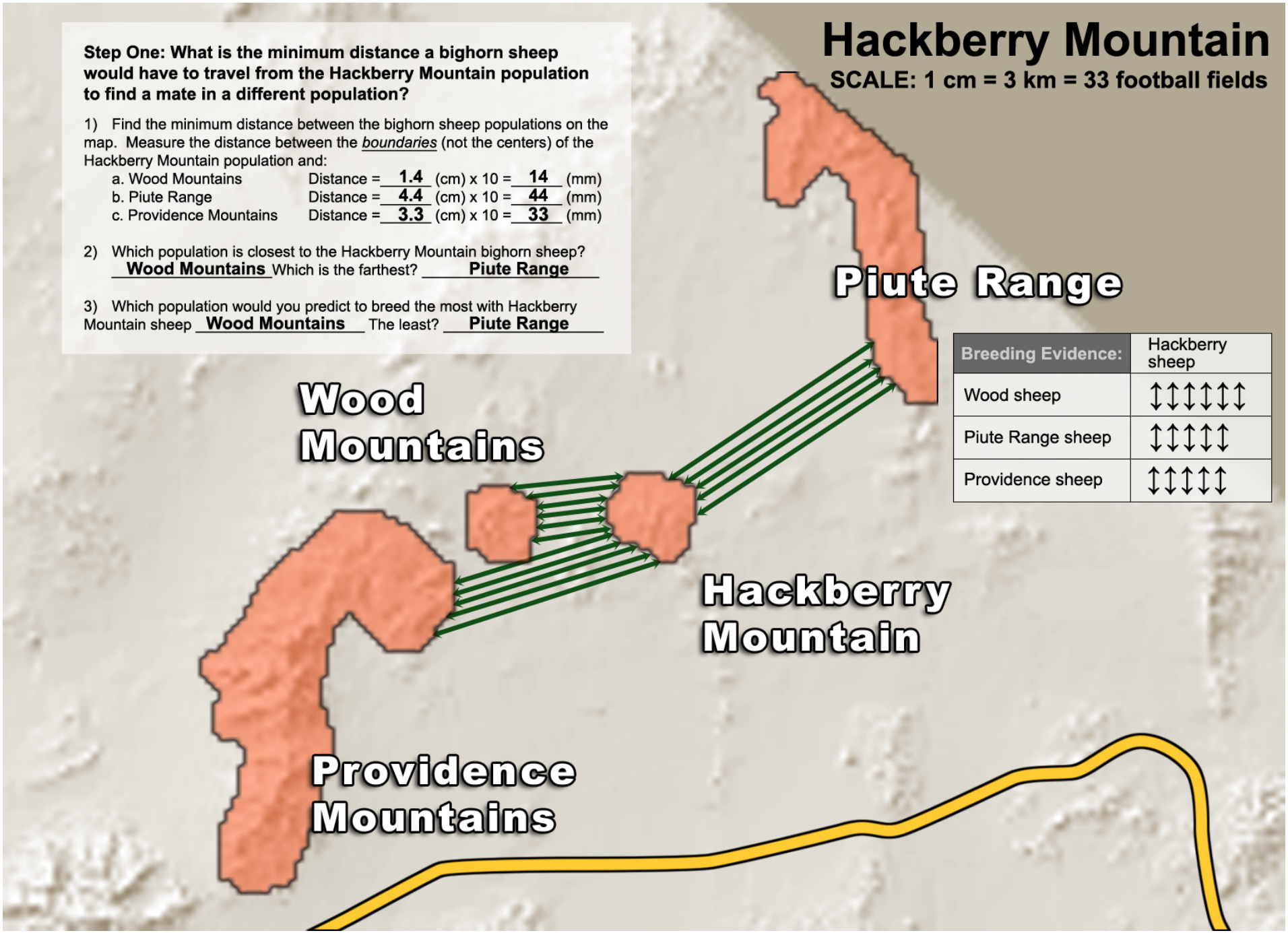
Step One: What is the minimum distance a bighorn sheep would have to travel from the Hackberry Mountain population to find a mate in a different population?

