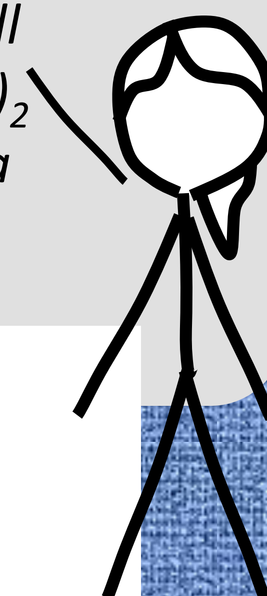
Determination of K_{sp} for Calcium Hydroxide
15 February 2018

Objectives: To determine a useful value: an equilibrium constant.

Today we will perform a colorful titration on our way to estimating a value of an equilibrium constant for a sparingly soluble salt.

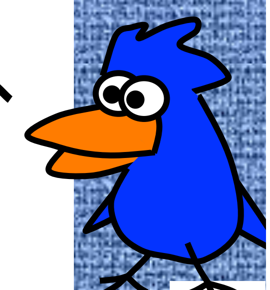
The salt we will study is $Ca(OH)_2$ which is only a little soluble.



Overview:

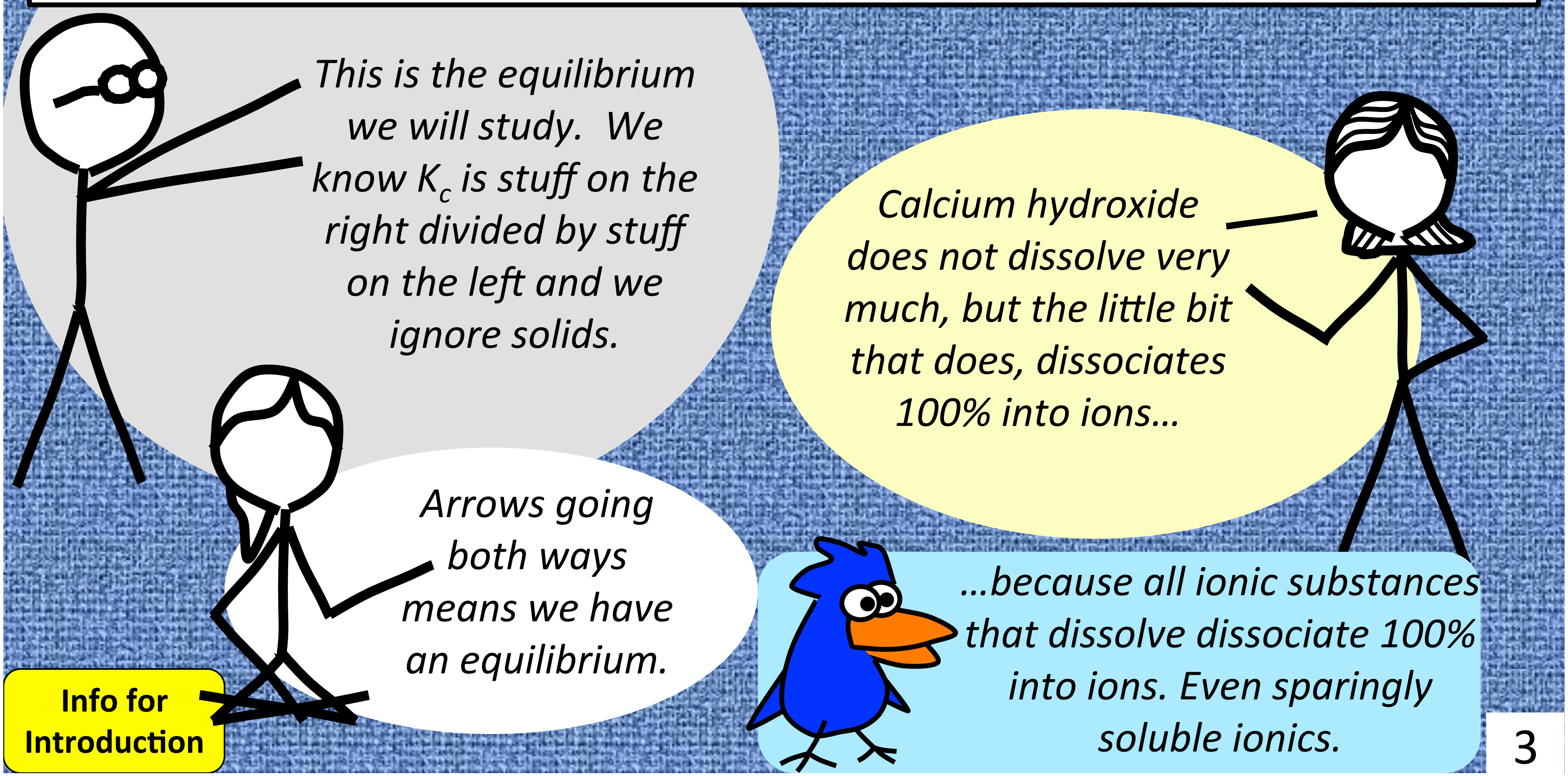
1. The equilibrium constant of a sparingly soluble ionic solid.
2. Overview of the experiment and calculations.
3. The titration
4. Procedure: What we do today
5. Your lab report

