

Neutron Activation Analysis

- Neutron Activation Analysis (NAA) – one of a number of techniques used to accurately determine the concentrations of elements in a sample.
- This process requires the use of a nuclear reactor to irradiate the sample.
- We will illustrate this process with a plant sample to determine the amount of a particular metal its tissues contain (example: arsenic).

1. Obtain plant sample.
Wash the sample to remove possible contaminants.



2. Dehydrate the sample.

- Dehydration methods use heat or freeze-drying.
- A lyophilizer is frequently used for the freeze-dry method.
- A plant sample is then placed in the chamber atop the lyophilizer to the right.



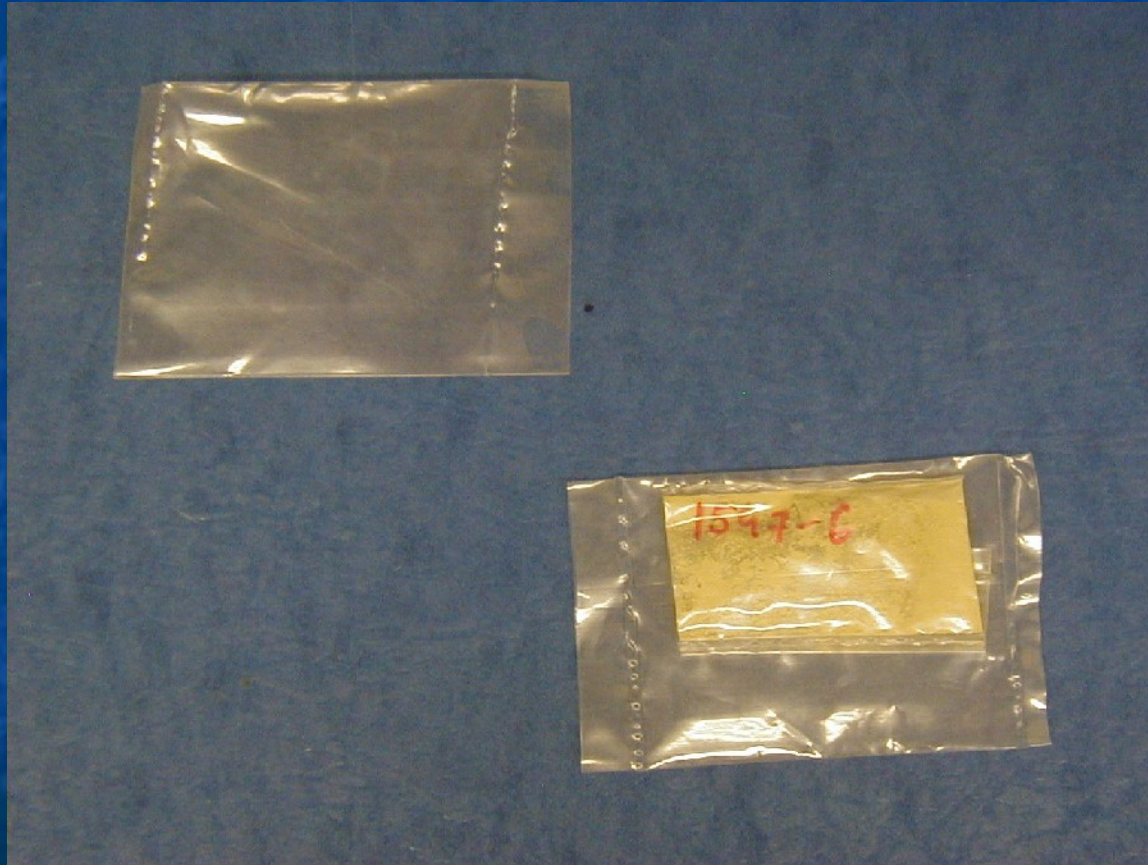
3. The dehydrated sample is then prepared for testing.
A small amount of dehydrated plant material is removed from this bag.



4. A portion of the dried plant material is ground into a powder using a mortar and pestle. Sterile technique is required to avoid cross contamination.



5. Bag the sample.
Some of the ground plant powder is bagged into a small plastic envelope. The sample is double-bagged and labeled.



6. Select a standard for comparison.

- When looking for arsenic in plant material, you would need to prepare a sample of a standard containing arsenic in a similar matrix.
- The “standard” contains a known quantity of the element you are looking for.
- Containers of certified standards are pictured.



