## 1. The Case of the Bloody Knife

Late one April night, government agents received an anonymous tip that the Smithsonian Museum was about to be robbed of its priceless jewel collection. When the FBI agents arrived at the museum, they saw that they were too late: the jewels were gone. Lying facedown on the floor next to the empty jewel case was the body of a man. The chief inspector recognized the man as Heinrich Milhouse. Milhouse had been shot in the chest at close range; his clothes were saturated with blood. Underneath the body, the inspectors found a bloody knife. At the Washington International Airport the next day, police apprehended Englewood Smink, the murdered thief's occasional partner in crime. Smink denied all knowledge of the murder and the theft. When asked about the fresh cut on his hand, Smink said that he had had an accident in the kitchen that morning. Suspicious, the chief FBI inspector ordered DNA tests on the victim, the blood on the victim's clothes, the blood on the end of the knife found under the victim, and Smink. The results of the test are shown in the figure above. Should Smink be released? Why or why not?
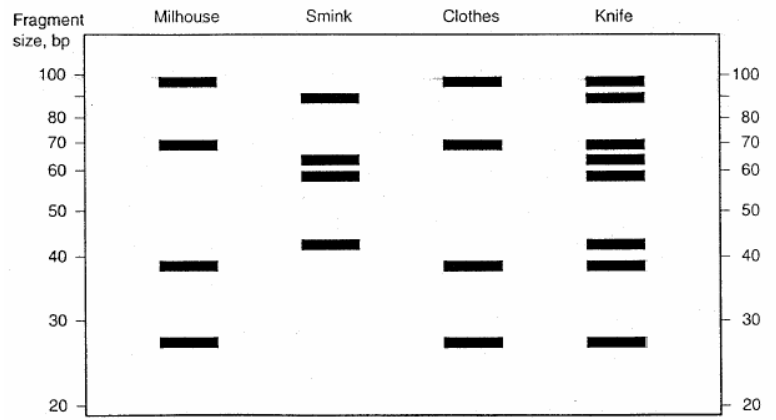
2. Genetic Relatedness of Bears

According to the DNA gel results, which of the five species listed are most closely related? How do you know? Which one is the most genetically distinct? How do you know?
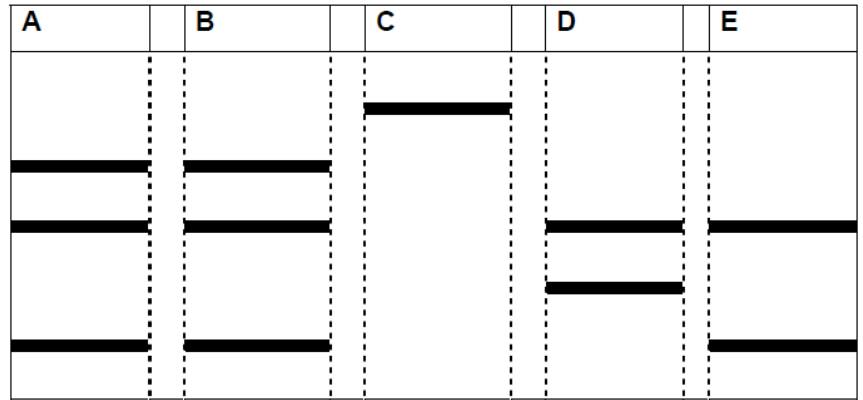
A = American black bear   B = Asiatic black bear
C = giant panda   D = polar bear   E = sloth bear

3. Restriction Enzyme Analysis

Below is a plasmid with restriction sites for BamHI and EcoRI. Several restriction digests were performed using these two enzymes either alone or in combination.

   A.   Which lane shows a digest with BamHI only?
   B.   Which lane shows a digest with EcoRI only?
   C.   Which lane shows the fragments produced when the plasmid was incubated with both EcoRI and BamHI?
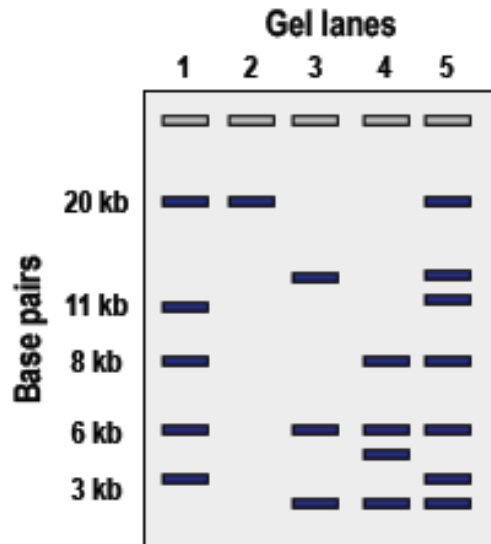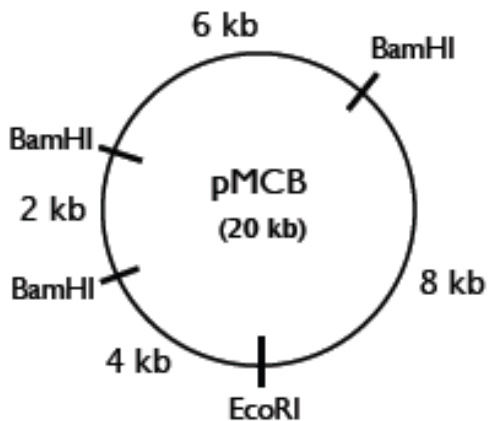
4. The following are restriction sites for restriction enzymes used in genetic engineering, use them to answer the next questions:

