Learning About GC by Doing It, Not Reading About It

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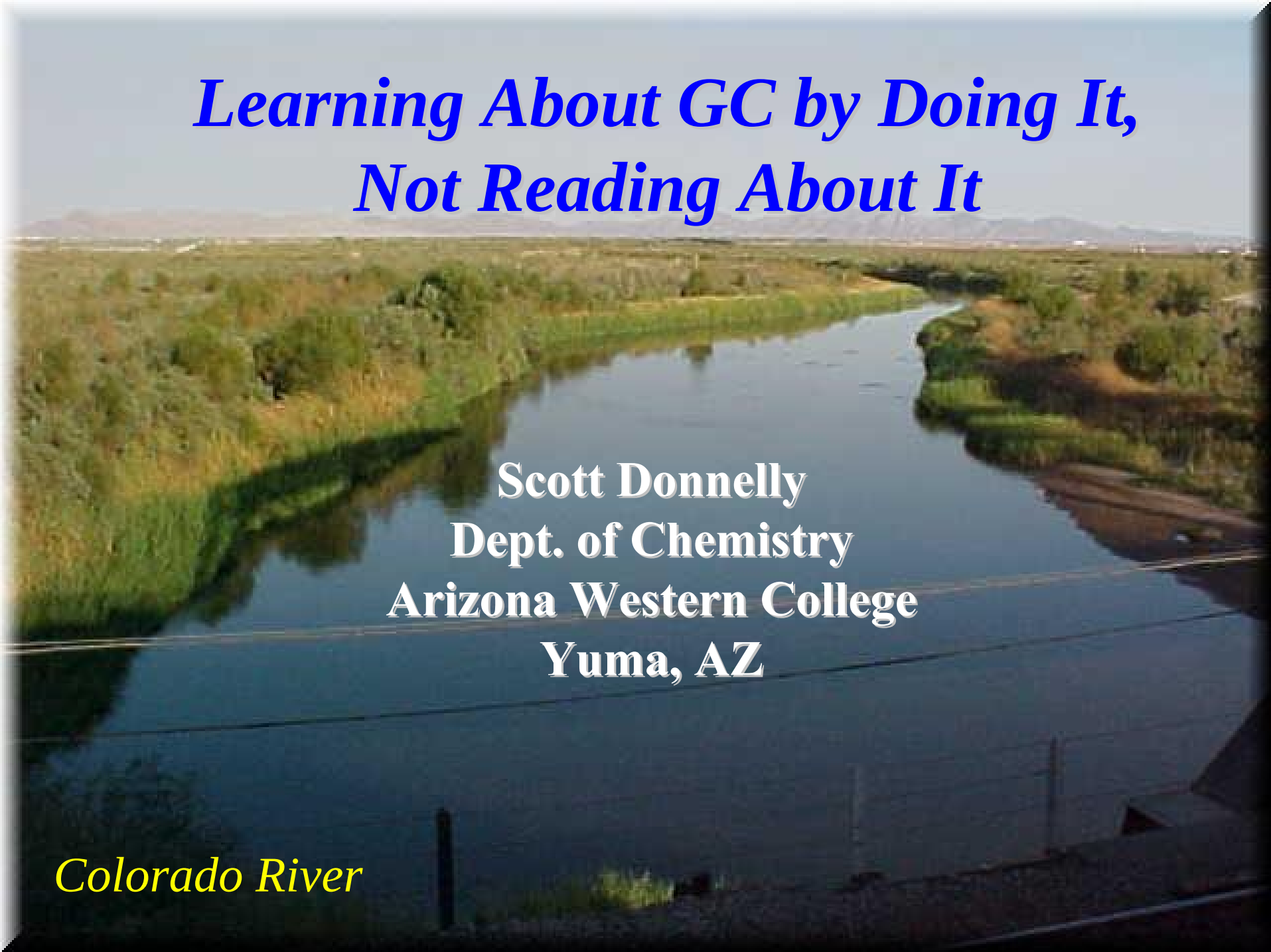
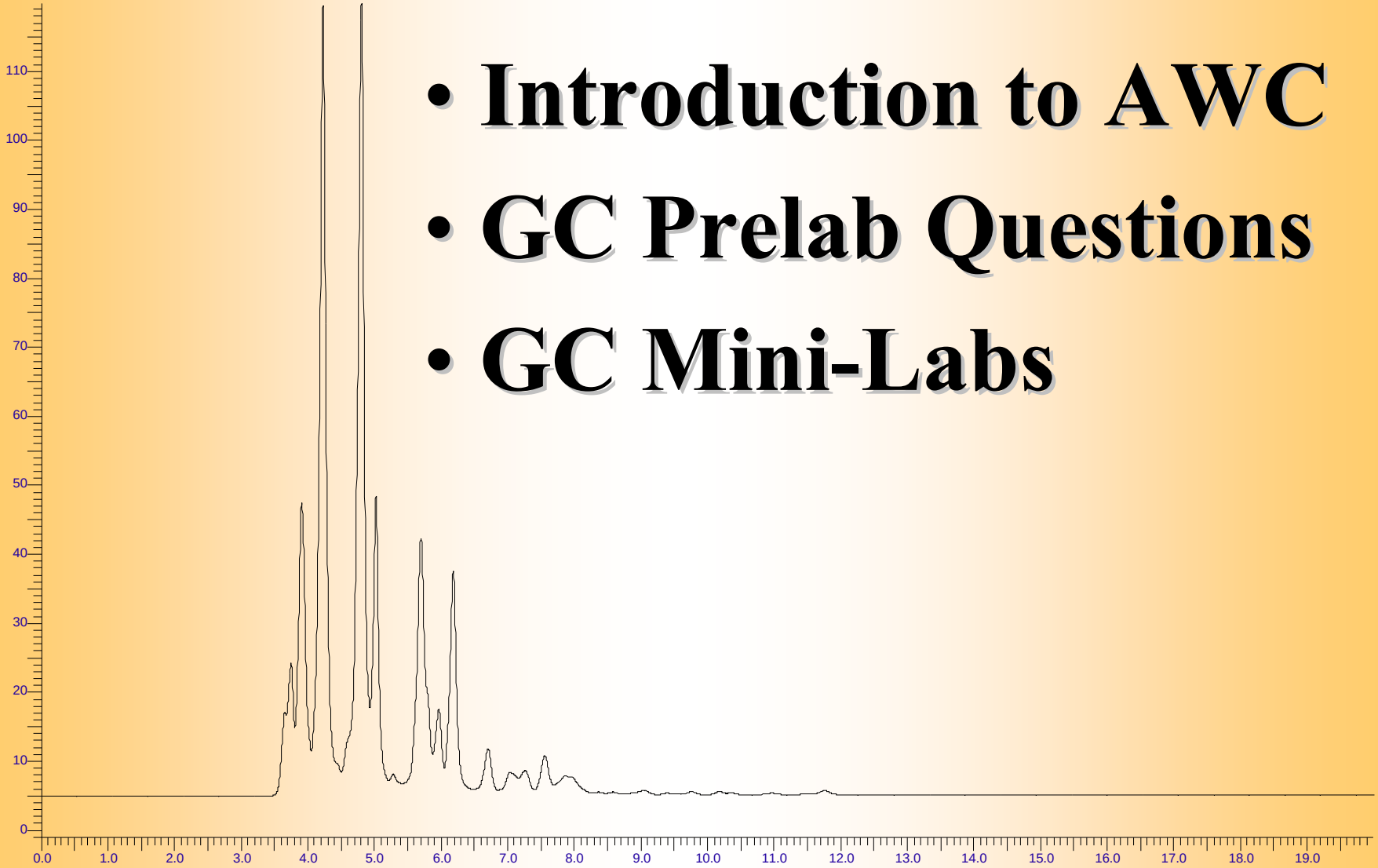