7. Place packages of both the prepared sample and standard sample in a capsule.



8. Take sample to the rabbit system apparatus.



- The rabbit system works much like the system used by banks at drive-through windows. A canister carries items back and forth between the customer and teller.
- The sample is sent through the wall in a mini canister into the nuclear reactor located behind the wall.
- Once inside the reactor, the sample is irradiated with neutrons.

8 (a). This is a close-up view of a capsule being placed into the rabbit system. Sterile technique is required.



9. Upon return of the capsule after irradiation, the capsule must be determined safe for transfer.

A Geiger Counter is used to assess radiation emission to confirm a safe level.



10. The prepared sample and standard sample are placed in a “detector” one at a time.



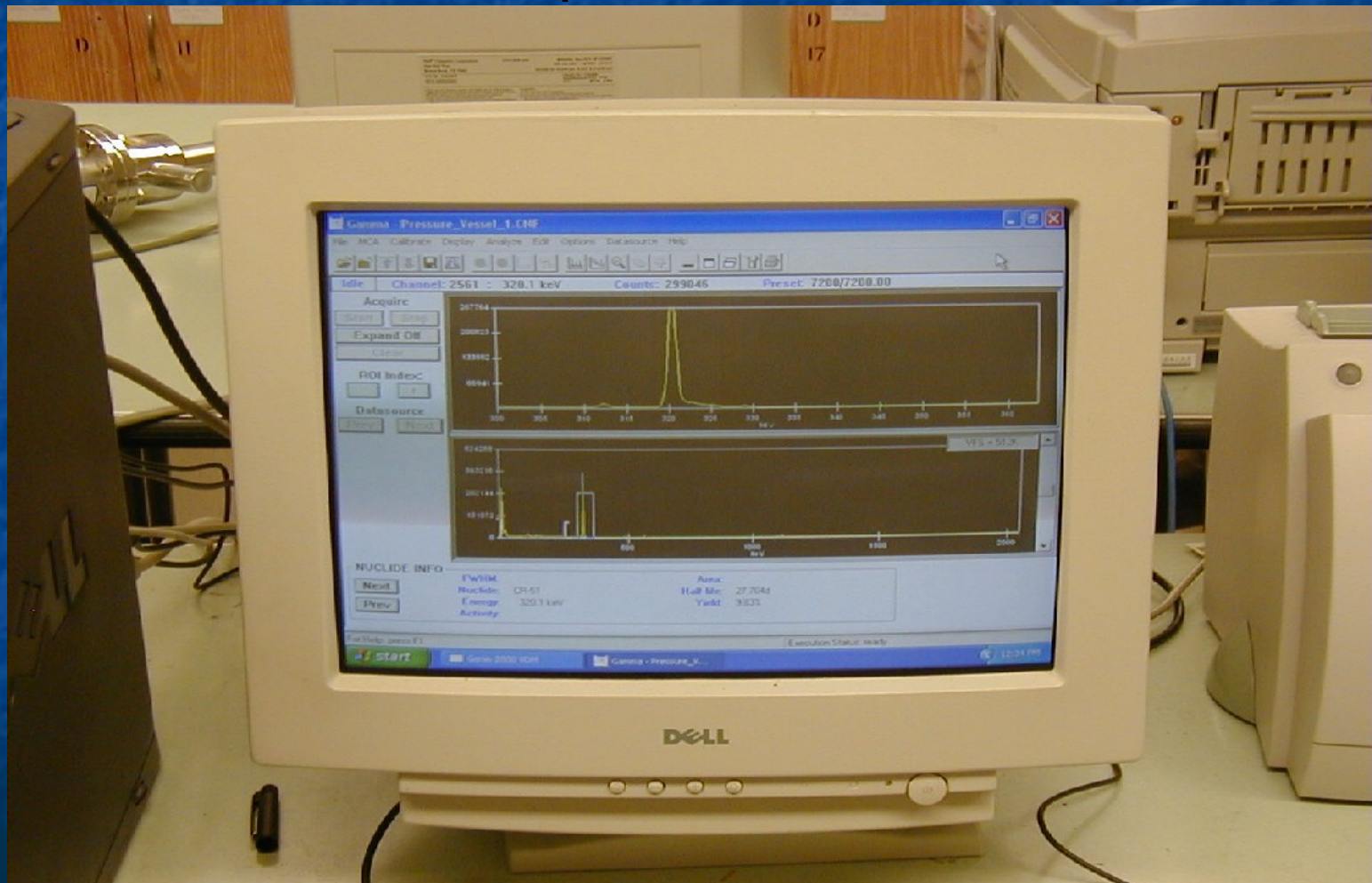
- The detector system counts and records gamma radiation emissions for a period of time.
- Time varies, but is usually in the range of 5 minutes to an hour.

