

# **DPAA Laboratory**

## **Introductions and Overview**



*Dr. John Byrd*  
*Director, DPAA Laboratory*

# **DPAA Laboratory**

## **Update on Isotope Testing**



*Ms. Lesley Chesson*  
*PAE, Contractor at DPAA Laboratory*



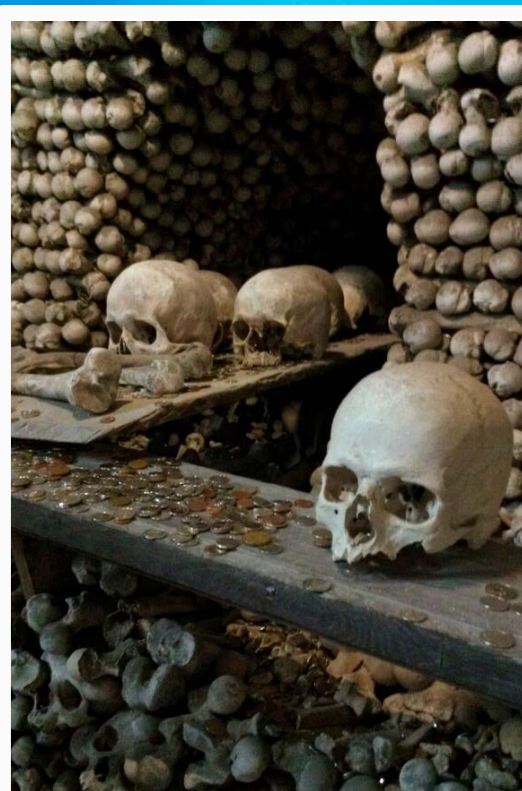


# Commingled Remains



## ❖ Identification of commingled remains is difficult.

Not DPAA casework





# Analytical Tools



❖ **Analytical tools are needed to support human ID.**

❖ **What's currently in the DPAA's toolbox?**

- ❖ Forensic anthropology
- ❖ Forensic odontology
- ❖ Material evidence
- ❖ Histology
- ❖ Chest radiograph comparison
- ❖ DNA analysis







# New Tool: Isotope Testing



Isotopes are "nature's recorders."

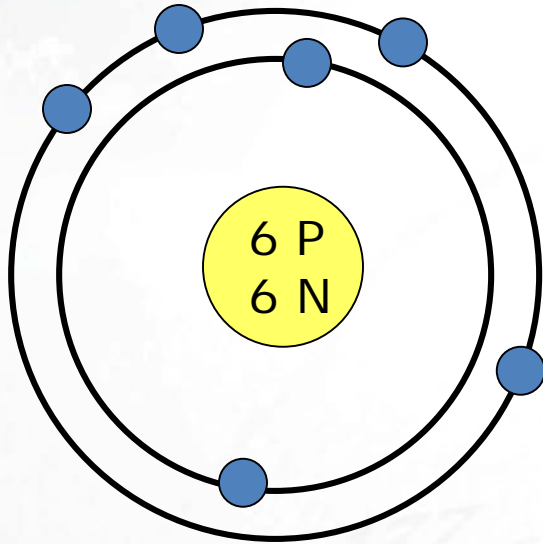




# What are Isotopes?



❖ Isotopes of an element differ in mass (or weight).



$$6 + 6 = 12$$

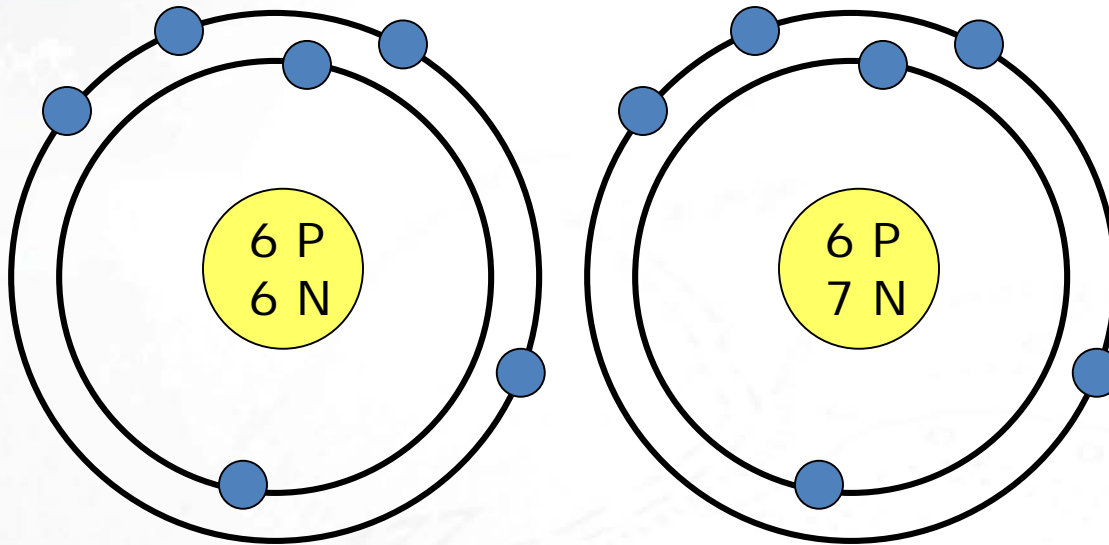




# What are Isotopes?



❖ Isotopes of an element differ in mass (or weight).



$$6 + 6 = 12$$

$^{12}\text{C}$

$$6 + 7 = 13$$

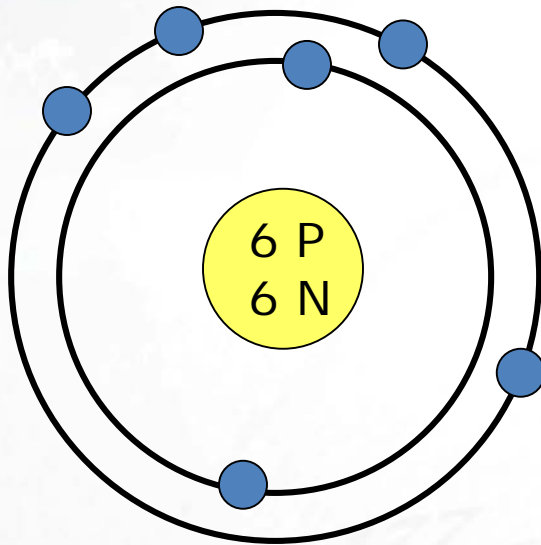
$^{13}\text{C}$



# What are Isotopes?

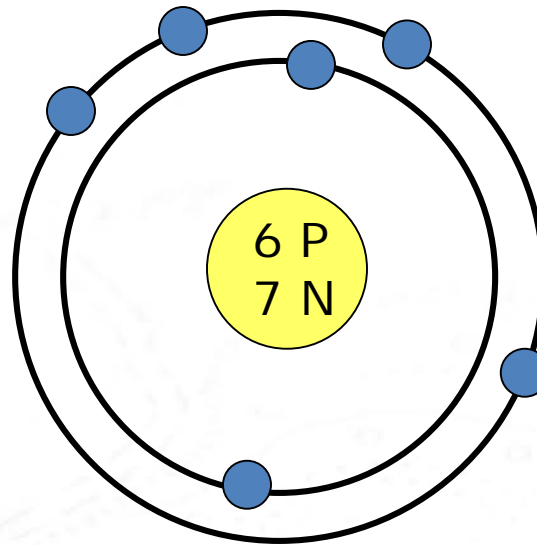


❖ Isotopes of an element differ in mass (or weight).



