

## Biological question



Healthy peanut plant



Virus infection

## Protein extraction

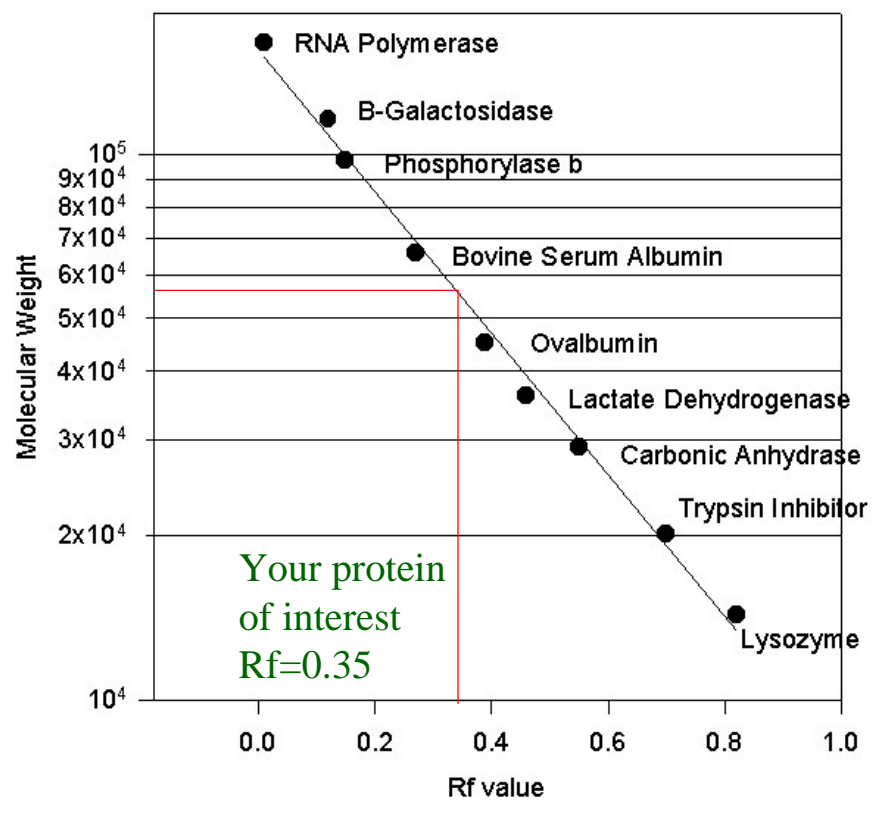
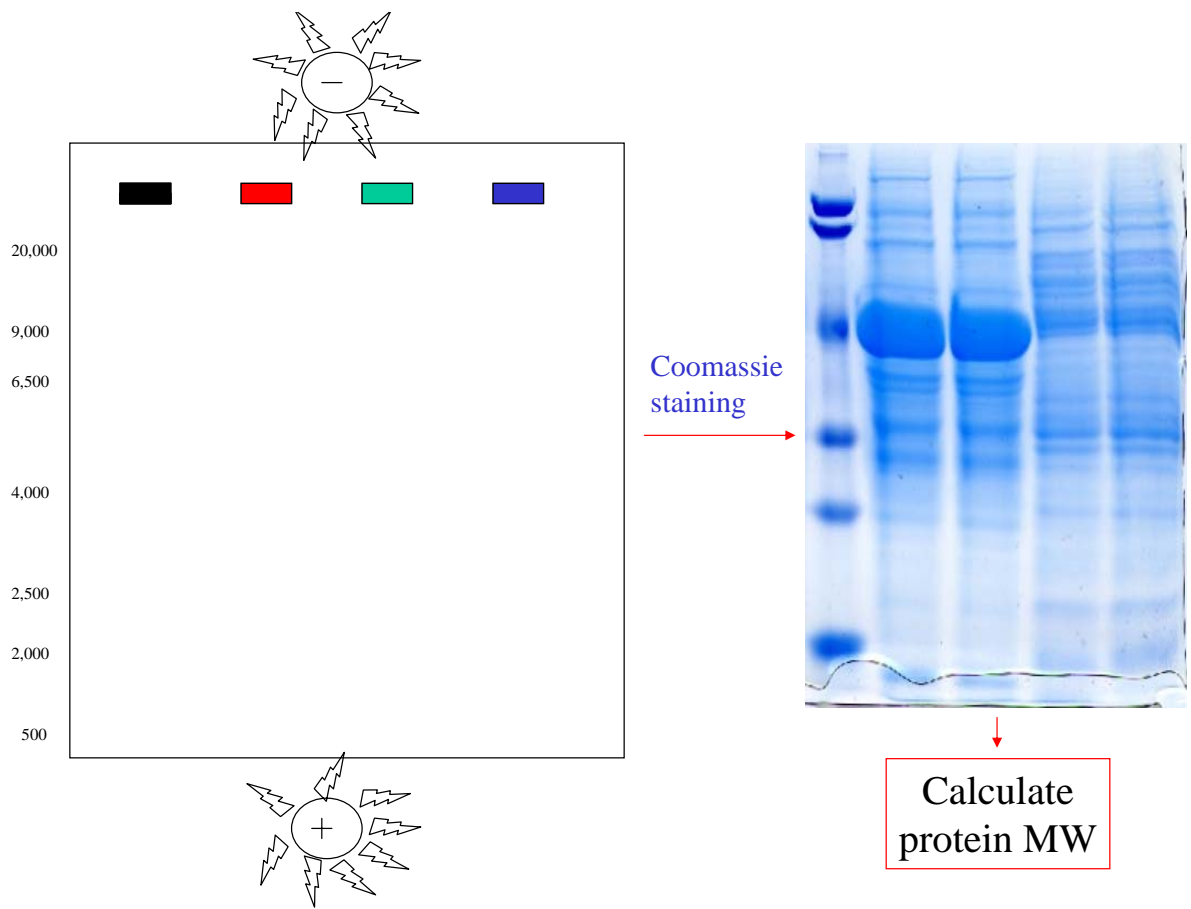
### Healthy and virus infected leaves