Colorado River

Presentation Topics



- **Introduction to AWC**
- **GC Prelab Questions**
- **GC Mini-Labs**


Las Vegas
Glen Canyon Dam
San Juan River
Little Colorado River
Flagstaff
Colorado River
Phoenix
ARIZONA
NEW MEXICO
AWC
Tucson
MEXICO

Arizona Western College

- **Public Two-Year College**
- **Partnerships with NAU & UA**
- **New 40,000ft^2 Agriculture-Science bldg., Spring 2007**

- ***Classes:*** **Organic Chemistry, General Chemistry 2, & Environmental Science**

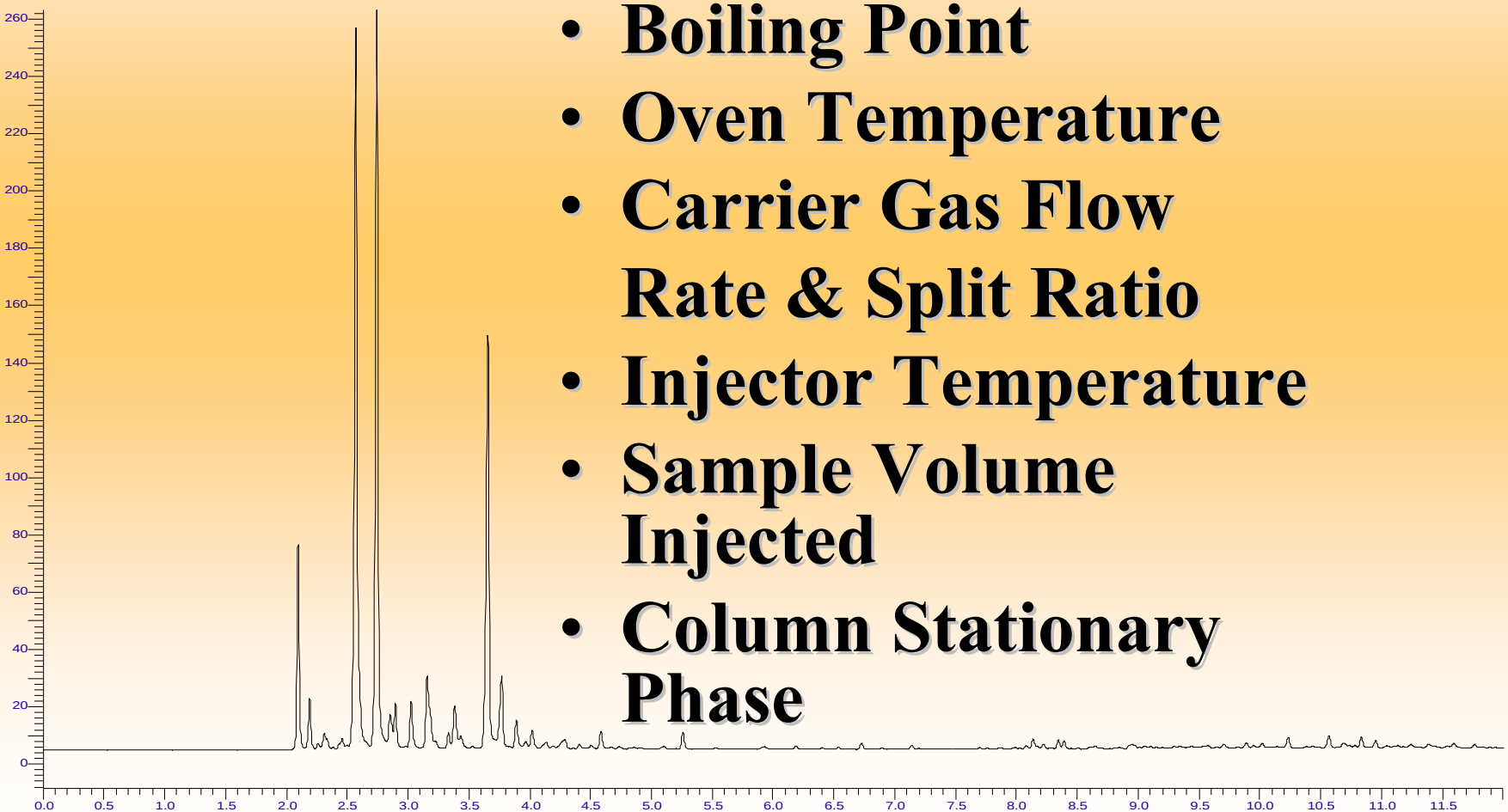
- ***GC Prelab:***
  - **Conceptual questions**
  - **5-10 minutes in length**
  - **Four consecutive weeks**