1) Find the minimum distance between the bighorn sheep populations on the map. Measure the distance between the *boundaries* (not the centers) of the Hackberry Mountain population and:

a. Wood Mountains Distance = **1.4** (cm) x 10 = **14** (mm)
b. Piute Range Distance = **4.4** (cm) x 10 = **44** (mm)
c. Providence Mountains Distance = **3.3** (cm) x 10 = **33** (mm)

2) Which population is closest to the Hackberry Mountain bighorn sheep? **Wood Mountains** Which is the farthest? **Piute Range**

3) Which population would you predict to breed the most with Hackberry Mountain sheep **Wood Mountains** The least? **Piute Range**



HACKBERRY MOUNTAIN

Step 2: How much mating is taking place between sheep populations on neighboring mountains?

By looking at the genes of different populations, scientists can tell how much breeding takes place between neighboring populations.

The genetic data below translated into arrows indicate breeding levels between sheep populations from different mountains:
Many arrows (↕↕↕↕↕↕) means that more breeding occurs between two populations
Few arrows (↕) means that less breeding occurs between populations – Inbreeding

Instructions:

1) Draw double-headed arrows on your map to connect the sheep populations from different mountains to one another.
2) Use the number of arrows indicated by the table below. For example, use five double-headed arrows to connect Hackberry to Piute Range

Breeding Evidence of Hackberry Sheep	
	Hackberry Sheep
Wood Sheep	↕↕↕↕↕↕
Piute Range Sheep	↕↕↕↕↕
Providence Sheep	↕↕↕↕↕

Step 3: Compare your predictions from step 1 with the data from step 2:

Instructions:
1) Answer questions below
2) Use your answers to the questions to make a prediction of where the highway is located. Draw the highway onto the map.