11. Counts recorded by the detector system are sent to a computer.

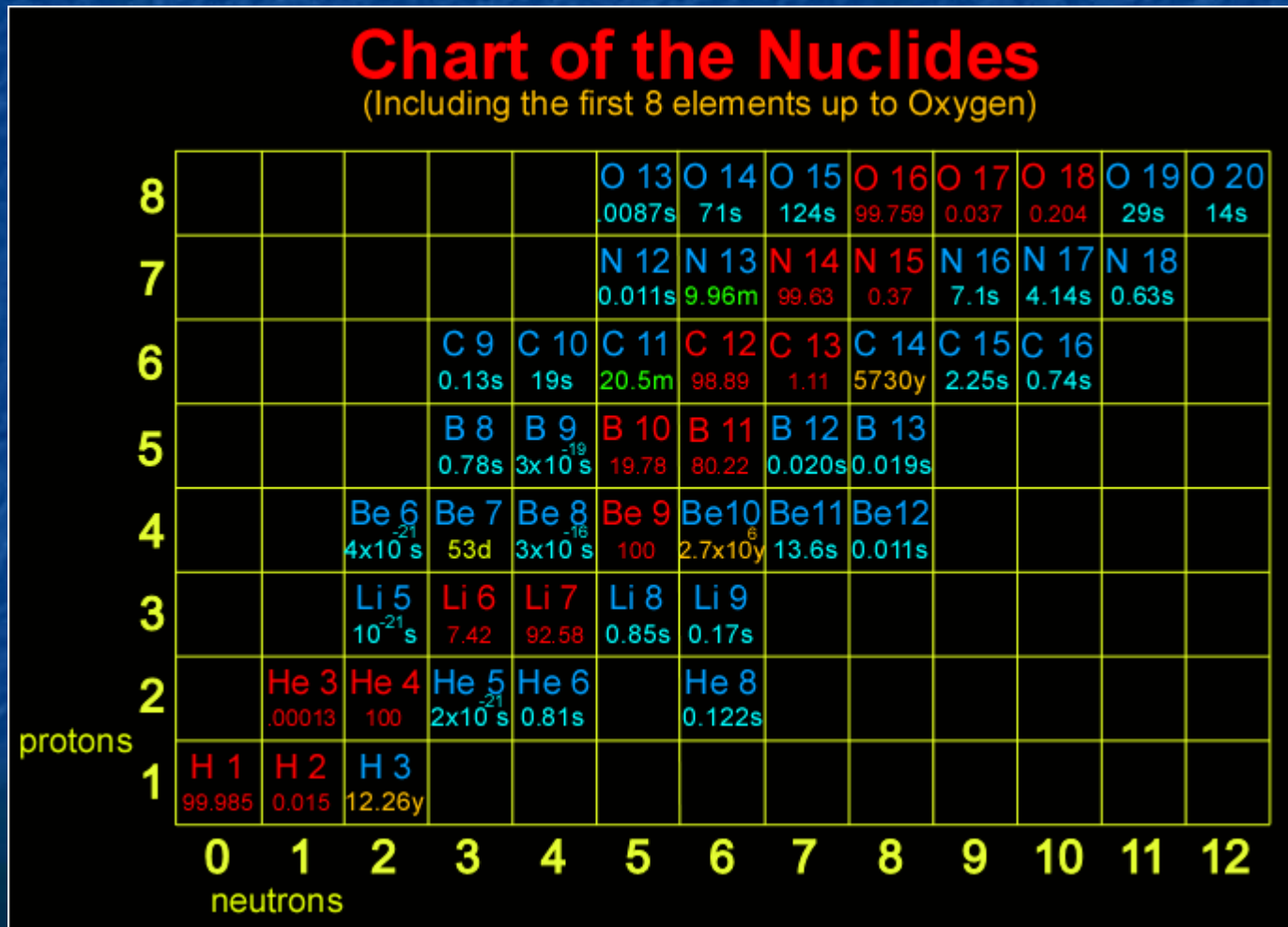


12. Specialized software analyzes radiation peaks.

Peak data is correlated to specific elements for identification and quantification.



13. Computer data is compared to a nuclide chart to evaluate the results.



Uses of Neutron Activation Analysis

- NAA can be used to determine the presence of a variety of elements in a sample.

Examples include:

- Mercury levels in tuna fish
- Aluminum levels in finger nails
- Gold levels in hair
- Zinc levels in soil
- Arsenic levels in plants

(Photos courtesy of the Laboratory Facility at the University of Florida Training Reactor)