- ***GC Lab:*** **runs simultaneously with scheduled lab**

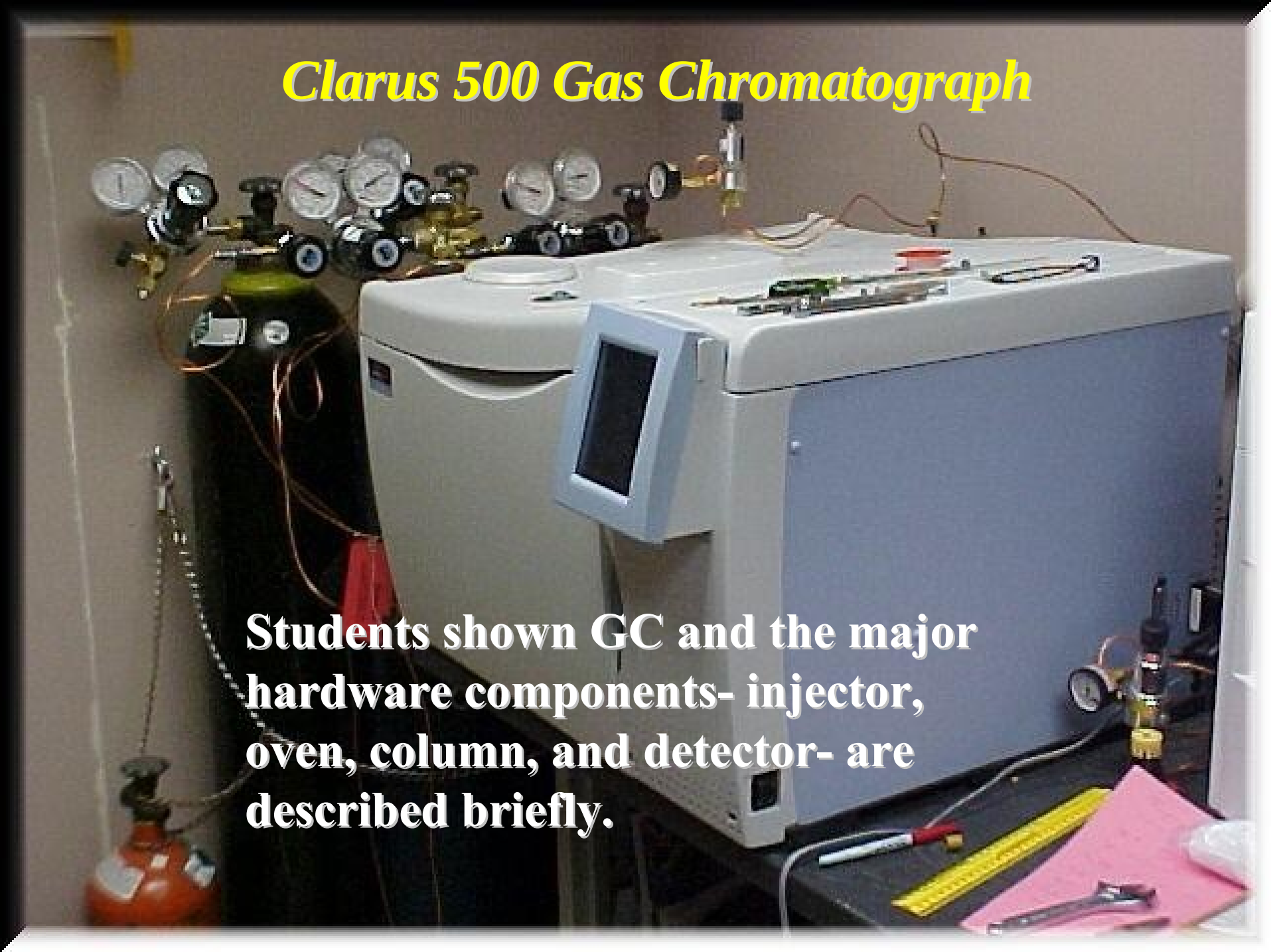
- ***GC Postlab Assessment Questions:***
  - **Embedded in quizzes and exams**
  - **Take home lab exercise(s)**
  - **Chromatography/Visible Spectroscopy Exam**

Mini GC Labs: Potential Factors Affecting Retention Time, R_t

- **Molecular Weight**
- **Boiling Point**
- **Oven Temperature**
- **Carrier Gas Flow Rate & Split Ratio**
- **Injector Temperature**
- **Sample Volume Injected**
- **Column Stationary Phase**