$$6 + 6 = 12$$

$^{12}\text{C}$



$$6 + 7 = 13$$

$^{13}\text{C}$

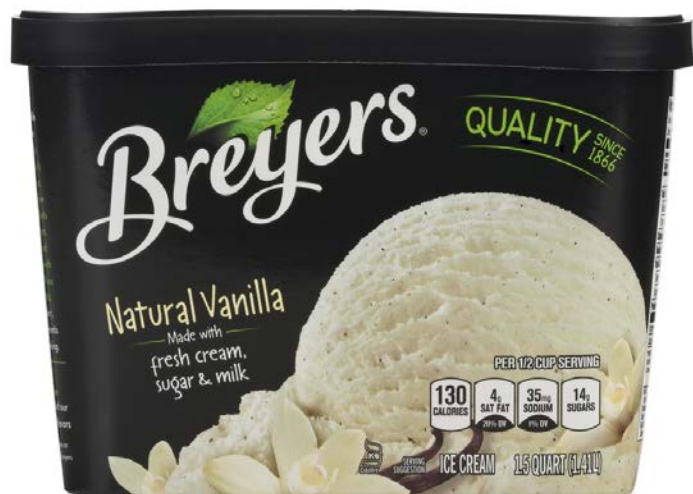
Used in  
radio-  
carbon  
dating

$^{14}\text{C}$





# Isotopes and Ice Cream





# Isotopes and Ice Cream



$^{12}\text{C}$

Nutrition Facts		
Serving Size 1/2 Cup (66g)		
Servings Per Container 12		
Amount Per Serving		
Calories	130	
Calories From Fat	60	
% Daily Value*		
Total Fat	7g	11%
Saturated Fat	4g	20%
Trans Fat	0g	
Cholesterol	20mg	7%
Sodium	35mg	1%
Total Carbohydrate	14g	5%
Dietary Fiber	0g	0%
Sugars	14g	
Protein	2g	
Vitamin A		4%
Vitamin C		0%
Calcium		8%
Iron		0%
*Percent Daily Values are based on a 2,000 calorie diet		
MILK, CREAM, SUGAR, VEGETABLE GUM (TARA), NATURAL FLAVOR. Ingredients and Nutrition Facts are current as of August 2015. Please see shelf packaging for any changes. Nutrition Facts may vary in high altitude areas.		



$^{13}\text{C}$

Nutrition Facts		
Serving Size 1/2 Cup (65g)		
Servings Per Container 12		
Amount Per Serving		
Calories	140	
Calories From Fat	60	
% Daily Value*		
Total Fat	7g	11%
Saturated Fat	4.5g	23%
Trans Fat	0g	
Cholesterol	45mg	15%
Sodium	50mg	2%
Total Carbohydrate	16g	5%
Dietary Fiber	0g	0%
Sugars	14g	
Protein	2g	
Vitamin A		4%
Vitamin C		0%
Calcium		8%
Iron		0%
*Percent Daily Values are based on a 2,000 calorie diet		
MILK, CREAM, SUGAR, CORN SYRUP, EGG YOLKS, WHEY, CAROB BEAN GUM, MONO AND DIGLYCERIDES, VANILLA BEANS*, NATURAL FLAVOR, RUM, NATURAL VANILLA FLAVOR*, TARA GUM, ANNATTO (FOR COLOR), GUAR GUM, SALT. Ingredients and Nutrition Facts are current as of August 2015. Please see shelf packaging for any changes. Nutrition Facts may vary in high altitude areas.		





## All 102 Aboard Saved As Big Plane Ditches

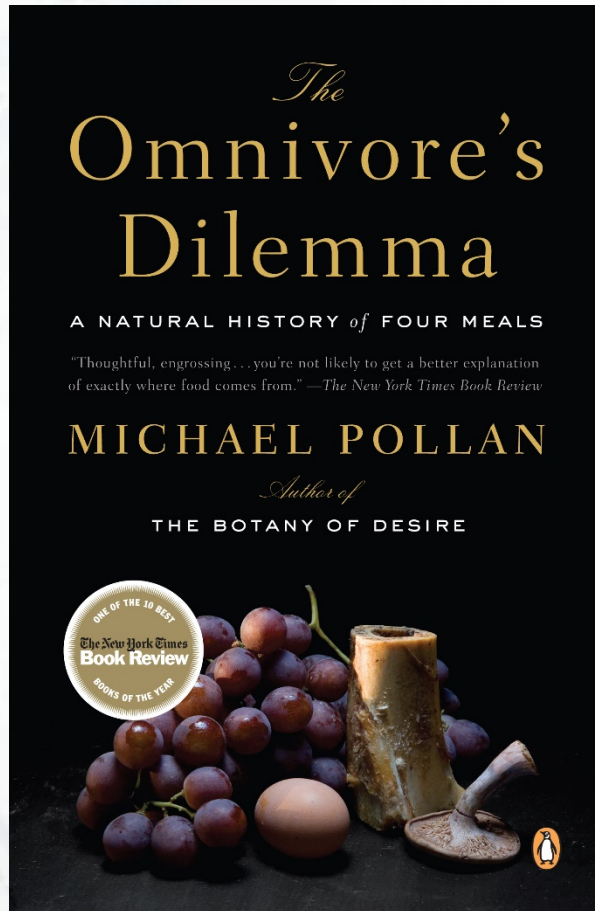
The official orders bearing President Kennedy's signature are just as tough as the speech itself. On the highest auth-

1. Ships carrying additional offensive weapons in force





# Isotopes in the Literature



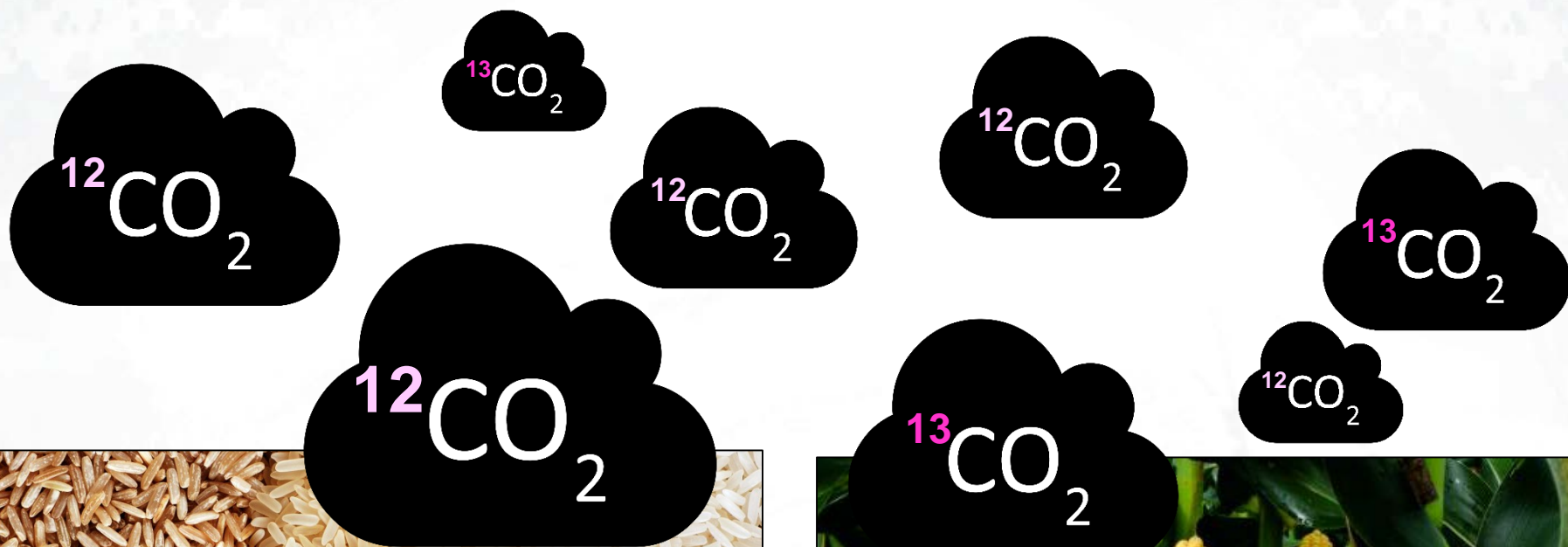
When you look at the stable isotopes of carbon, "We North Americans look like corn chips with legs."