I use the word sparingly sparingly.



1. The equilibrium constant of a sparingly soluble ionic solid.

$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2\ OH^-(aq)$ $K_c = [Ca^{2+}][OH^-]^2$

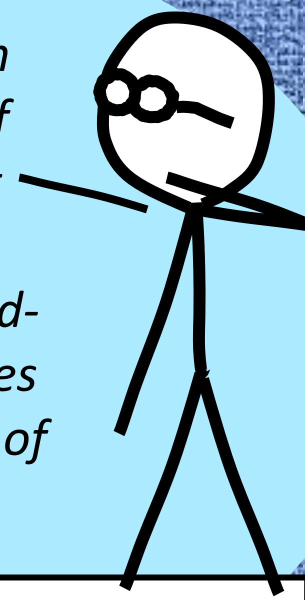


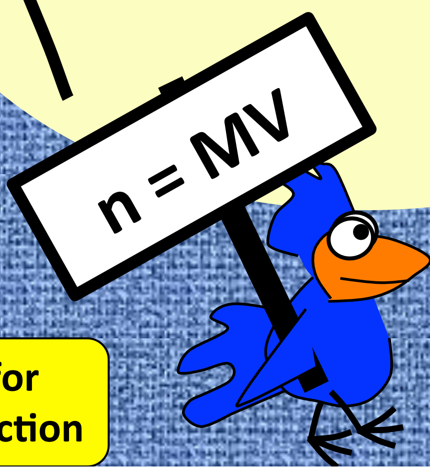
2. Overview of the experiment and calculations

$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2\ OH^-(aq)$ $K_c = [Ca^{2+}][OH^-]^2$

If we titrate the OH^- with a known concentration of HCl(aq), we can figure out moles of HCl used by using $n_{acid} = M_{acid}V_{acid}$.

And from there we can figure out the moles of OH^- that were present from the 1:1 stoichiometry of the acid-base titration. The moles of OH^- equals the moles of H_3O^+, $n_{base} = n_{acid}$.



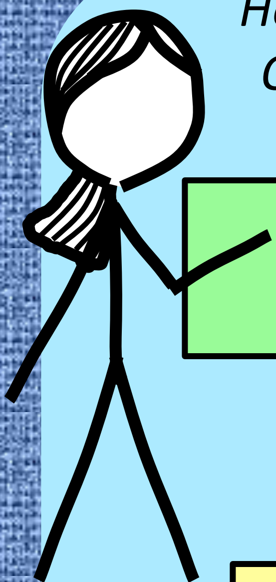


$H_3O^+(aq) + OH^-(aq) \rightarrow 2\ H_2O(l)$

Info for Introduction

2. Overview of the experiment and calculations

$$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2\ OH^-(aq) \quad K_c = [Ca^{2+}][OH^-]^2$$



Here's our "road map". From moles of OH^-, we get the molarity of OH^-. That gives us $[Ca^{2+}]$ from the 2:1 stoichiometry. With $[OH^-]$ and $[Ca^{2+}]$ we calculate K_c! Easy peasy.