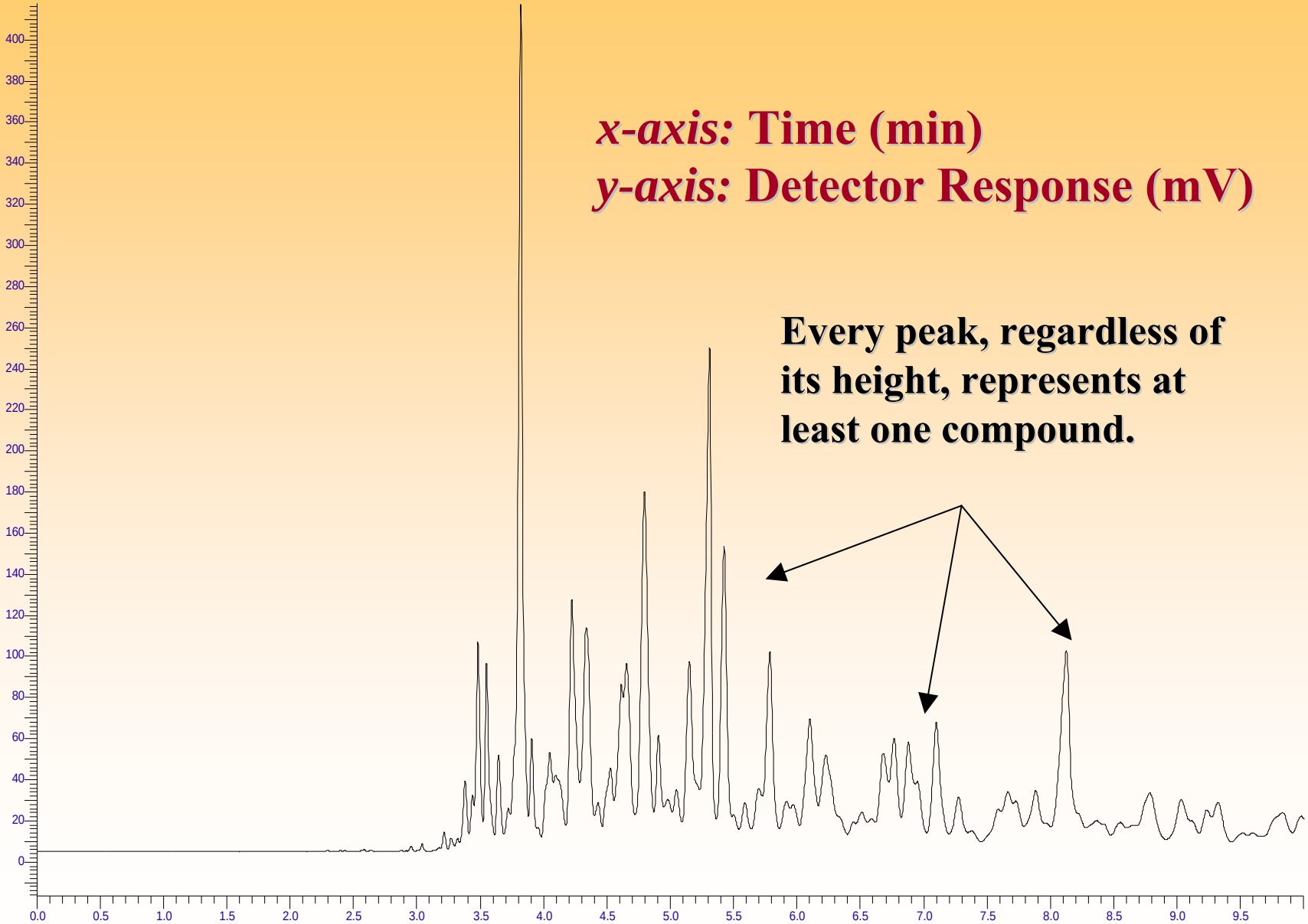


Clarus 500 Gas Chromatograph



Students shown GC and the major hardware components- injector, oven, column, and detector- are described briefly.

Chromatogram of Paint Thinner



x-axis: **Time (min)**

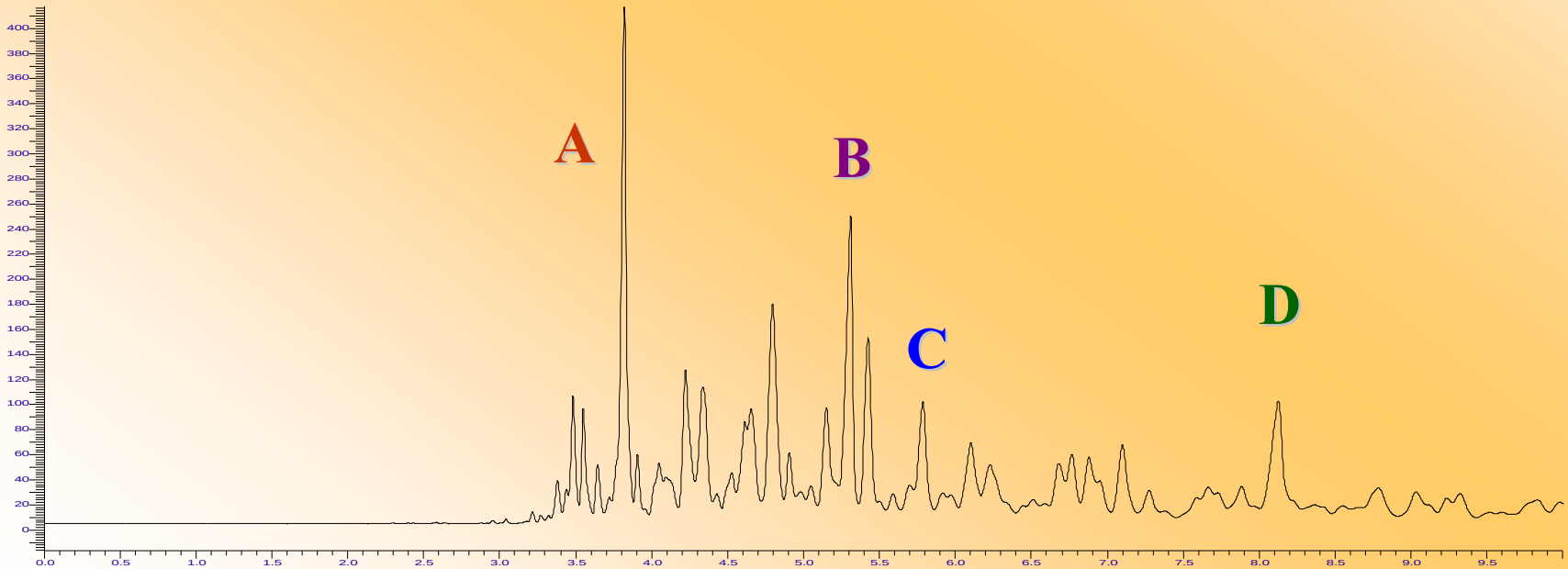
y-axis: **Detector Response (mV)**

Every peak, regardless of its height, represents at least one compound.

Prelab 1 Questions

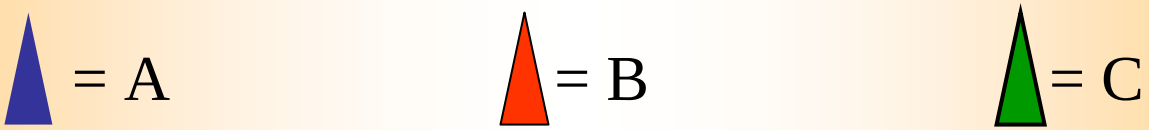
- **What physical factors might influence the separation of different compounds found in the paint thinner?**

- **Retention time, R_t, is the difference in time between when a substance was injected and when it exits the GC into the detector. Given this definition, which peak represents the compound with the longest R_t?**