A. Based upon distance, what sheep population would you have expected Hackberry sheep to breed with most frequently?

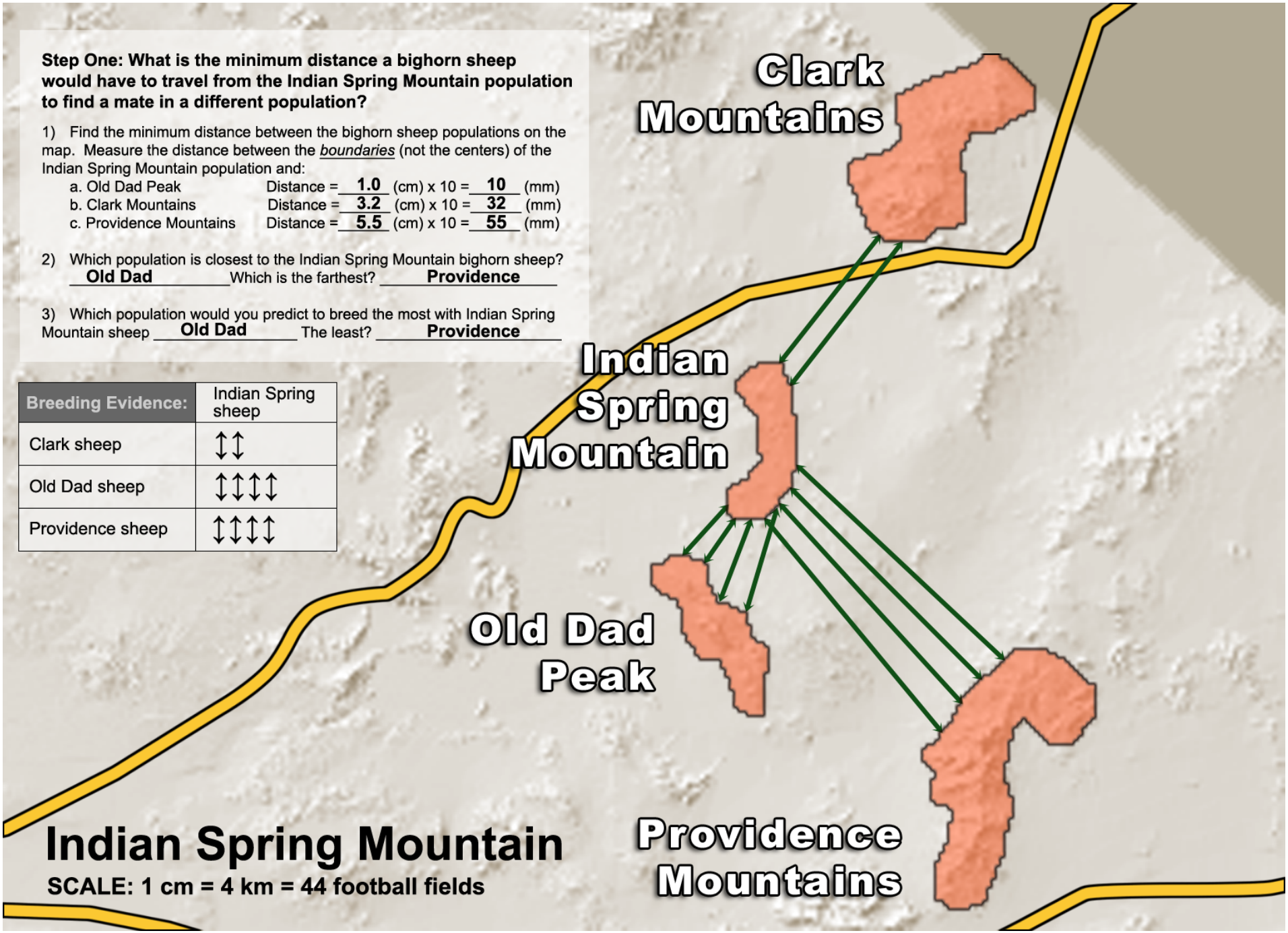
Wood

B. B. What do the genetic data show? With which population do they breed with most frequently?

Wood

C. Where do you predict the highway lies amongst these mountain ranges? Can you find an obvious place to put the highway?

I cannot find an obvious place to put the highway.



Step One: What is the minimum distance a bighorn sheep would have to travel from the Indian Spring Mountain population to find a mate in a different population?

1) Find the minimum distance between the bighorn sheep populations on the map. Measure the distance between the *boundaries* (not the centers) of the Indian Spring Mountain population and:

a. Old Dad Peak Distance = **1.0** (cm) x 10 = **10** (mm)
b. Clark Mountains Distance = **3.2** (cm) x 10 = **32** (mm)
c. Providence Mountains Distance = **5.5** (cm) x 10 = **55** (mm)

2) Which population is closest to the Indian Spring Mountain bighorn sheep? **Old Dad** Which is the farthest? **Providence**

3) Which population would you predict to breed the most with Indian Spring Mountain sheep **Old Dad** The least? **Providence**

Breeding Evidence:	Indian Spring sheep
Clark sheep	↕↕
Old Dad sheep	↕↕↕↕
Providence sheep	↕↕↕↕

INDIAN SPRING MOUNTAIN

Step 2: How much mating is taking place between sheep populations on neighboring mountains?

By looking at the genes of different populations, scientists can tell how much breeding takes place between neighboring populations.

The genetic data below translated into arrows indicate breeding levels between sheep populations from different mountains:
Many arrows (↕↕↕↕↕↕) means that more breeding occurs between two populations
Few arrows (↕) means that less breeding occurs between populations – Inbreeding

Instructions:

1) Draw double-headed arrows on your map to connect the sheep populations from different mountains to one another.
2) Use the number of arrows indicated by the table below. For example, use two double-headed arrows to connect Clark and Indian Spring sheep.

Breeding Evidence of Indian Spring Sheep	
	Indian Spring
Clark Sheep	↕↕
Old Dad Sheep	↕↕↕↕
Providence Sheep	↕↕↕↕

Step 3: Compare your predictions from step 1 with the data from step 2:

1) Answer questions below
2) Use your answers to the questions to make a prediction of where the highway is located. Draw the highway onto the map.

A. The data show that Indian Spring Mountain sheep breed less frequently with Clark Mountain sheep than with Providence sheep. Why do you think this is so?