$$n_{OH^-} = n_{H_3O^+}$$

$$[OH^-] = \frac{n_{OH^-}}{V_{\text{original } Ca(OH)_2 \text{ Sol'n}}}$$

$$[Ca^{2+}] = \frac{[OH^-]}{2}$$

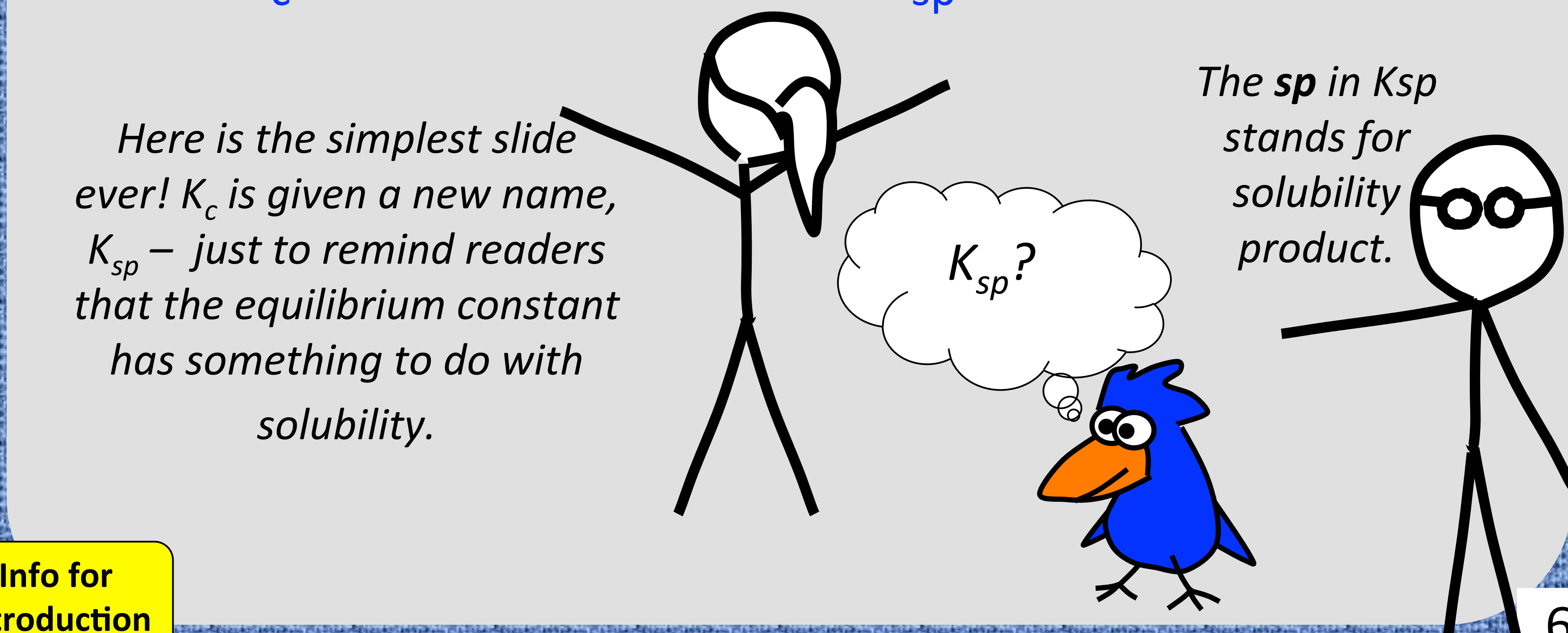
$$K_c = [Ca^{2+}][OH^-]^2$$

