

Introduction to STEM-Specific L^AT_EX

Session 3 of 5

Daniel Dia and Jad Kanaan
American University of Beirut

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Today

1. Lists

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2. Mathematics: the essentials

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3. Numbers, units, and uncertainties

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4. Figures, and the idea of a float

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2. Mathematics: the essentials
3. Numbers, units, and uncertainties
4. Figures, and the idea of a float
5. A mixed exercise from your own field

SECTION 1

Lists

Three kinds

TYPE ALONG

```
\begin{itemize}
  \item Bulleted.
\end{itemize}

\begin{enumerate}
  \item Numbered automatically.
  \item Insert one above and everything renumbers.
\end{enumerate}

\begin{description}
  \item[Analyte] The substance being measured.
  \item[Matrix] Everything else in the sample.
\end{description}
```

Nesting and tweaking

```
\usepackage{enumitem}

\begin{enumerate}[label=(\roman*)]           % (i), (ii), (iii)
\begin{itemize}[noitemsep]                   % tighter spacing
\begin{enumerate}[label=Step \arabic*:]      % Step 1, Step 2...
```

- Nesting works four levels deep, and markers change automatically.

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- Nesting works four levels deep, and markers change automatically.
- `label=Step \arabic*`: gives you a numbered protocol immediately.
- That last one is the single most useful list trick for anyone who writes methods sections.

SECTION 2

Mathematics

Two modes

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The variable x is not the same as the variable x .

Getting into maths mode

Inline maths sits in a sentence: the rate constant k was small.

Displayed maths gets its own line:

```
\[
  K_{\mathrm{eq}} = \frac{[\mathrm{C}][\mathrm{D}]}{[\mathrm{A}][\mathrm{B}]}
\]
```

- $\dots$ — inline, kept compact so line spacing survives.

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- $$\dots$$
 — displayed, unnumbered.
- $$\begin{equation} \dots \end{equation}$$
 — displayed *and numbered*. Use it whenever you might refer back.

Words inside maths

Words in maths mode get read as a product of single-letter variables, and the spaces are stripped.

```
\[  
  \text{rate} = k[\text{A}]^m[\text{B}]^n  
\]
```

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\[  
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\]
```

Use `\text{}`. And load these two, always: `amsmath` and `amssymb`.

Subscripts and superscripts

TYPE ALONG

```
 $x^2$      $x_i$      $V_{\max}$      $K_{\mathrm{M}}$      $2^{10}$   
 $e^{-x^2/2}$      $\mathrm{H_2SO_4}$      $\mathrm{C}^{14}$ 
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$e^{-x^2/2}$    $\mathrm{H_2SO_4}$    $\{ \}^{\{14\}} \mathrm{C}$
```

Braces group; a bare character does not

`$x^{10}$` raises only the 1, giving x^10 . `$x^{\{10\}}$` gives x^{10} .

The document compiles happily and prints the wrong thing. Brace anything longer than one character, always, as a reflex.

Function names

Wrong: `$\log(x) + \sin(y)$`

Right: `$\log(x) + \sin(y)$`

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- $\log$ is not a shortcut for three letters.
- It sets them upright — a function name is not a product of three variables — and spaces them correctly.
- Same for $\ln$, $\exp$, $\sin$, $\cos$, $\max$, $\min$.

Greek and common symbols

```
 $\alpha$   $\beta$   $\gamma$   $\delta$   $\epsilon$   $\lambda$   $\mu$   $\pi$   
 $\rho$   $\sigma$   $\tau$   $\phi$   $\omega$   
 $\Delta$   $\Sigma$   $\Omega$   $\Lambda$   
  
 $\times$   $\cdot$   $\pm$   $\leq$   $\geq$   $\neq$   $\approx$   $\sim$   $\propto$   
 $\rightarrow$   $\rightarrowtail$   $\Leftarrow$   
 $\in$   $\cup$   $\cap$   $\infty$   $\partial$   $\nabla$   $\bar{x}$   $\hat{y}$ 
```

Greek and common symbols

```
$\alpha \beta \gamma \delta \epsilon \lambda \mu \pi  
 \rho \sigma \tau \phi \omega$  
$\Delta \Sigma \Omega \Lambda$  
  
$\times \cdot \pm \leq \geq \neq \approx \sim \propto$  
$\rightarrow \leftarrow \Rrightarrow$  
$\in \cup \cap \infty \partial \nabla \bar{x} \hat{y}$
```

Lowercase is `\alpha`; uppercase capitalises the command, `\Gamma`. Where a capital Greek letter looks identical to a Latin one, just type the Latin one.

Numbering an equation

Initial velocity follows Equation~\eqref{eq:mm}.