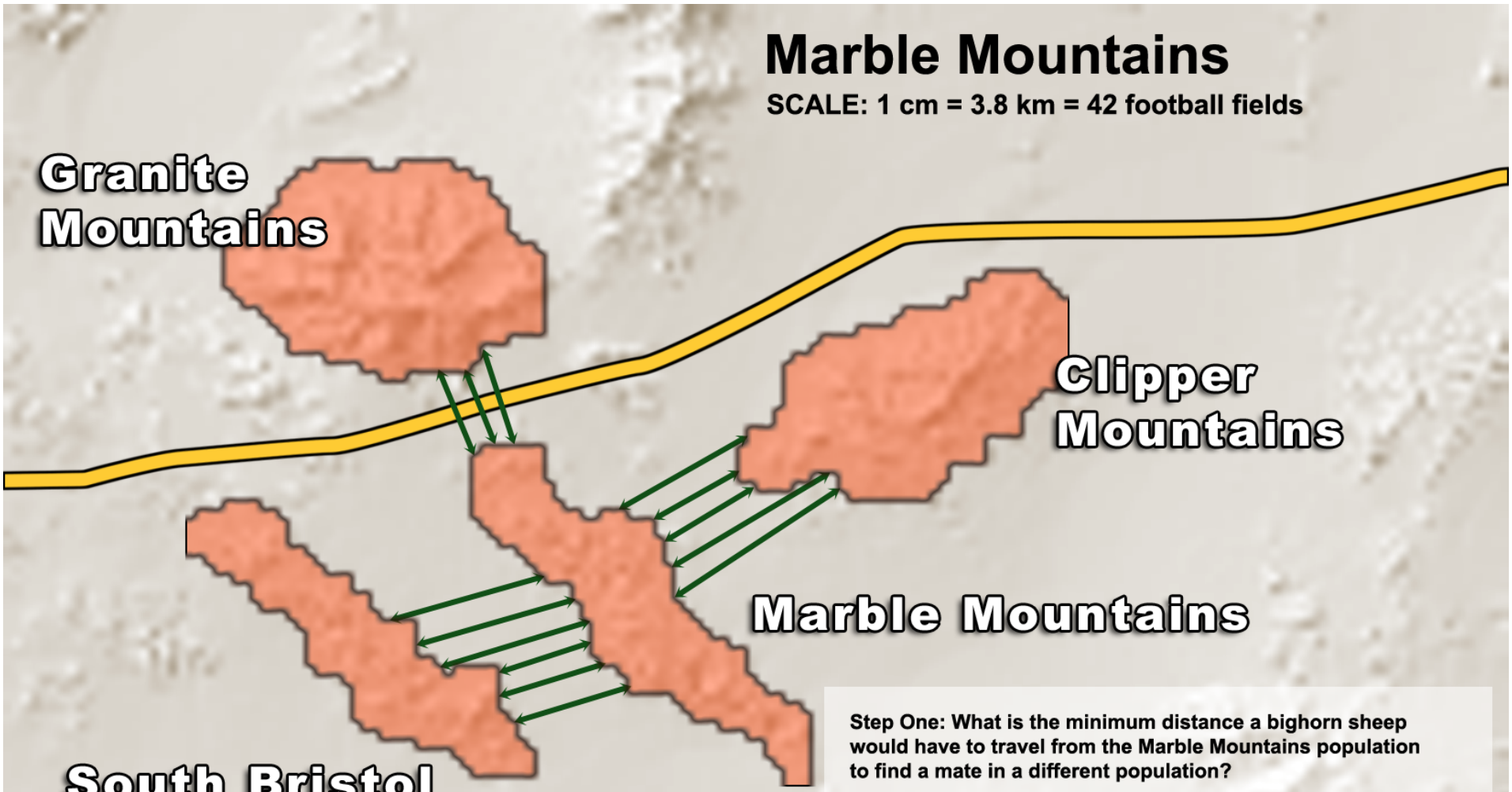
Because a highway prevents breeding between the populations

B. Where do you predict the highway lies amongst the mountain ranges? Draw your prediction on the map.

The highway lies between Indian Spring and Clark Mountains.

Marble Mountains

SCALE: 1 cm = 3.8 km = 42 football fields



Breeding Evidence:	Marble sheep
Granite sheep	↕↕↕↕
South Bristol sheep	↕↕↕↕↕↕
Clipper sheep	↕↕↕↕↕

Step One: What is the minimum distance a bighorn sheep would have to travel from the Marble Mountains population to find a mate in a different population?