Info for Introduction

2. Overview of the experiment and calculations

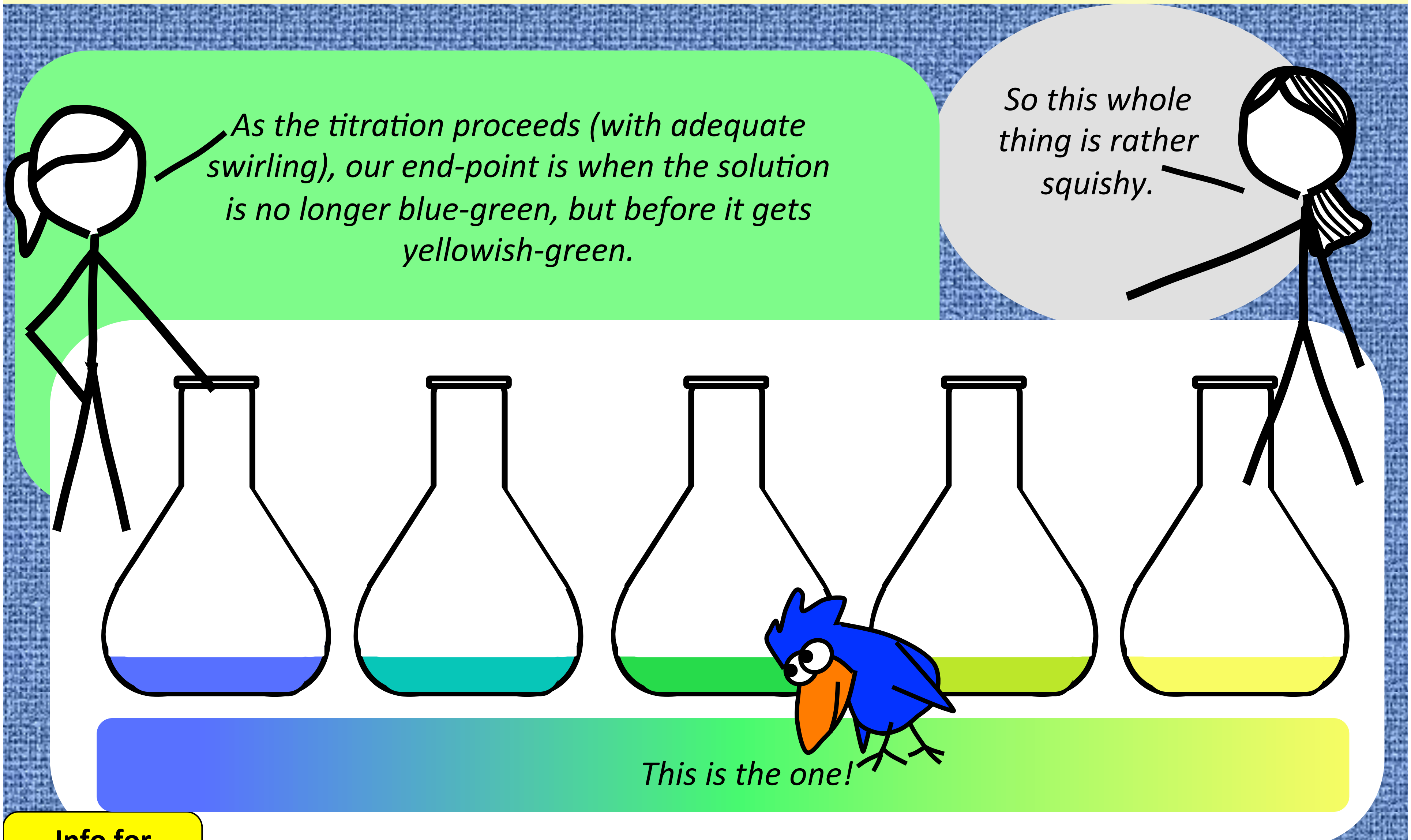
$$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2\ OH^{-}(aq) \quad K_{sp} = [Ca^{2+}][OH^{-}]^2$$