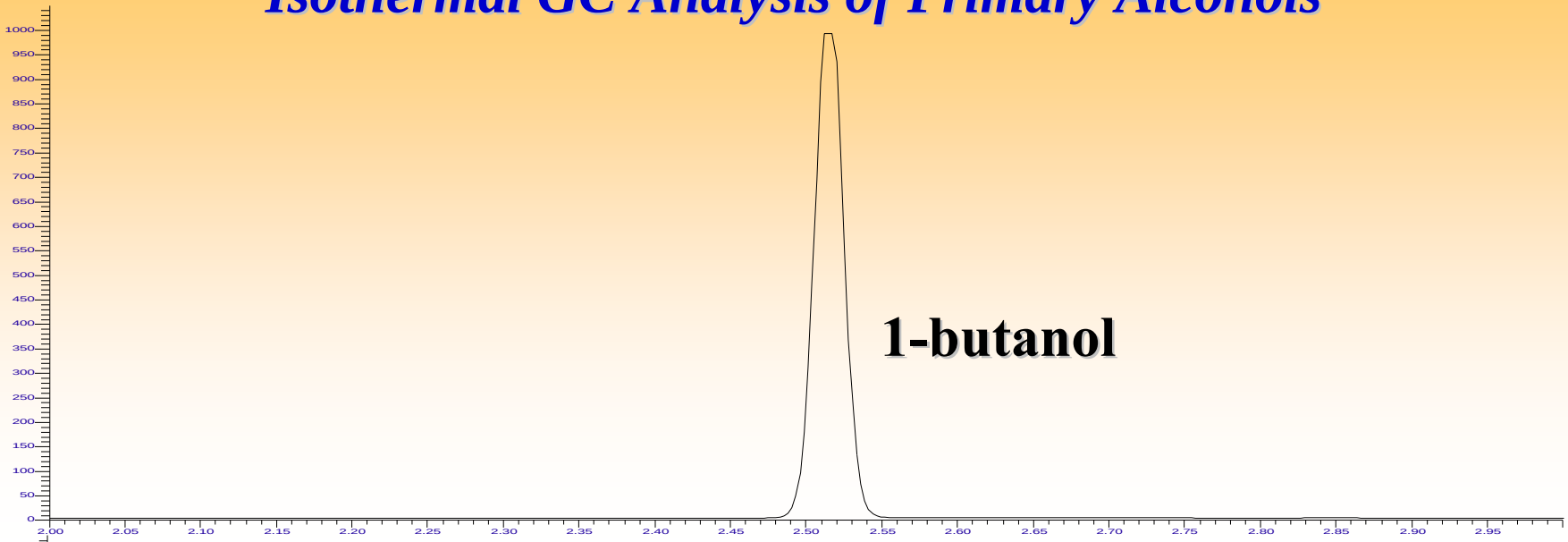


Prelab 1 Question: Molecular Weight

Gas-liquid chromatography, or GC for short, physically separates liquids in a mixture according to a number of factors, one of which is molecular weight (MW). Suppose a mixture of three liquid hydrocarbons- A, B, and C- was injected into a GC with constant oven temperature, T_{oven}. The relative MWs of the three hydrocarbons are B > A > C. Based on this information arrange the three compounds in the order that they elute or exit from the column. Then explain your reasoning.



Isothermal GC Analysis of Primary Alcohols



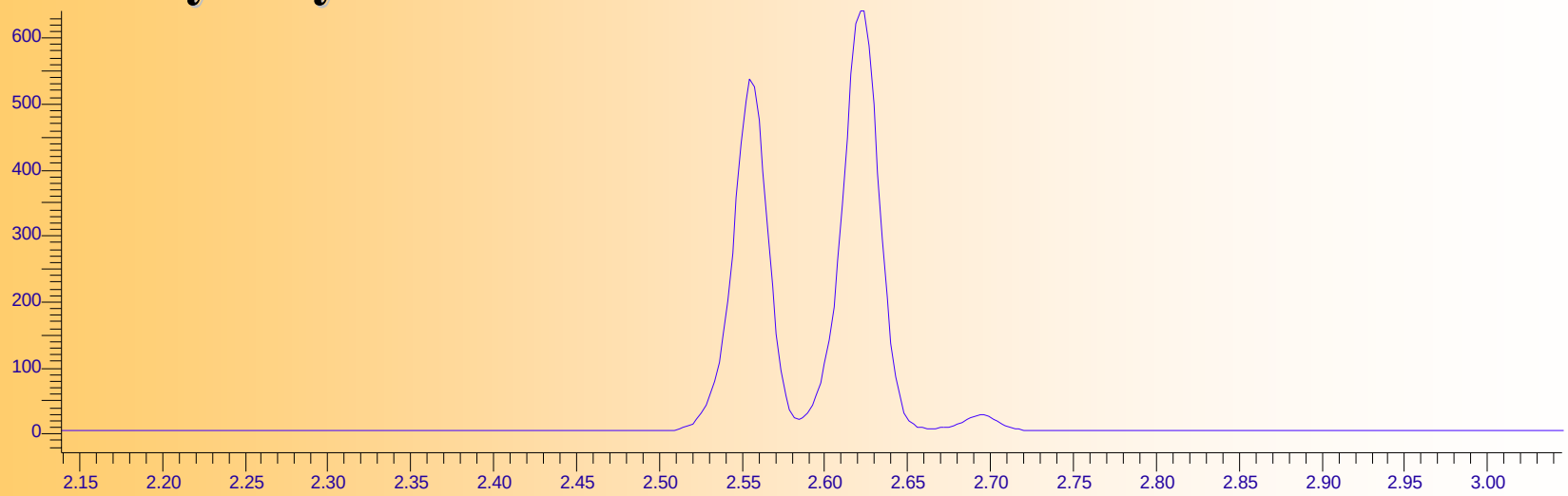
1-butanol

Other alcohols include ethanol and 1-octanol.