```
\begin{equation} \label{eq:mm}
    v_0 = \frac{V_{\max}\,, [\mathrm{S}]}{K_{\mathrm{M}} + [\mathrm{S}]}
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- `\label` goes *inside* the environment, right after `\begin`.

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- `\eqref` gives (3) with parentheses; `\ref` gives just 3.
- Same machinery as tables last week. One mechanism, four uses.

Two lines, aligned

```
\begin{align}
\Delta G &= \Delta H - T\Delta S \\
&= -RT \ln K
\end{align}
```

- & marks the alignment point — put it just before the =.

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Enough for a two-step derivation, which is as much as most documents ever need.

Finding a symbol you do not know

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From here on

Every “how do I get the symbol for...” question has the same answer. Detexify scales. We do not.

SECTION 3

Numbers and Units

```
\usepackage{siunitx}
```

The sample was heated to $\text{SI}{372.5}{\text{\kelvin}}$ at $\text{SI}{1.2\text{e-}3}{\text{\pascal}}$ over $\text{SI}{45}{\text{\minute}}$.

Concentrations ranged from $\text{SIrange}{0.5}{2.5}{\text{\milli}\text{\molar}}$.

We measured $\text{SI}{5.34 \text{ pm } 0.12}{\text{\milli}\text{\gram}\text{\per}\text{\liter}}$.

A bare number: $\text{num}{1.6\text{e-}19}$. A bare unit: $\text{si}{\text{\micro}\text{\liter}}$.

What it fixes

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You already met this package last week, for decimal-aligned table columns.

SECTION 4

Figures

Getting an image in

TYPE ALONG

```
\usepackage{graphicx}           % in the preamble  
  
\includegraphics[width=0.6\textwidth]{setup.png}
```

- Upload via the button at the top of the file tree, or drag and drop.

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- `pdflatex` takes `.pdf`, `.png`, `.jpg` — not `.eps`.
- Vector for plots and diagrams. Raster for photographs and micrographs.

The real version

```
\begin{figure}[htbp]
  \centering
  \includegraphics[width=0.6\textwidth]{setup.png}
  \caption{The experimental apparatus, viewed from above.}
  \label{fig:setup}
\end{figure}
```

As shown in Figure~\ref{fig:setup}, the detector sits downstream.

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\begin{figure}[htbp]
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```

As shown in Figure~\ref{fig:setup}, the detector sits downstream.

Caption *below* the image for figures. Label after the caption. Tilde before \ref.

The same silent bug as last week

`\label` must come after `\caption`

`\caption` increments the figure counter. The label attaches to whatever was counted most recently.

Put the label first and every reference points at the enclosing *section* number instead — silently, with no error.

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This is the most common cross-referencing bug in $\text{\LaTeX}$.

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Do not fight it

`\usepackage{float}` and `[H]` will pin a figure exactly where you typed it — and leave large gaps at the bottom of pages.

Write the whole document first. Worry about float placement only once the text has stopped moving.

SECTION 5

Exercise

A page from your own field

Build a single page containing

1. A numbered protocol of at least four steps

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2. Two equations from your field — one inline, one displayed, numbered, labelled, and referred to from prose

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3. Three measurements with `siunitx`, one with an uncertainty

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3. Three measurements with `siunitx`, one with an uncertainty
4. Your figure: captioned, labelled, referred to from the text

Starter equations

Biology	$v_0 = \frac{V_{\max}[\text{S}]}{K_{\text{M}} + [\text{S}]}$
---------	--

Chemistry	$K_{\text{eq}} = \frac{[\text{C}]^c[\text{D}]^d}{[\text{A}]^a[\text{B}]^b}$
-----------	---

Physics	$F = G \frac{m_1 m_2}{r^2}$
---------	-----------------------------

Maths	$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$
-------	--

Any	$\bar{x} \pm t \frac{s}{\sqrt{n}}$
-----	------------------------------------

SECTION 6

Final Project

Due at the start of Session 4

A short paper, three to five pages, on anything

- Title block, abstract, table of contents

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- Title block, abstract, table of contents
- Three sections with subsections

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- Three citations from a `.bib` file, and a bibliography

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- Three measurements with `siunitx`
- One captioned, labelled figure, referenced from the text
- One `booktabs` table, captioned, labelled, referenced
- Three citations from a `.bib` file, and a bibliography
- One custom command, defined and used

Then the tracks

Track	Adds
Chemistry	<code>mhchem</code> , <code>chemfig</code> , reaction schemes
Biology	Sequence alignments, phylogenetic trees, figure panels
Physics	The <code>physics</code> package, vectors, Feynman diagrams
Mathematics	Theorem environments, proofs, commutative diagrams
TrEd	Proposals, citation libraries, podium remarks, mail merge

Questions?

<https://www.overleaf.com/learn> • <https://tex.stackexchange.com>