**What does that mean,  
corn chips with legs?**



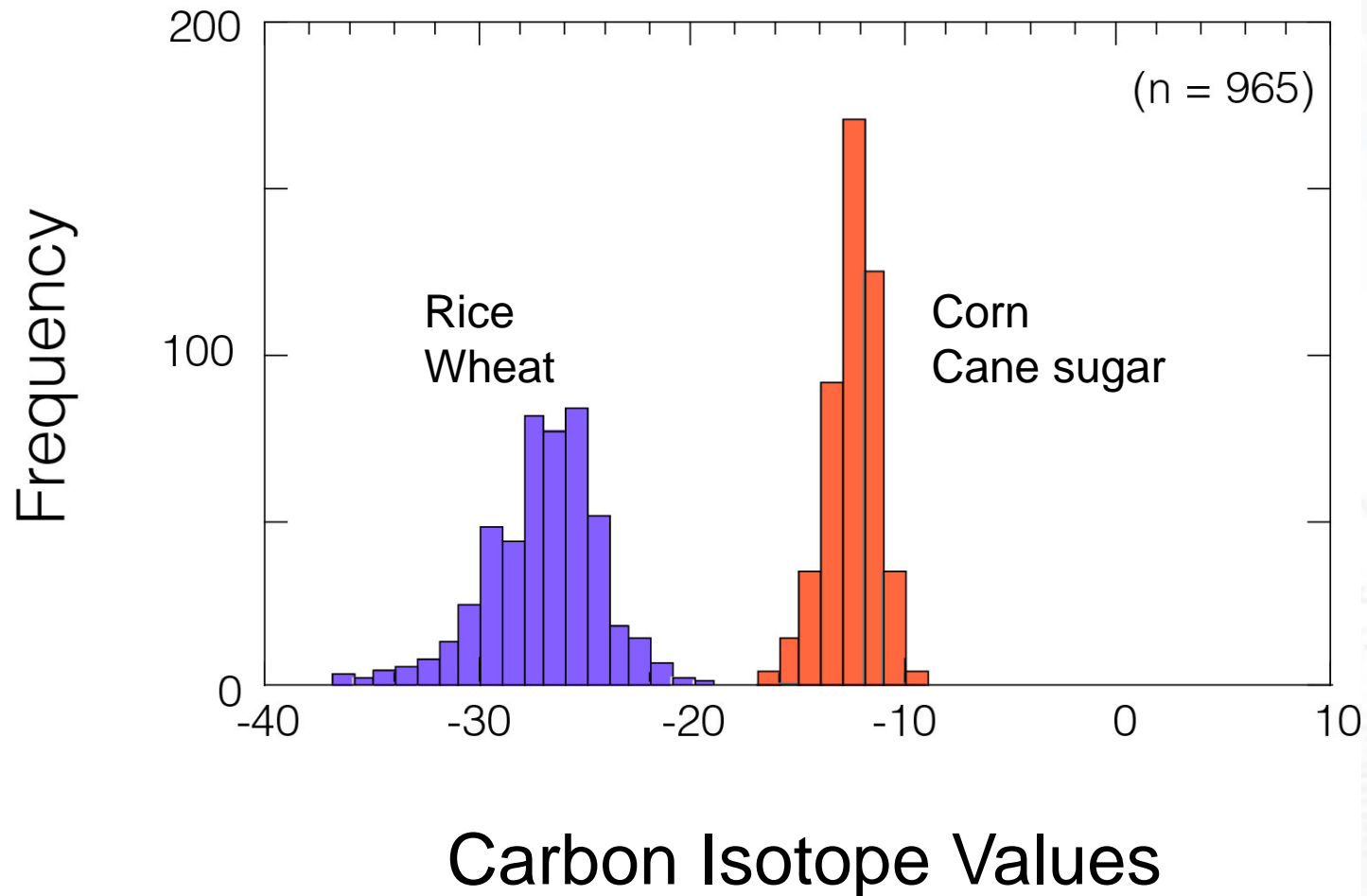


# Stable Isotopes and Plants





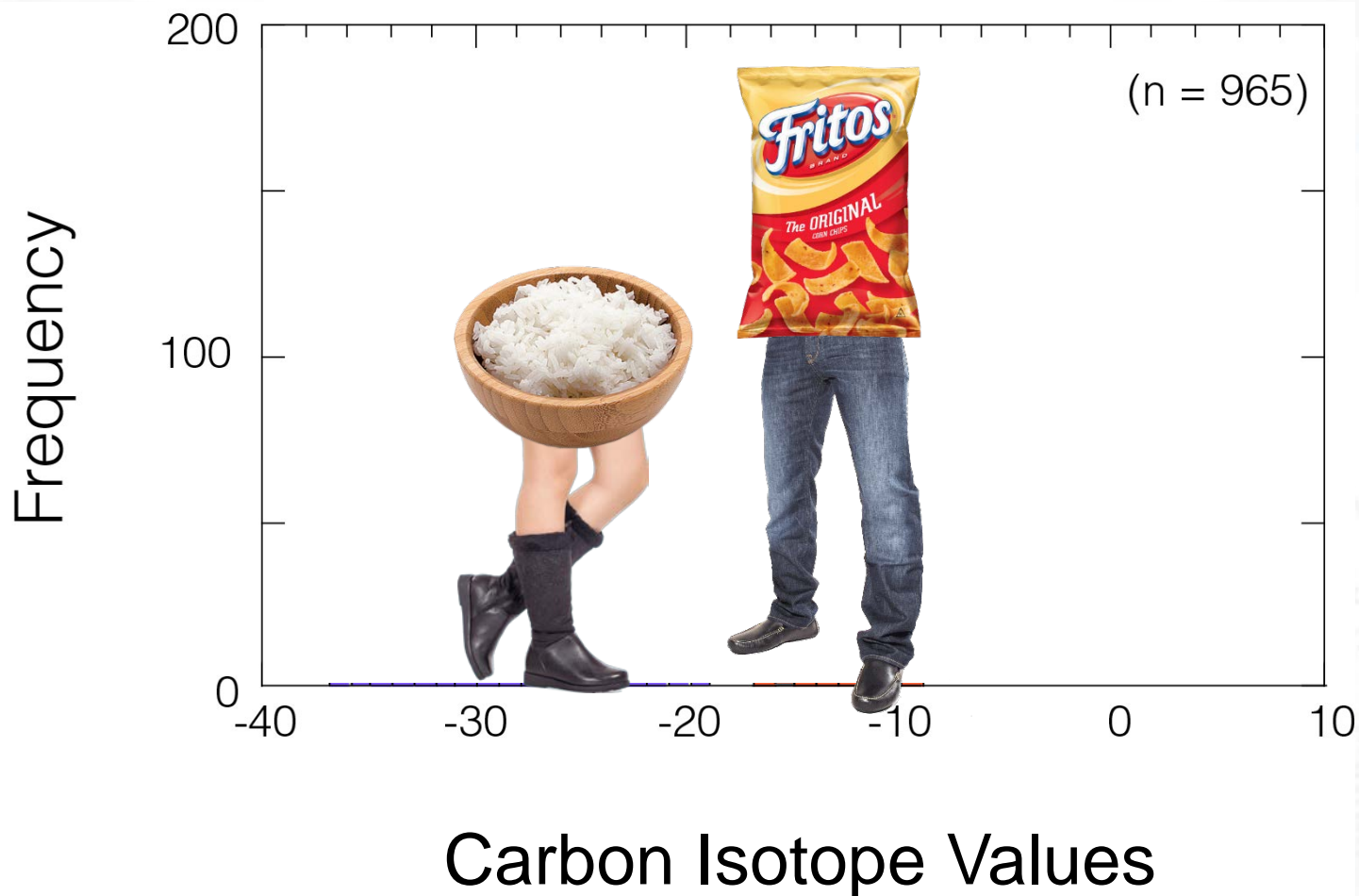
# Carbon Isotopes and Plants







# Carbon Isotopes and Diet

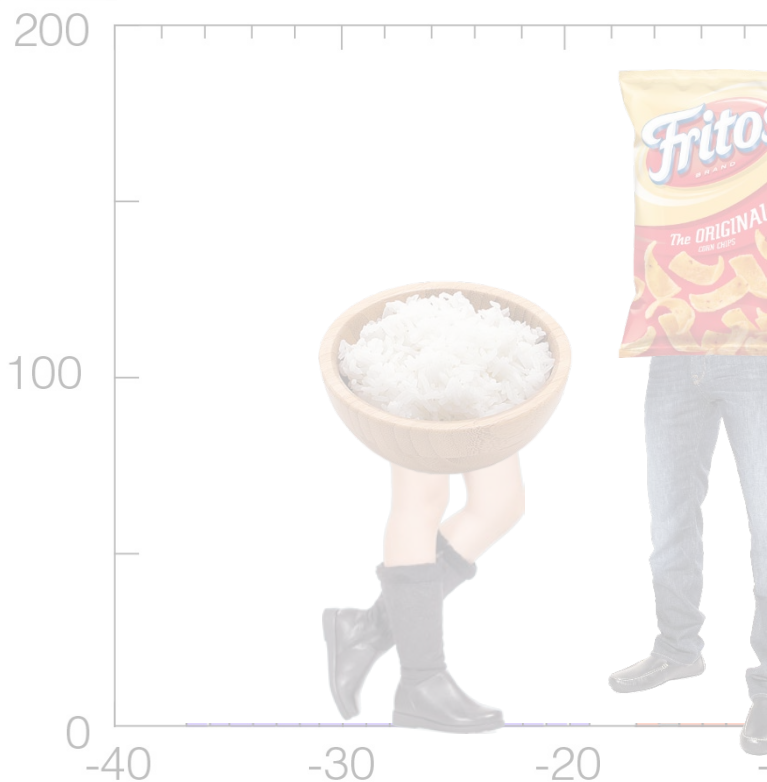