1-pentanol

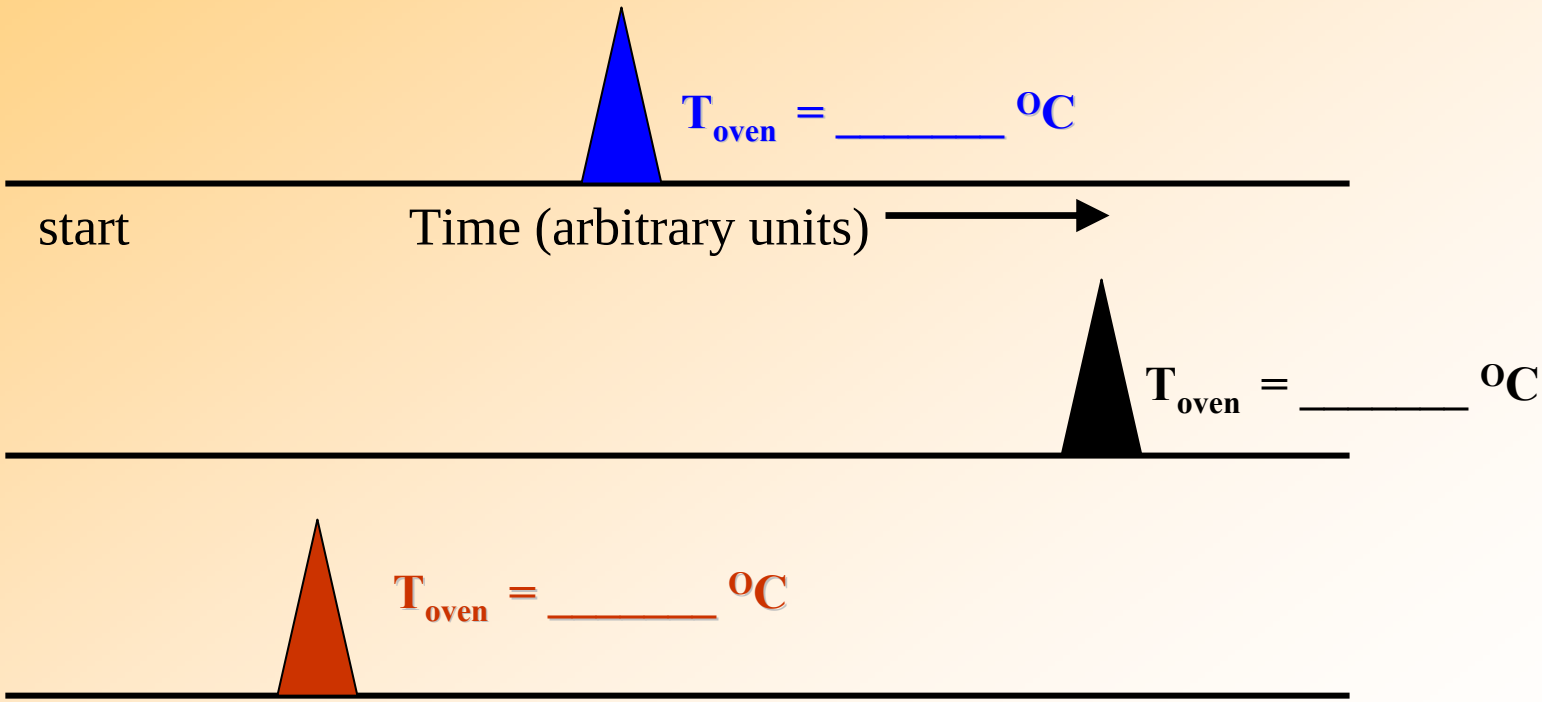
Prelab 2 Question: Boiling Point

The chromatogram below is for a two component liquid mixture, containing the alcohols 1-propanol and 2-propanol. Both alcohols have the molecular formula C_3H_8O and hence the same molecular weight (MW). Yet, as shown the two alcohols have different retention times (R_t) under identical GC conditions. Since their MWs are the same, their differences in R_t cannot be explained on account of a difference in MW. So what then is a plausible explanation for why they have different retention times?