$$K_c = [Ca^{2+}][OH^{-}]^2 \quad \text{or} \quad K_{sp} = [Ca^{2+}][OH^{-}]^2$$



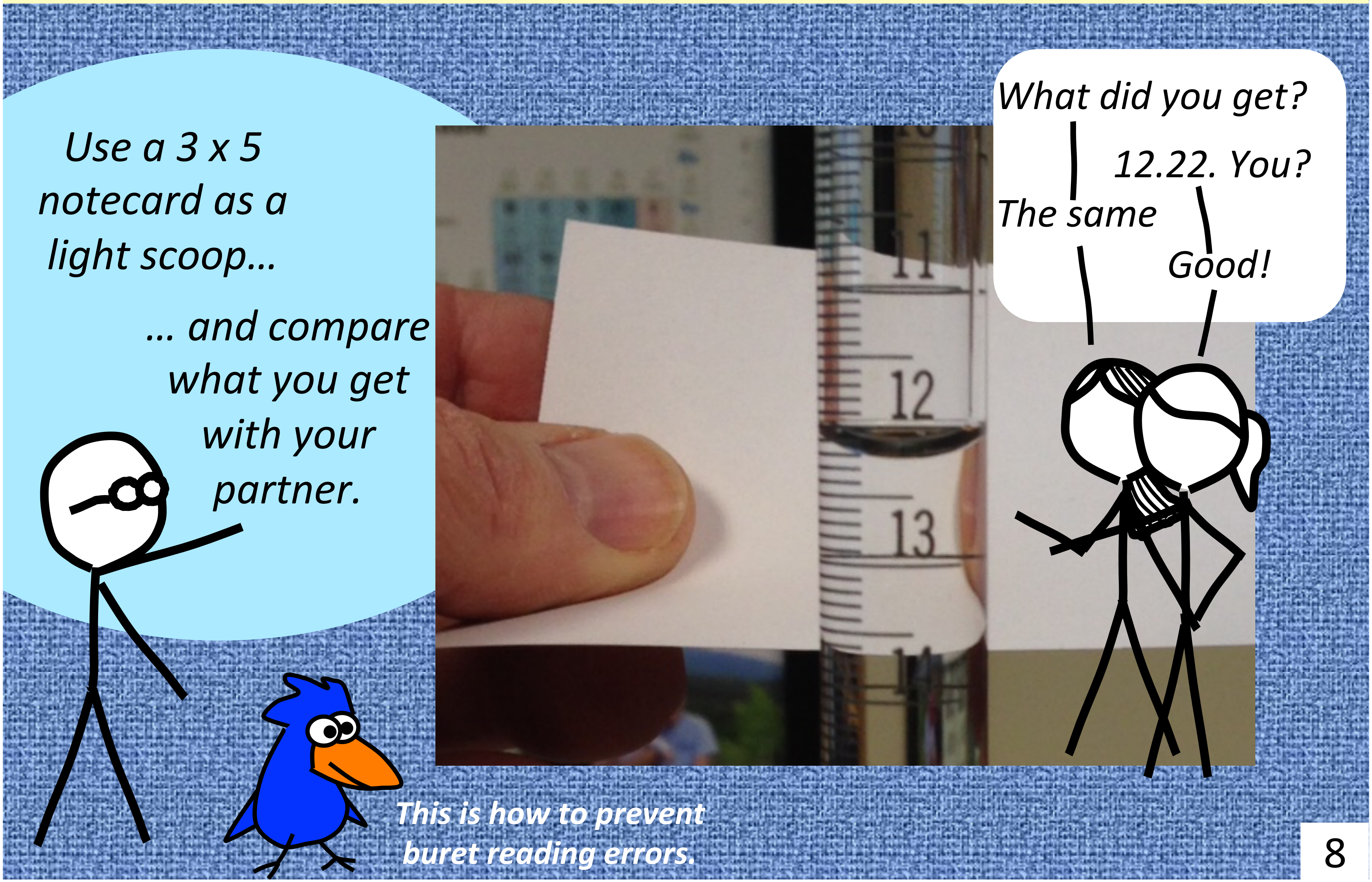
Info for Introduction

3. The titration

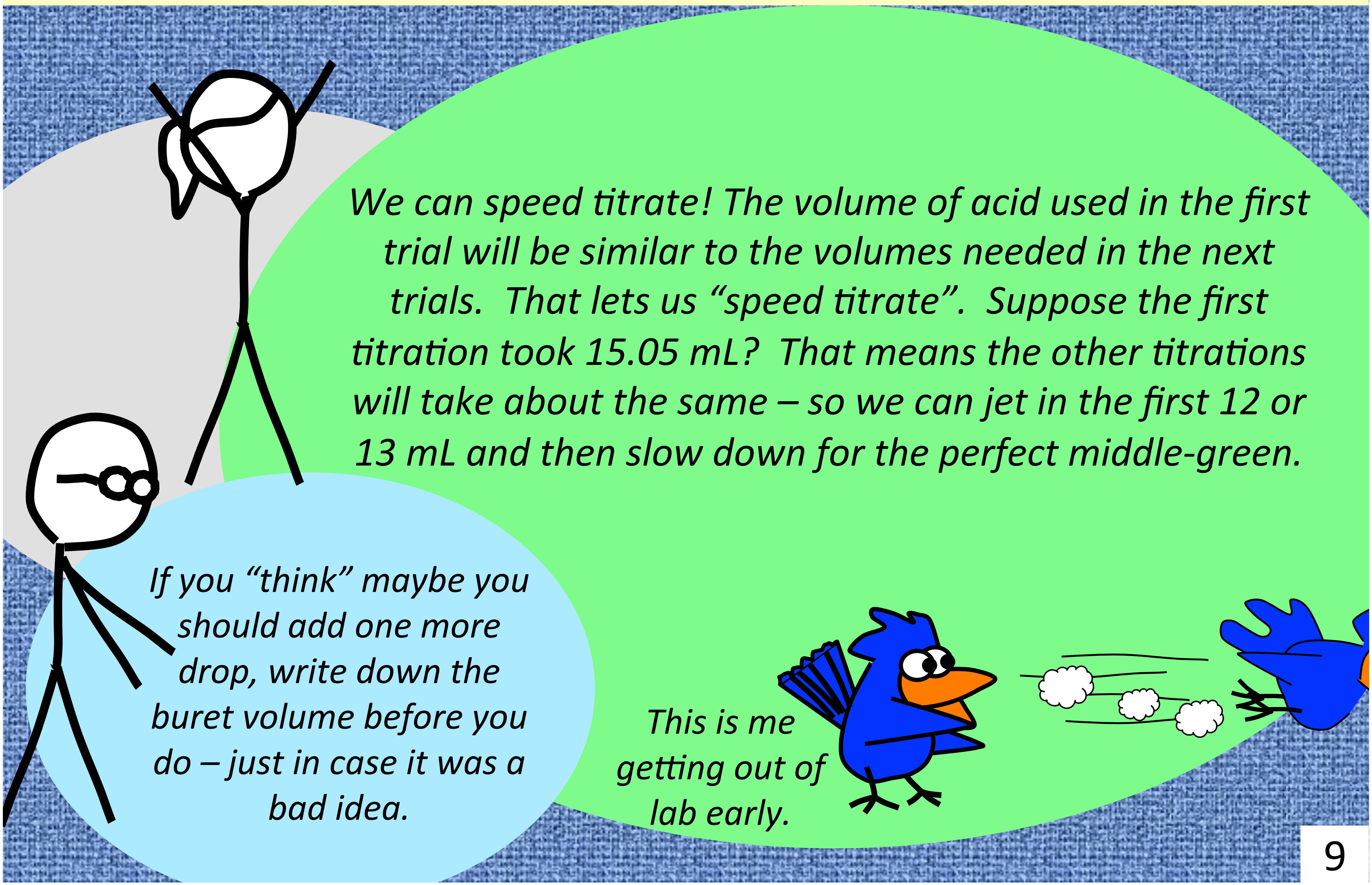


Info for Introduction

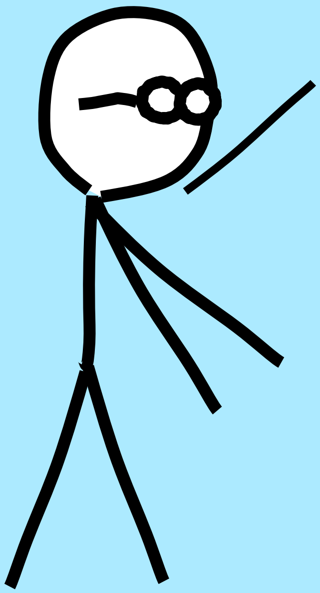
3. The titration



3. The titration



4. Procedure: What we do today



① *Take time writing an introduction in your own words before lab.*

② *Record observations and details as carefully as possible. Show your calculations with formulas, units, and significant figures!*

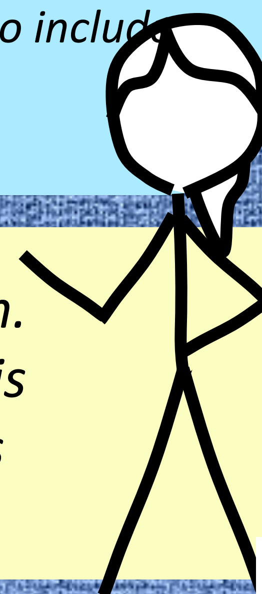
③ *After the first titration is done, the subsequent titrations will take about the same volume of HCl(aq).*

④ *Compare your K_{sp} with the literature value (from our textbook or the internet). Cite your reference.*

⑤ *The cover sheet summarizes everything that you need to include with your report.*

Only this one way will work!

You'll be entering data into a Google form. Exponential numbers are entered as in this example: 8.00 x 10^{-6} would be entered as ***8.00E-6*** *– note there are no spaces!*



5. Your lab report

① First, the cover page with TA initials.

② Next, the trimmed copy pages from your lab notebook stapled together. Staple all together.

③ **On-line results** due at the end of class today. Late submissions are not graded – see the syllabus.

④ No attached pages today.

⑤ Turn in lab report ***before*** the start of class tomorrow. Late labs may not be graded – see the syllabus.

Stick people inspired by xkcd cartoons by Randall Munroe (www.xkcd.com)