**Leaves:** ~ 0.2 g fresh weight

Grind in gel buffer,  
heat it up, and  
quick spin.



- Glycerol – high density for loading
- SDS – denature protein and put on charge
- $\beta$ -Mercaptoethanol – reduce S-S bond
- Bromophenol blue – monitor process of electrophoresis



# Suitcase TOF: A Man-Portable Time-of-Flight Mass Spectrometer

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**T**he need for man-portable analytical instrumentation to detect and identify potential chemical and biological hazards in the environment is growing as the number of natural and man-made threats increases. To that end, APL has been developing the Suitcase TOF, a small suitcase-sized Time-of-Flight Mass Spectrometer, and testing it extensively on known chemical and biological agents. This article introduces the reader to TOF mass spectrometry, describes the features of the Suitcase TOF that make it portable and rugged, and touches on the results of agent testing. Application areas include first-responder and special operations spot checks, clinical medicine, medical research, infrastructure and environmental monitoring, law enforcement, and military troop protection.

## INTRODUCTION

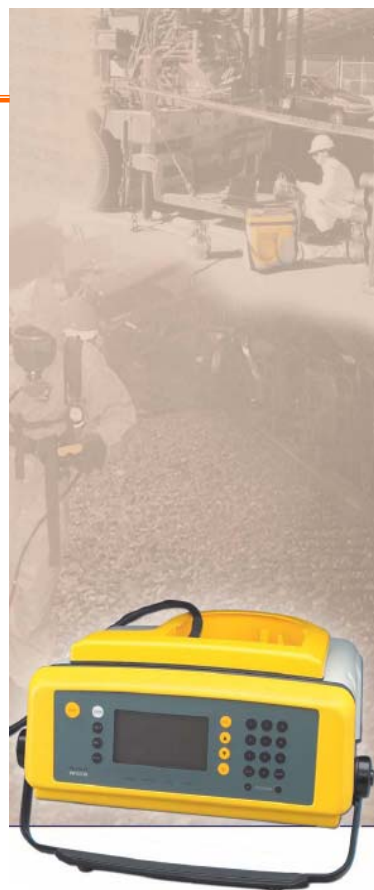
The mass spectrometer is a powerful analytical device that has the capability of detecting a wide range of chemical and biological substances. Mass spectrometry is a method of measuring the masses and fragmentation patterns of those substances to determine the composition of the original sample. Coupled with the soft ionization technique called Matrix-Assisted Laser Desorption and Ionization (MALDI),<sup>1</sup> the Time-of-Flight Mass Spectrometer (TOFMS) can measure very large, intact molecules. For example, biological toxins with masses greater than 50 kDa have been readily detected in our portable MALDI TOFMS.

The ability to deploy mass spectrometers for the field detection of chemical and biological threats has been hindered by the size, weight, and power requirements of

typical instruments. APL has been developing a small suitcase-sized TOFMS<sup>2,3</sup> that has undergone extensive testing on known chemical and biological agents. This article gives an overview of the components of the Suitcase TOF and their operation, presents encouraging results of field testing on actual agents, and touches on future improvements toward fielding a man-portable TOF instrument.

