

Mass Spectrometry: Group 1

1. What is mass spectrometry? What can it tell us about mummies?
Mass Spectrometry is a chemical analysis technique that sorts the different kinds of molecules in compounds. Scientists can use it to analyze hair and tissue samples of mummies
2. What sorts of compounds can be identified by mass spectrometry? (Name at least five.)
Answer will include opiate drugs, cannabinoids and caffeine, plant steroids and bioflavonoids like those found in the blue lotus, poisons like arsenic and lead, and single atoms of gases like helium, carbon, and neon.
3. Why do you think Garner and Counsell wanted to evaluate the blue lotus?
Tomb paintings indicated that ancient Egyptians inhaled the flower scent and drank it with wine. Perhaps they wanted to learn about the compounds in the blue lotus that would explain why Egyptians favored it.
4. Describe below how the basic mass spectrometry procedure works.
A small amount of the item to be analyzed is placed into a chamber and then blasted with a high-energy beam of negatively charged electrons, the particles that make up an electric current. The beam ionizes the molecules in the sample, turning them into positively and negatively charged ions of various types and sizes. The ions are then swept through a curved tube by a magnetic field, toward a detector. The field sorts the ions based on their mass and charge. Heavier ions, for example, are less deflected by the magnet and will take a wider path, so they take longer to slam into the detector. Each ion that is in the sample will produce a peak on a graph. The size of the peak indicates its relative concentration, and, from the pattern of peaks, researchers can decipher what sorts of chemicals were in the original sample."

Extracting Mummy DNA: Group 2

1. Why is it difficult to extract DNA from mummies?
Extracting DNA is difficult because of the possibility of contamination
2. What do scientists hope to learn from collecting DNA evidence and analyzing it?
They hope to learn more about the mummy's background—to verify genealogy and sometimes the practice of marrying relatives.
3. Describe the careful precautions taken in Dr. Woodward's lab to ensure that the samples are not contaminated. Why is this important?
"Once tissue samples are recovered, they are taken back to Dr. Woodward's lab, where the DNA is extracted under carefully controlled conditions. Any previously isolated DNA samples are removed from the lab, for instance, and the final sequences are compared to all other DNA patterns that have been deciphered in the lab." "They have to be unique, and to make sense within the expected genealogical structure," Dr. Woodward says."
4. Why are Egyptian mummies particularly good for extracting DNA evidence?
Since DNA tends to degrade over time, Egyptian mummies are unusually well preserved and therefore good subjects for an extraction.
5. What do scientists do to increase the amount of a small DNA sample so that it can be more easily read?
If a sample is too small "a technique called polymerase chain reaction, or PCR, is used to produce millions of copies of the DNA fragments so their sequence can easily be read."

Studying Ancient Disease: Group 3

1. Why is it no longer necessary to unwrap or even remove mummies from their coffins for study?

Non-invasive medical and diagnostic techniques have made it possible to study mummies without unwrapping them or removing them from their coffins.

2. From which part of the mummy is the majority of evidence for ancient disease is gathered from and why?

The majority of the evidence about ancient diseases is gathered from mummy bones because the soft tissues are generally in very poor condition.

3. What can scientists learn about mummies from x-rays?

Using x-rays, scientists can see fractures, the degeneration of bone from osteoarthritis—which was very common among the Egyptians—and make assumptions about lifestyle and diet. Muscles leave an imprint on bone telling how big they were and how much they were used, which can provide information as well.

4. How does technology help scientists "see through coffins" and virtually unwrap a mummy they'd like to learn about?

CT-scans allow scientists to virtually remove layers of skin, bone, or other materials in and around the mummy. Software assembles slices of the subject so that scientists can virtually remove layers without disturbing the remains.

5. After a sample of internal tissue is carefully rehydrated, what can scientists do to gather evidence from the sample?

Samples can be "examined microscopically, stained to detect the presence of parasites or the immunological signature of bacterial infections, or subjected to chemical analyses that reveal the use of narcotics or poisons."

6. What diseases did the ancient Egyptians suffer from? What two modern diseases did they rarely suffer from?

The site points out that "Parasitic diseases—from roundworm and tapeworm infection to schistosomiasis, strongyloides, and malaria—were rampant among the ancient Egyptians (who compiled their own catalogues of parasitic worms). Sand pneumoconiosis, which is caused by the repeated inhalation of sand, was common, as was tuberculosis. Signs of polio have been found, as have indications of plague and fairly good evidence of smallpox." Ancient Egyptians rarely had modern diseases like cancer and heart disease.