BamHI: 5' G/GATCC 3
EcoRI: 5' G/AATTC 3'
HindIII: 5' A/AGCTT 3'
PstI: 5' CTGCA/G 3'
Sma: 5' CCC/GGG 3'

Imagine you were to cut the following DNA with any of the appropriate enzymes above

5' ATCCGCGAATTCATCAGGACCACCAATTACTGAATTCCGGGGGATTCCGAGAATTCATC 3'
3' TAGGCGCTTAAGTAGTCCTGGTGGTTAATGACTTAAGGCCCCTAAGGCTCTTAAGTAG 5'

1. Which enzyme(s) would be able to cut the DNA?
2. How many DNA fragments were produced by the enzyme(s) if used one at a time?
3. Do the enzyme(s) produce sticky or blunt cuts?
4. Which lane in the gel electrophoresis below would look the most like the the cut DNA above?
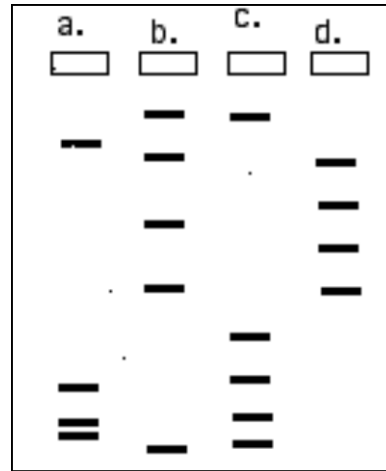
5. The segment of DNA shown below has restriction sites 1 and 2 which create restriction fragments A, B, and C. What would the gel produced by electrophoresis look like after separation of these fragments?
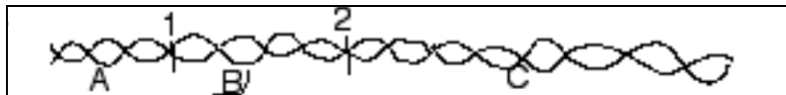
Draw a picture of the gel bands created by the above pieces of DNA in a gel box. Label each band with the correct letter. The position and spacing can be determined from the cuts. Show the well in a drawing.

6.

If a pipette display says:

What volume of liquid would be dispensed if it was a:
   a) P20
   b) P200
   c) P2000

| 1 |
| 7 |
| 4 |

What if it said?

| 0 |
| 3 |
| 9 |

DNA EXTRACTION:

WHAT?

WHY?

HOW?

8. The restriction enzyme *HhaI* has a restriction site of 5' gcg|c 3'. If the enzyme is used to cut a DNA that reads
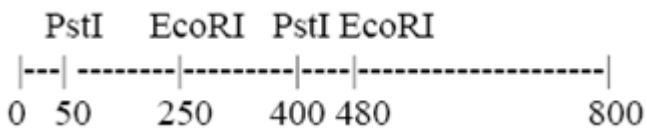
   5'...GTCCTTCGACCCGAGCCCGCGCGGCCTTTCCGGGACCCTGGCCCCGCG...3'

   How many fragments of DNA will result by exposing this DNA to the enzyme?

   How long (in base pairs) will each fragment be?

   Will the ends of the fragment be sticky or blunt?

9. Here is a restriction map of a linear piece of DNA.

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  PstI    EcoRI  PstI EcoRI
|---| --------|---------|----|--------------------|
0  50    250     400 480               800
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How many fragments and how many base pairs long are each fragment if you cut the DNA with:
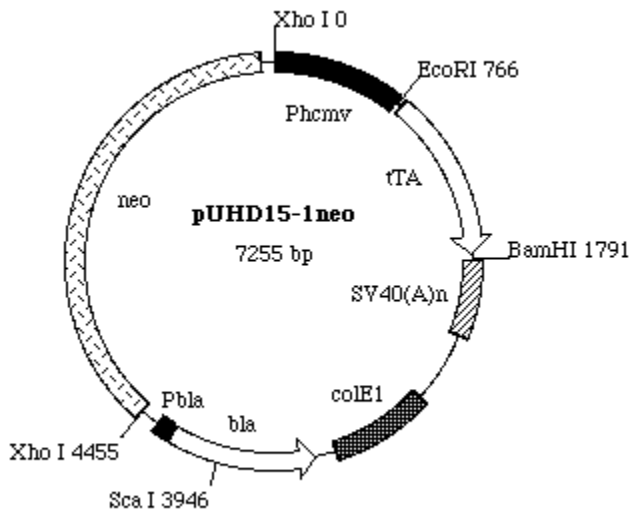1.   PstI only?
2.   EcoRI only?
3.   PstI AND EcoRI?

10. **PCR:**

WHAT?

WHY?

HOW?

11. Here is a restriction map of a plasmid with the enzyme cut locations indicated on the OUTSIDE of the ring.

Xho I 0
EcoRI 766
Phcmv
tTA
neo
pUHD15-1neo
7255 bp
BamHI 1791
SV40(A)n
Pbla
colE1
bla
Xho I 4455
Sca I 3946

How many fragments and how many base pairs long are each fragment if you cut the DNA with:

XhoI only?
EcoRI only?
BamHI only?
EcoRI and BamHI?
ScaI and XhoI?