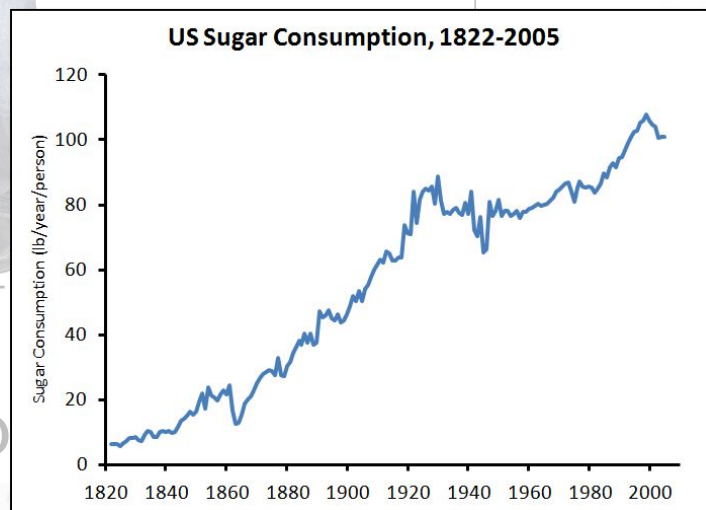
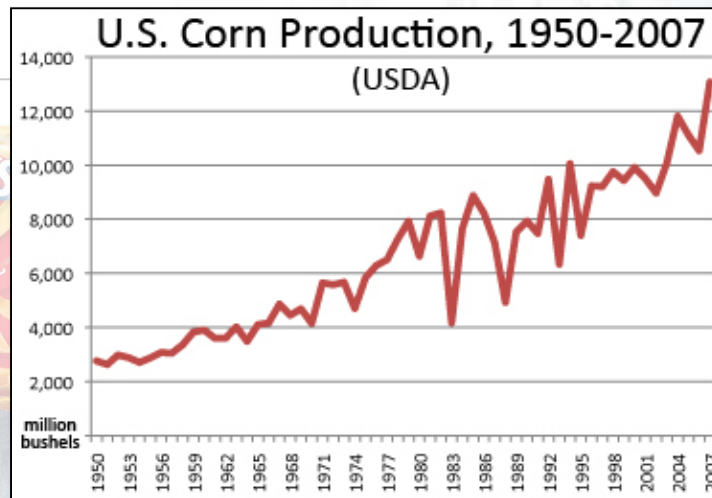
# Carbon Isotopes and Diet



Frequency



Carbon Isotop

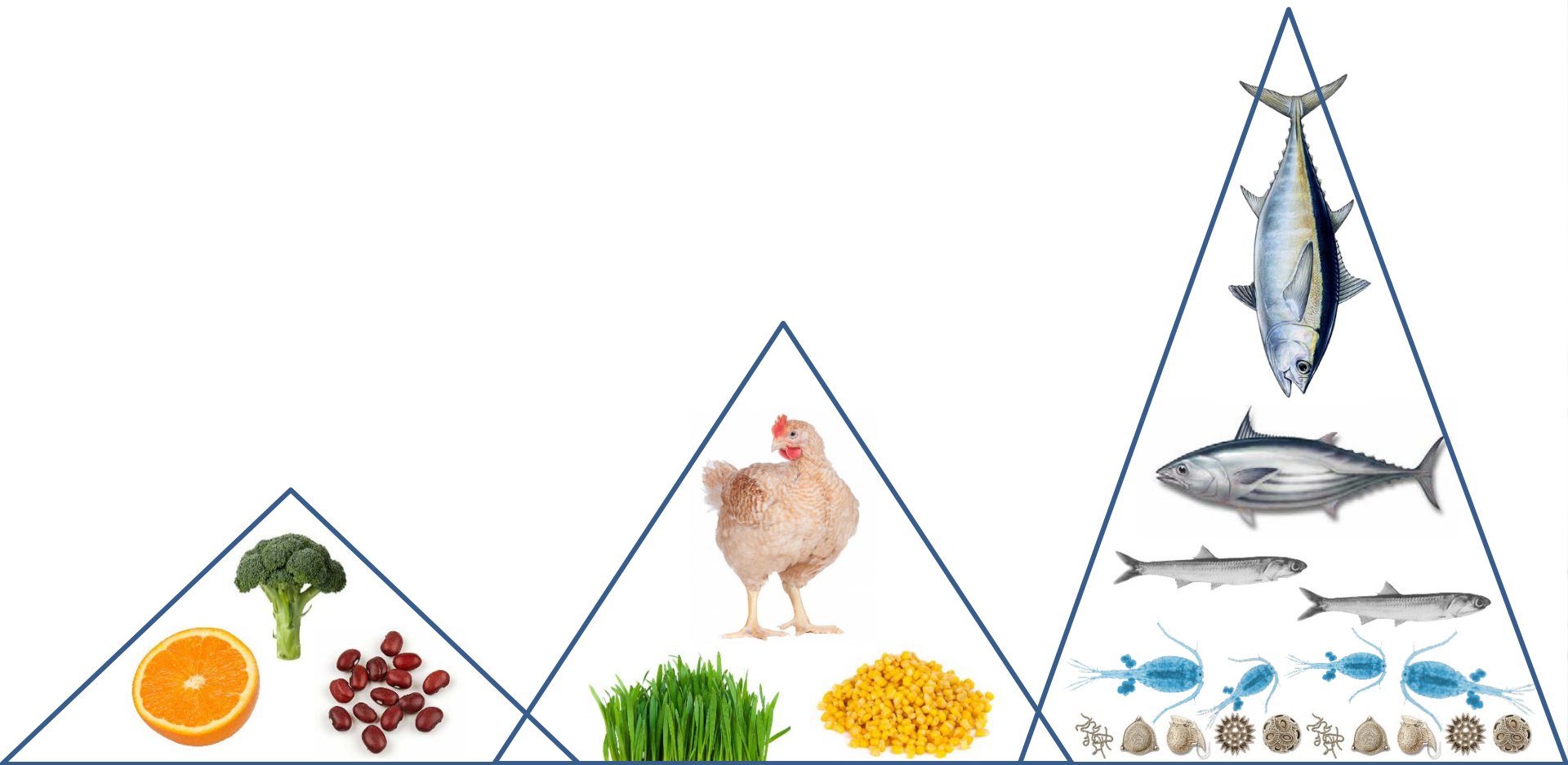




# Nitrogen Isotopes and Diet



❖ Nitrogen isotopes reflect how much meat you eat.