1) Find the minimum distance between the bighorn sheep populations on the map. Measure the distance between the *boundaries* (not the centers) of the Marble Mountains population and:

a. Granite Mountains Distance = **1.3** (cm) x 10 = **13** (mm)
b. South Bristol Mountains Distance = **1.5** (cm) x 10 = **15** (mm)
c. Clipper Mountains Distance = **1.6** (cm) x 10 = **16** (mm)

2) Which population is closest to the Marble Mountains bighorn sheep? **Granite** Which is the farthest? **Clipper**

3) Which population would you predict to breed the most with Marble Mountains sheep **Granite** The least? **Clipper**

MARBLE MOUNTAINS

Step 2: How much mating is taking place between sheep populations on neighboring mountains?

By looking at the genes of different populations, scientists can tell how much breeding takes place between neighboring populations.

The genetic data below translated into arrows indicate breeding levels between sheep populations from different mountains:
Many arrows (↕↕↕↕↕↕) means that more breeding occurs between two populations
Few arrows (↕) means that less breeding occurs between populations – Inbreeding

Instructions:

1) Draw double-headed arrows on your map to connect the sheep populations from different mountains to one another.
2) Use the number of arrows indicated by the table below. For example, use four double-headed arrows to connect Marble sheep and Granite sheep.

Breeding Evidence of Marble Sheep	
	Marble Sheep
Granite Sheep	↕↕↕↕
South Bristol Sheep	↕↕↕↕↕↕
Clipper Sheep	↕↕↕↕↕

Step 3: Compare your predictions from step 1 with the data from step 2:

Instructions:

1) Answer questions below
2) Use your answers to the questions to make a prediction of where the highway is located. Draw the highway onto the map.