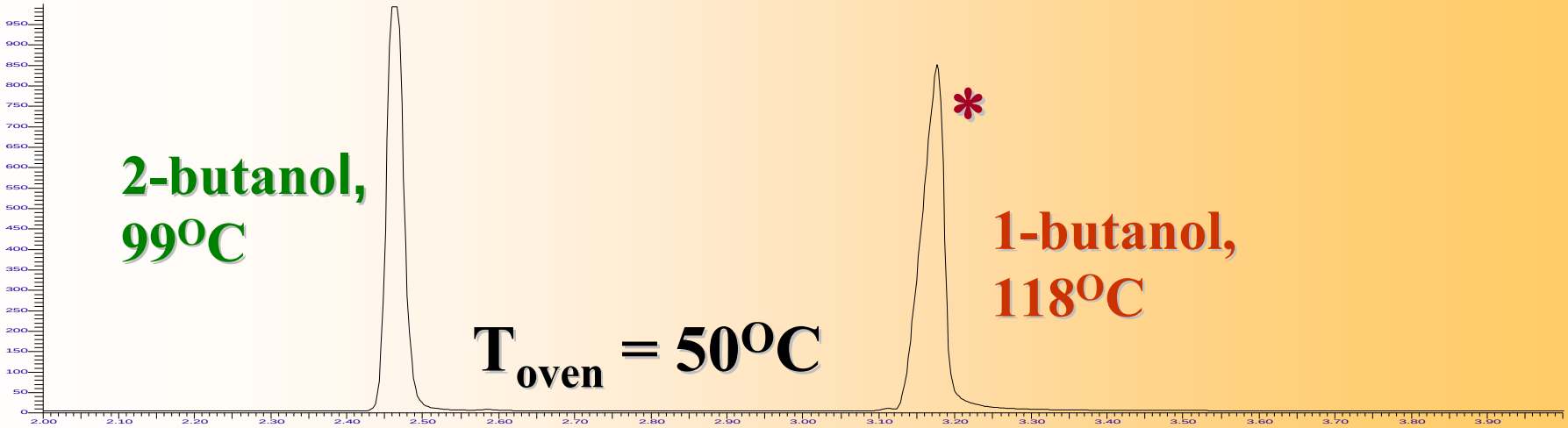


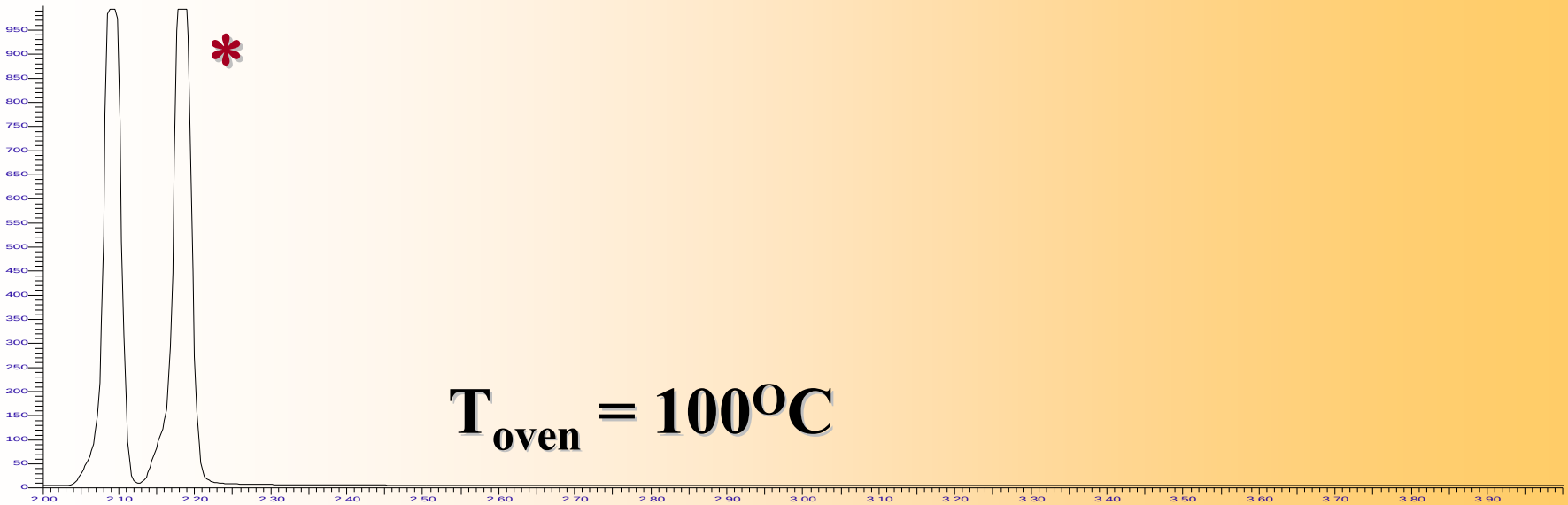
Prelab 2: Oven Temperature, T_{oven}

Three separate 0.2µL injections of 1-butanol were done at three different oven temperatures: 125°C, 100°C, and 75°C. The three separate chromatograms are shown below. Match each chromatogram with one of the three oven temperatures.



BP, T_{oven} , Peak Resolution, & R_t

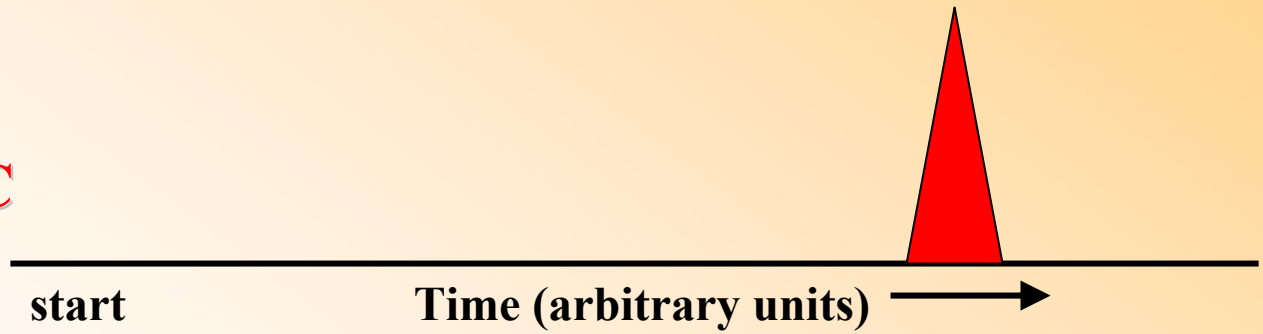




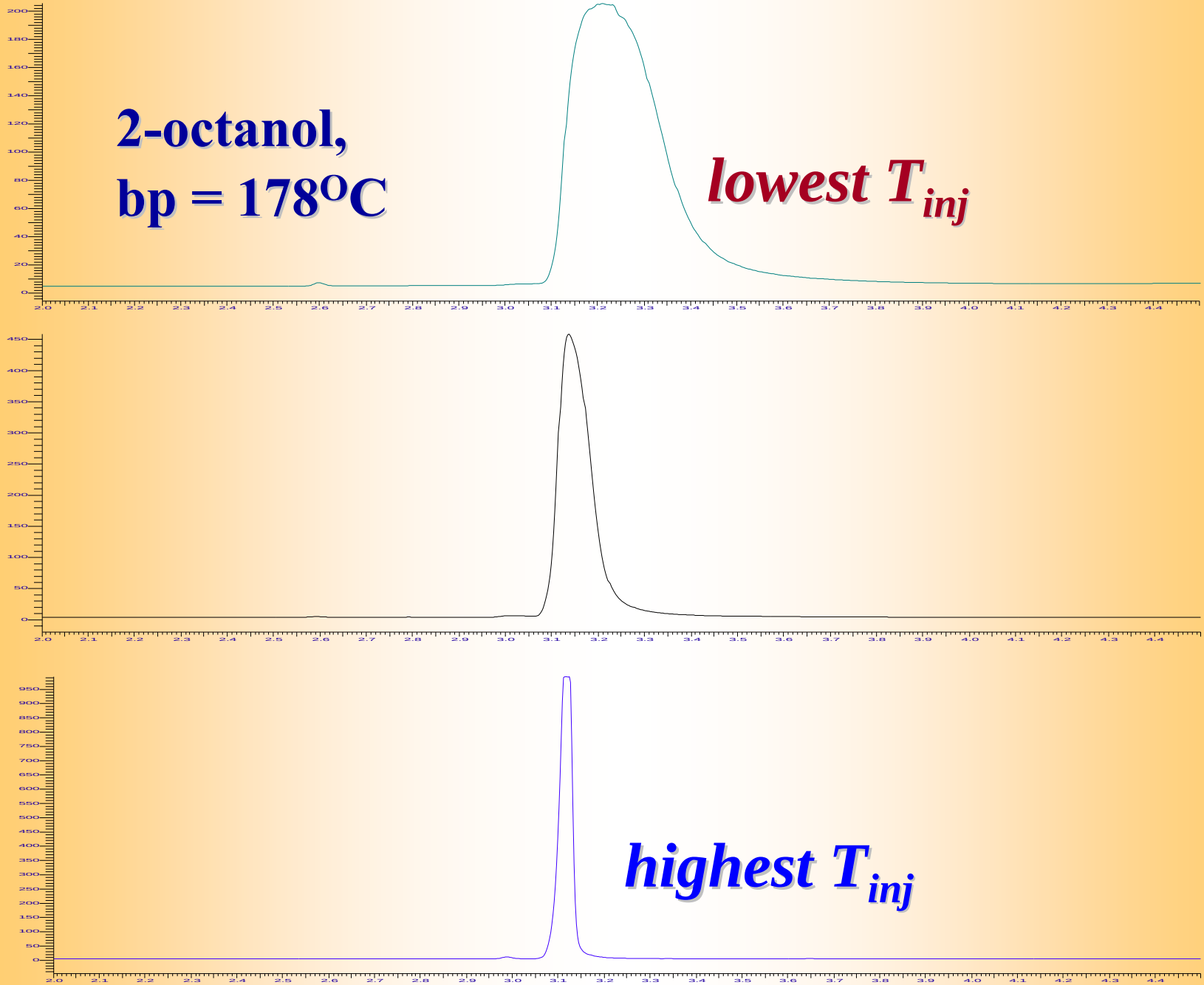
Prelab 3: Injector Temperature, T_{inj}

2-Pentanol's boiling temperature is 120^{O}C. The red triangle below represents 2-pentanol when T_{inj} = 150^{O}C. Suppose the same volume of 2-pentanol was injected into the GC but with T_{inj} = 90^{O}C. Using the bottom blank axis, draw the chromatogram for 2-pentanol when T_{inj} = 100^{O}C. Use a black triangle to represent 2-pentanol.