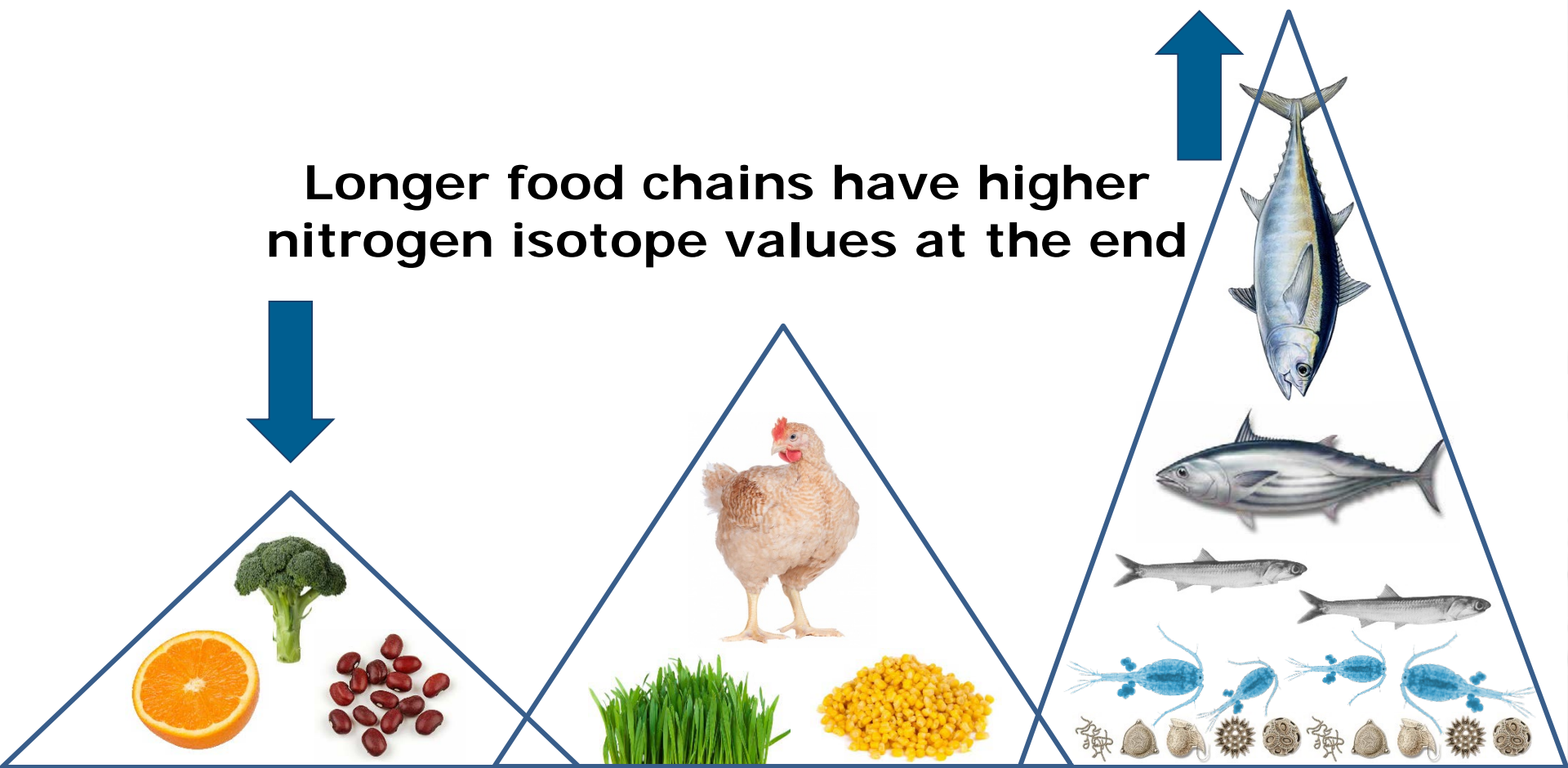


# Nitrogen Isotopes and Diet



❖ Nitrogen isotopes reflect how much meat you eat.

Longer food chains have higher nitrogen isotope values at the end

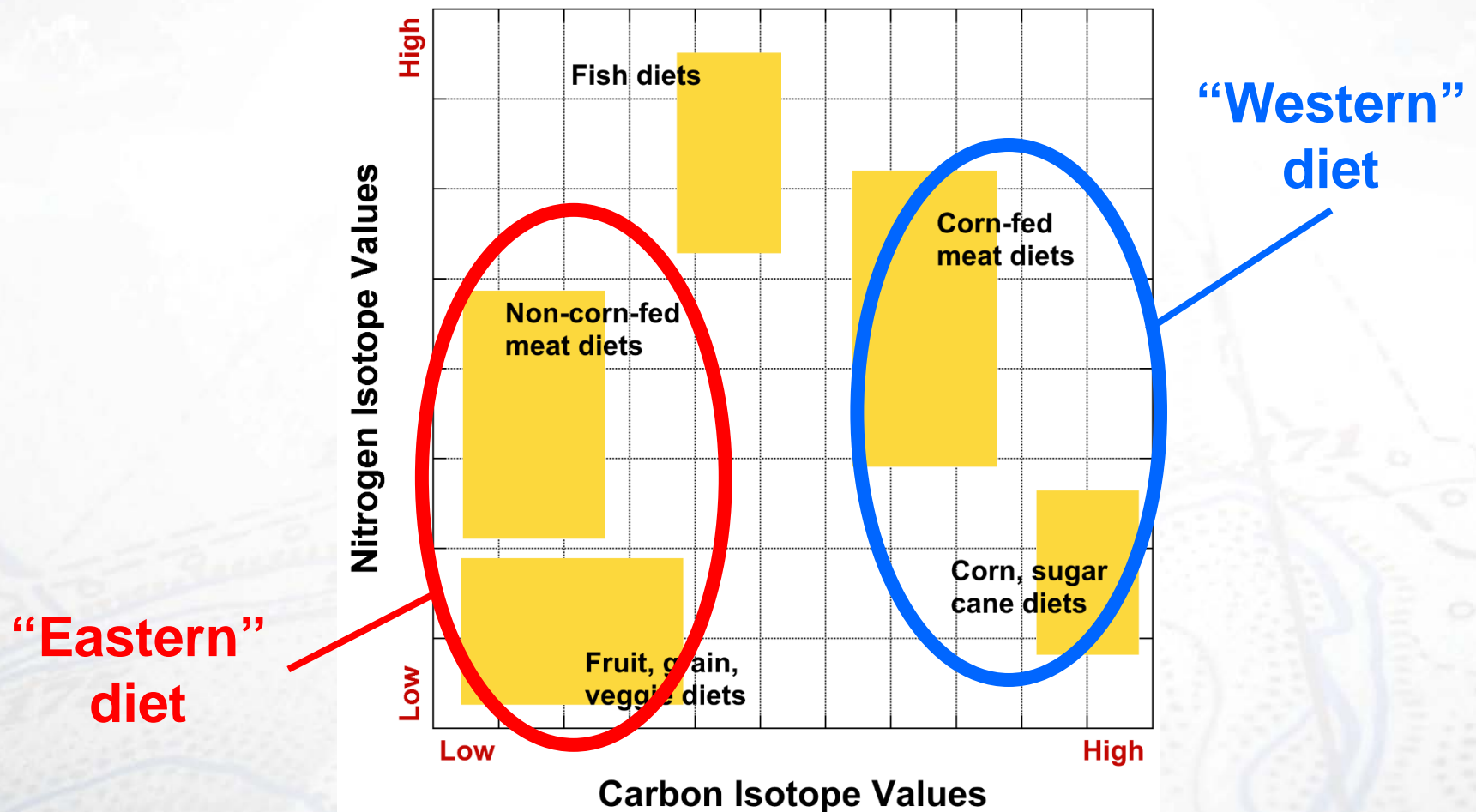




# The Role of Food Choice

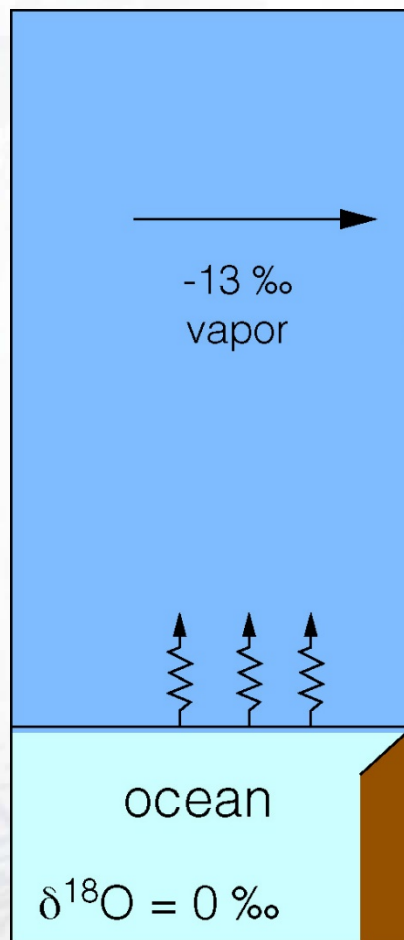


❖ You are what you eat – isotopically, at least.