A. Based upon distance, what sheep population would you have expected Marble sheep to breed with most frequently?

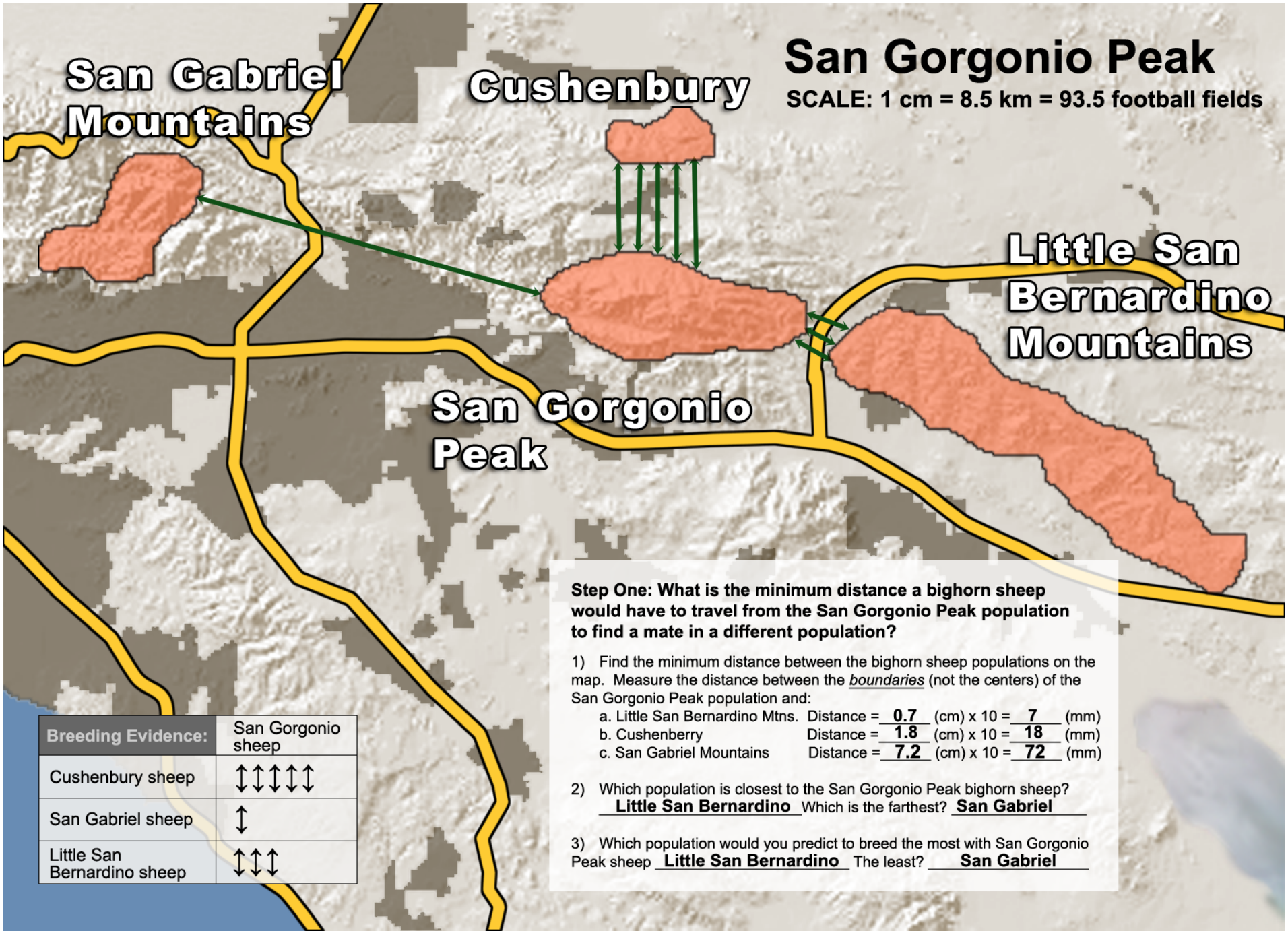
Granite Mountain sheep

B. What do the genetic data show? With which population do they breed with most frequently?

They breed most frequently with South Bristol sheep.

C. Where do you predict the highway lies amongst the mountain ranges? Draw your prediction on the map.

The highway must lie between Marble Mountain and Granite Mountain.



Breeding Evidence:	San Gorgonio sheep
Cushenbury sheep	↕↕↕↕↕
San Gabriel sheep	↕
Little San Bernardino sheep	↕↕↕

Step One: What is the minimum distance a bighorn sheep would have to travel from the San Gorgonio Peak population to find a mate in a different population?

1) Find the minimum distance between the bighorn sheep populations on the map. Measure the distance between the *boundaries* (not the centers) of the San Gorgonio Peak population and:

a. Little San Bernardino Mtns. Distance = **0.7** (cm) x 10 = **7** (mm)
b. Cushenberry Distance = **1.8** (cm) x 10 = **18** (mm)
c. San Gabriel Mountains Distance = **7.2** (cm) x 10 = **72** (mm)

2) Which population is closest to the San Gorgonio Peak bighorn sheep? **Little San Bernardino** Which is the farthest? **San Gabriel**

3) Which population would you predict to breed the most with San Gorgonio Peak sheep **Little San Bernardino** The least? **San Gabriel**

SAN GORGORNIO PEAK

Step 2: How much mating is taking place between sheep populations on neighboring mountains?

By looking at the genes of different populations, scientists can tell how much breeding takes place between neighboring populations.

The genetic data below translated into arrows indicate breeding levels between sheep populations from different mountains:
Many arrows (↕↕↕↕↕↕) means that more breeding occurs between two populations
Few arrows (↕) means that less breeding occurs between populations – Inbreeding

Instructions:

1) Draw double-headed arrows on your map to connect the sheep populations from different mountains to one another.
2) Use the number of arrows indicated by the table below. For example, use five double-headed arrows to connect Cushenbury sheep and San Gorgonio sheep.

Breeding Evidence of San Gorgonio Sheep	
	San Gorgonio
Cushenbury Sheep	↕↕↕↕↕
San Gabriel Sheep	↕
Little San Bernardino Sheep	↕↕↕

Step 3: Compare your predictions from step 1 with the data from step 2:

Instructions:

1) Answer questions below
2) Use your answers to the questions to make a prediction of where the highway is located. Draw the highway onto the map.

A. The sheep from San Gorgonio Mountain live very close to the sheep from Little San Bernardino Mountain. Why do the data show that they breed with those sheep less frequently than they do with Cushenbury sheep?
There must be a highway between them.

B. Where do you predict the highway lies amongst the mountain ranges? Draw your prediction on the map.
Between San Gorgonio and Little San Bernardino Mountains. San Gabriel might also be separated by a highway.