## INSTRUMENT DESCRIPTION AND OPERATION

The Suitcase TOFMS (Fig. 1) has four major subsystems—the vacuum system, optical system, source/analyzer, and electronics/data system—each with unique and innovative features.<sup>4</sup>



## You are a Bio-Sleuth

### Police/Detective

Who robbed the bank?



### Biologist

What is this protein ?



# GATHER EVIDENCE

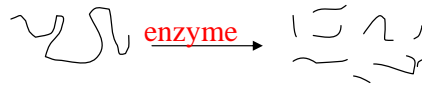
## Police/Detective

1. Interview witnesses
2. Dust for fingerprints

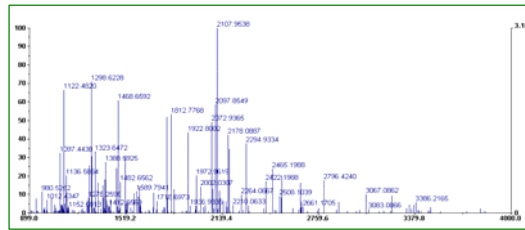


## Biologist

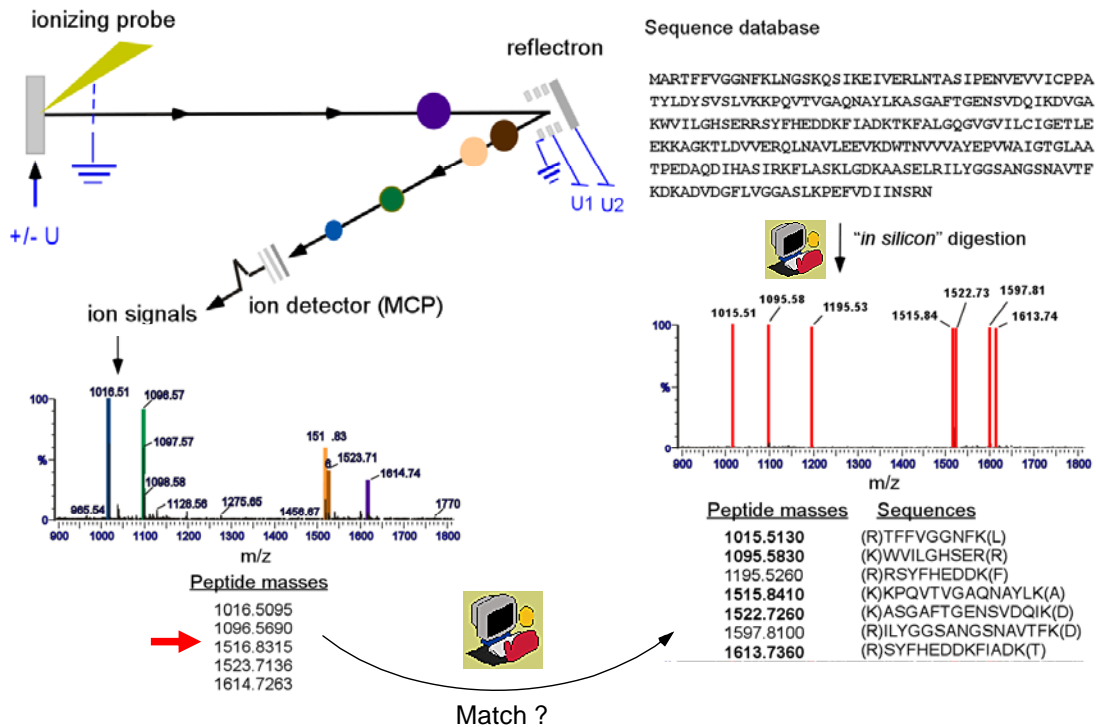
1. Interview biologist to find out information about the protein
2. Cleave protein to obtain peptide mixture



3. Obtain **peptide mass fingerprints** !



## Peptide mass fingerprinting (PMF)



# DATABASE SEARCH RESULTS

Police/Detective  
FBI fingerprint database

Identifies the robber

Anthony J. Felon



Mass Spectrometrists  
Translated protein database

Identifies the protein

Ribulose-1,5-bisphosphate  
carboxylase/oxygenase  
(Rubisco)



**Plants Are Diverse, Available in Nature,  
Lots of Questions to Ask and Address**



[www.moleculardetective.org](http://www.moleculardetective.org)