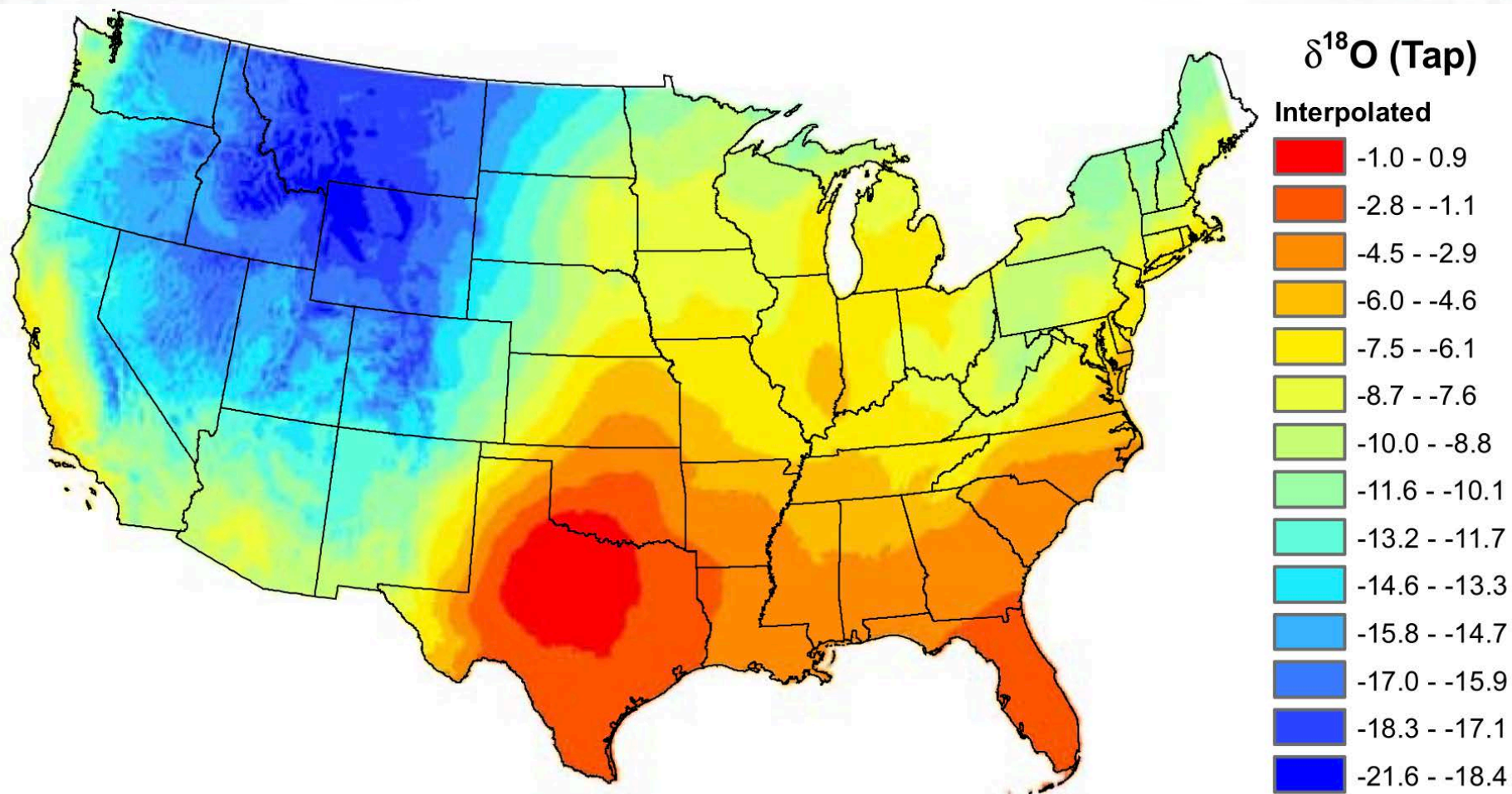
# Stable Isotopes in Water







# Geolocation with Isotopes





# Application of Isotopes



❖ How do we apply isotope testing to human remains?

❖ We ask a series of questions:



❖ Are these remains from a U.S. American?

❖ If yes, next conduct DNA analysis.

❖ (**Dietary discrimination**)

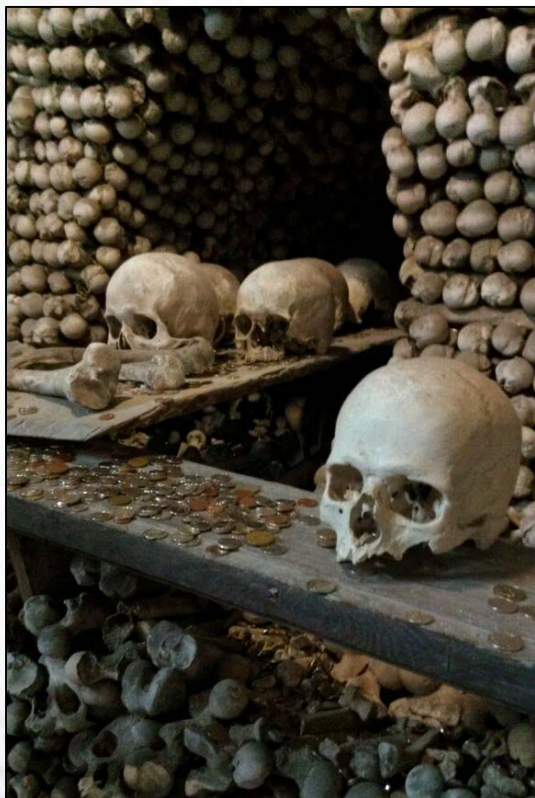
❖ Where was he living during childhood?

❖ Does this fit details of home of record?

❖ (**Geolocation**)



# Benefits of Isotope Testing



## ❖ Speed of sample preparation & analysis.

This increases with the buildout of in-house capabilities.

## ❖ Additional evidence for an identification.

Particularly useful in cases where DNA evidence is inconclusive.

## ❖ Separation of commingled remains.





# K55 and Isotope Testing



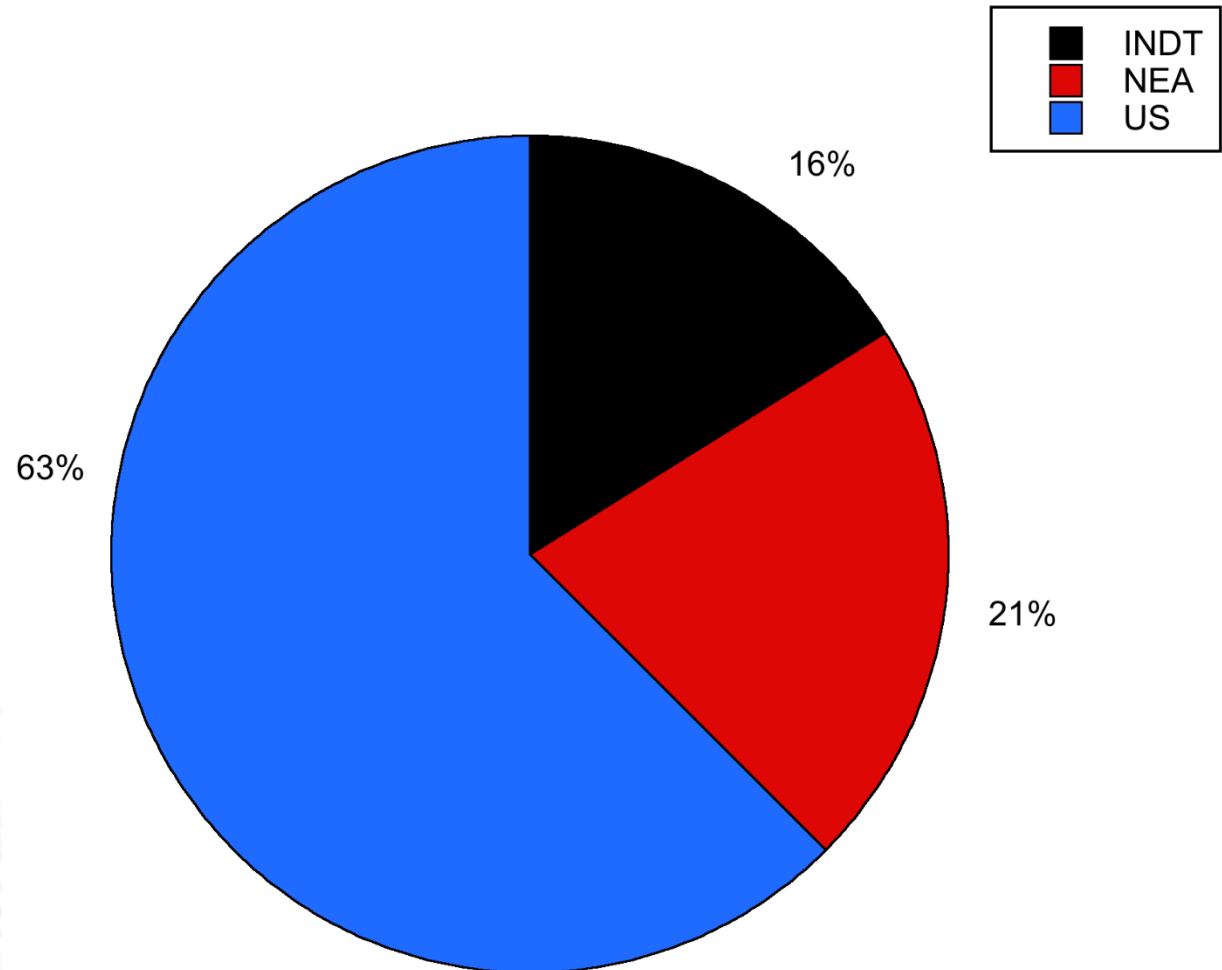
- ❖ **We have tested collagen (dietary discrimination).**
- ❖ **400 samples submitted to isotope testing.**
- ❖ **First: Prepare a random sample of 99 – pilot study.**
- ❖ Collagen extraction completed November.
- ❖ Data received December and January.
- ❖ **Next: Prepare all other samples on a rolling basis.**
- ❖ Collagen extraction completed early June.
- ❖ All data received by late June.