T_{inj} = 140^{O}C

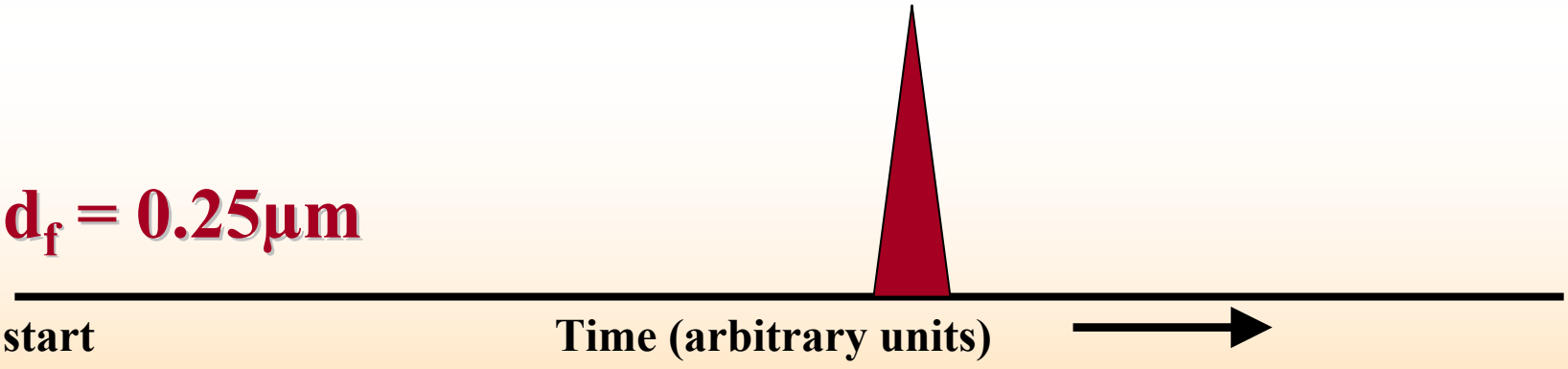


T_{inj} = 90^{O}C


2-octanol,
bp = 178°C
lowest T_{inj}
highest T_{inj}

Prelab 4: Stationary Column Thickness & R_t

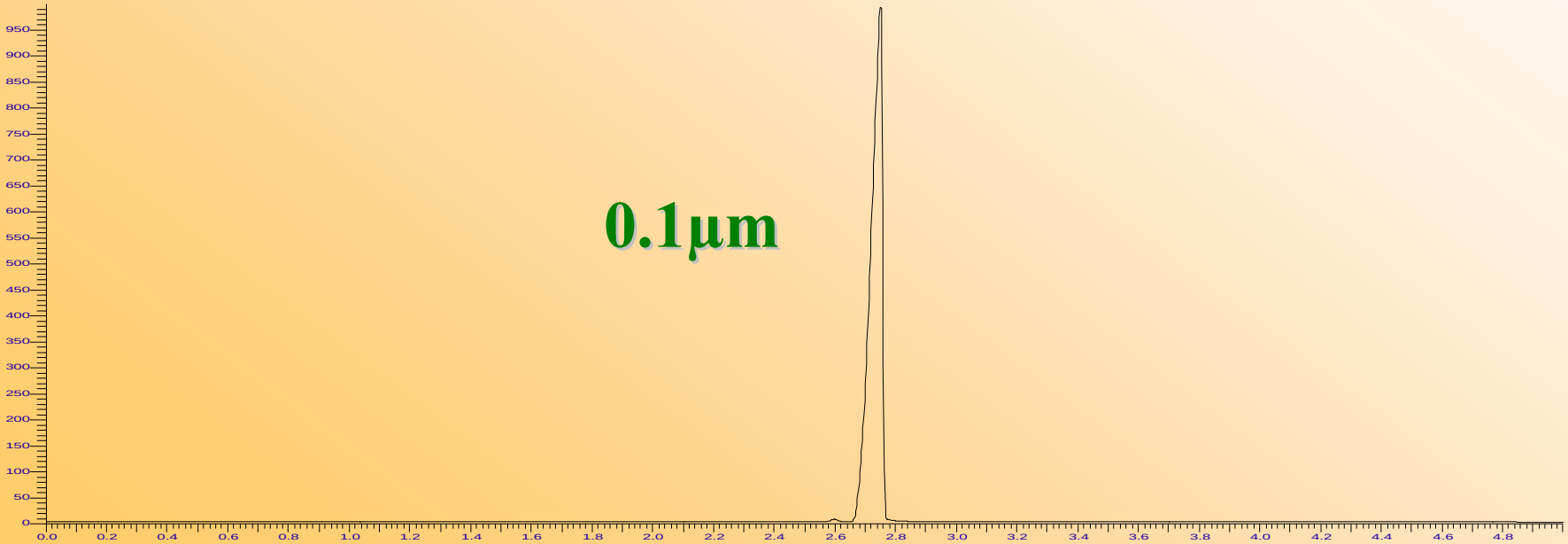
Throughout our GC studies we have used the same capillary column with a stationary phase thickness, d_f, equal to 0.25µm. Suppose the chromatogram below is for an isothermal GC analysis of octane using a capillary column with a stationary phase thickness of 0.25µm. Draw the chromatogram for octane analysis using a stationary phase thickness of 0.50µm.



$d_f = 0.50\mu m$

start Time (arbitrary units)

Stationary Phase Thickness & R_t



Acknowledgements

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2) Army Research Office (ARO)

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