# K55 and Isotope Testing



❖ **Pilot study**  
suggested 21%  
of samples came  
from individuals  
consuming an  
“Eastern” diet  
while 63% were  
predicted to be  
from U.S.  
Americans  
(“Western” diet).



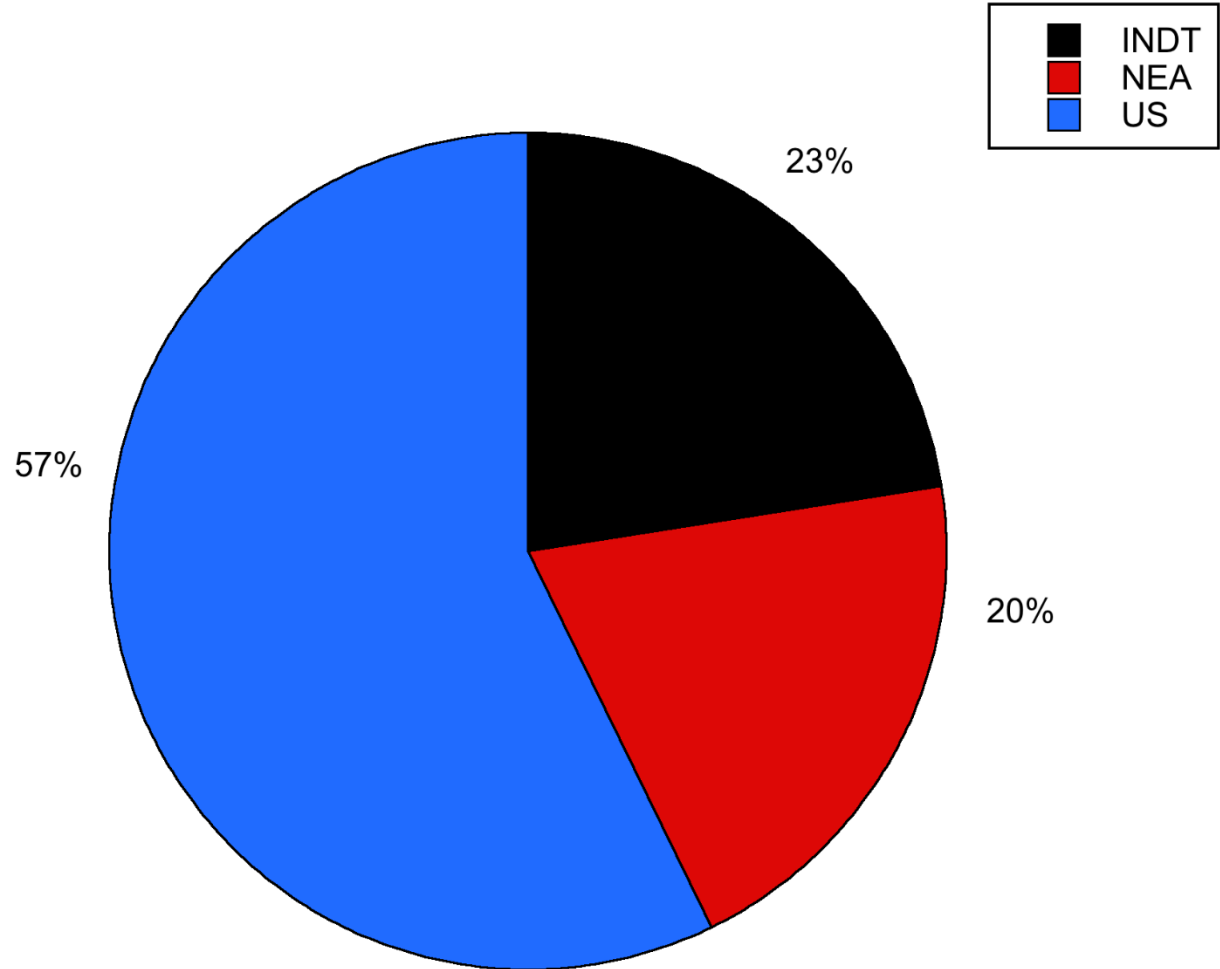
Pilot study  
(n = 99)



# K55 and Isotope Testing



❖ Proportion of individuals eating “Eastern” versus “Western” diet **does not** change dramatically when **all samples** are considered.

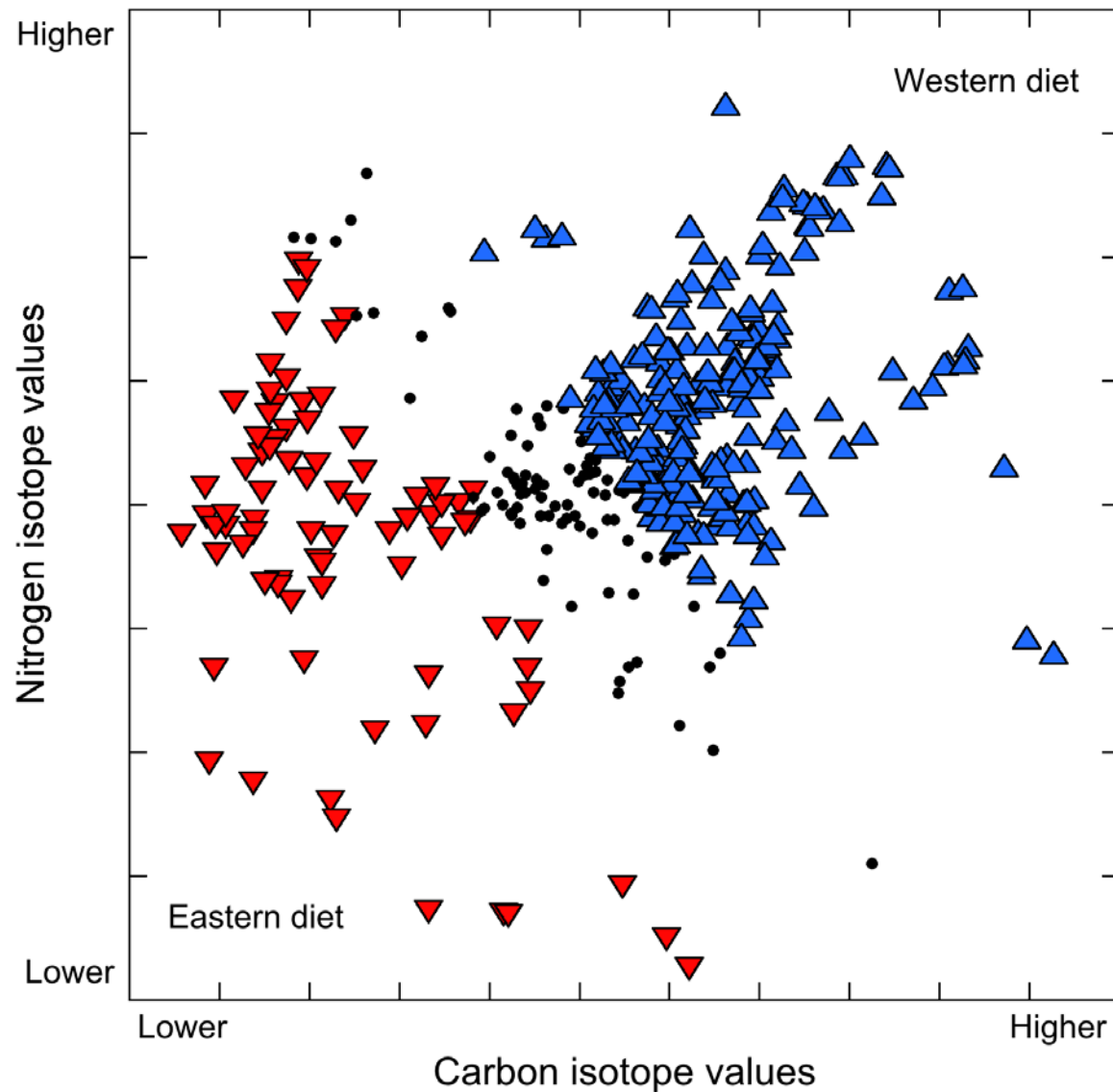
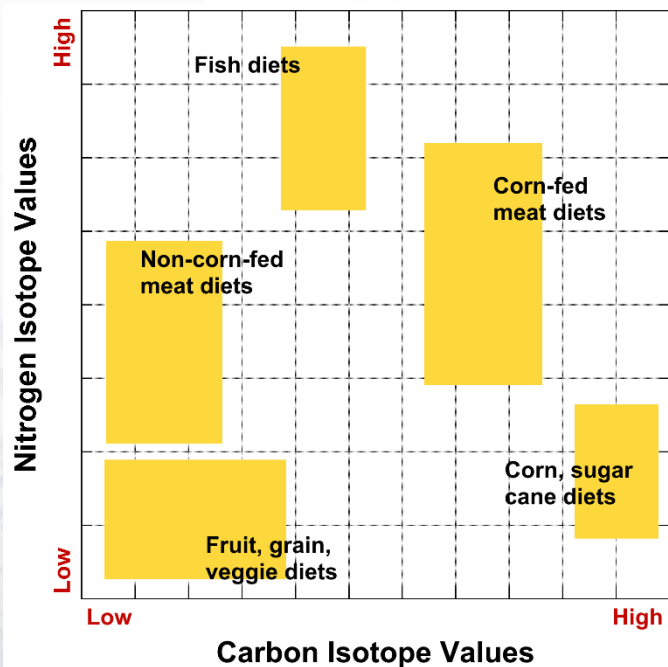


All samples  
(n = 400)



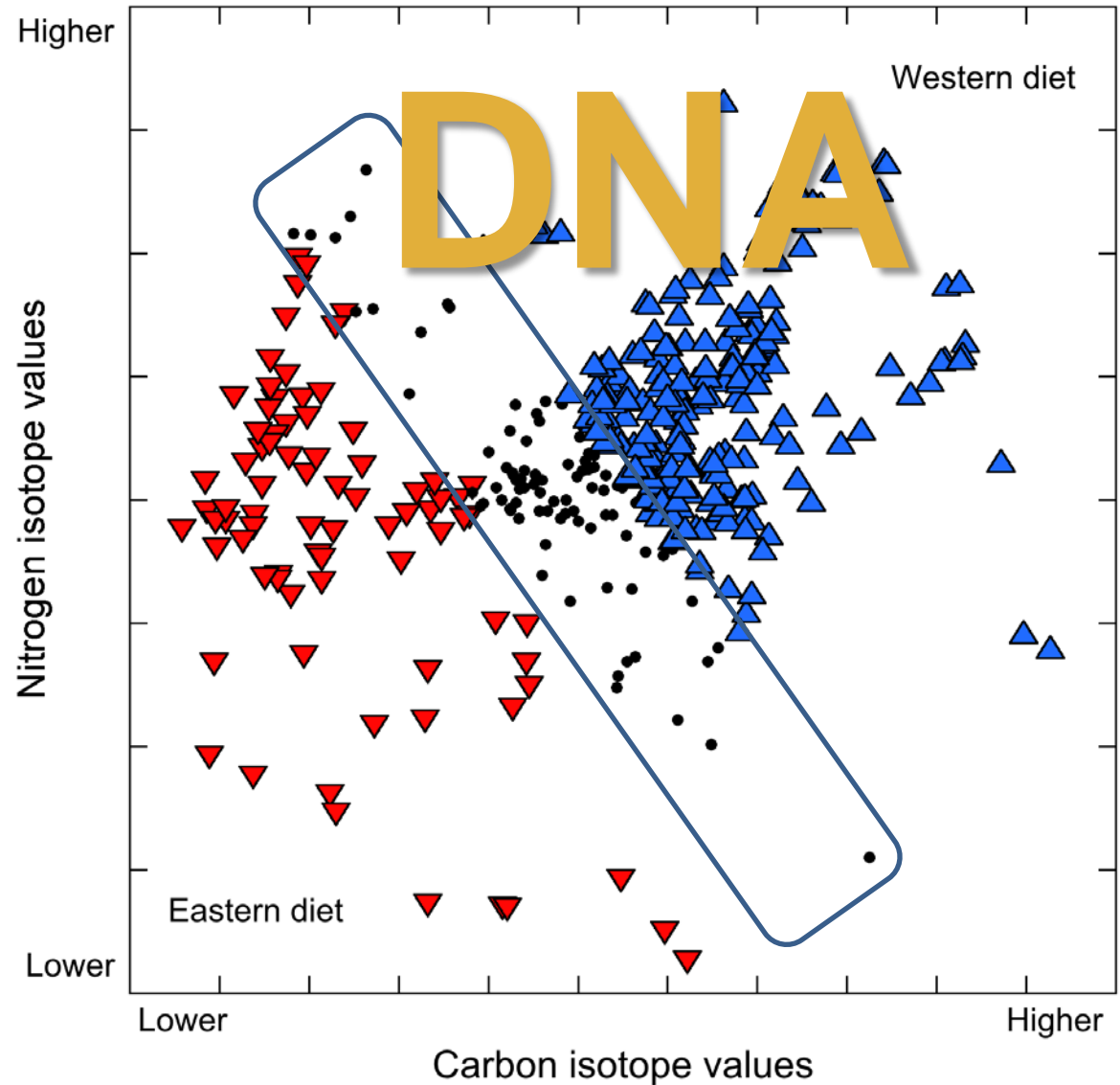
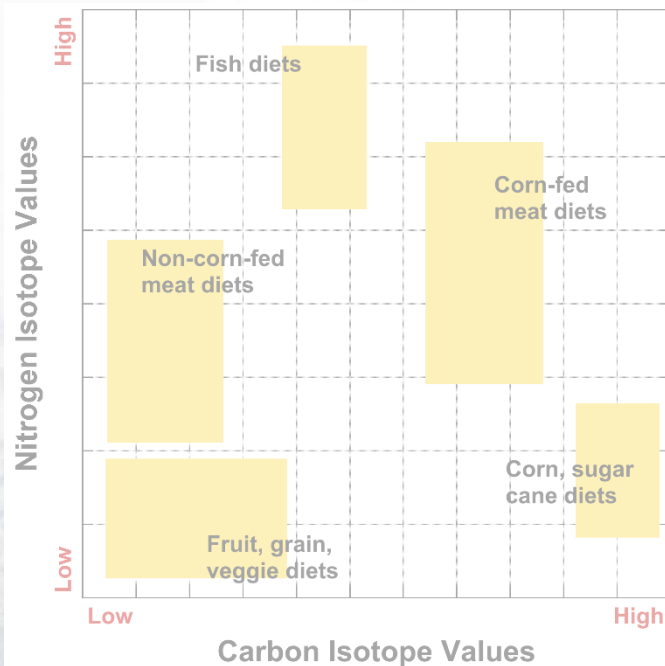


# K55 and Isotope Testing





# K55 and Isotope Testing





# Isotope Testing at the DPAA



## ❖ **Dietary discrimination:**

Triage samples into populations of interest (U.S., Asian).

**Saves time and money**

## ❖ **Geolocation:**

Compare isotope record to home of record.

**Provides evidence for an ID**

## ❖ **Classification:**

Separate commingled remains.

