1. **Make it your own.** Adapt your resources to put the learning you want at the heart of the practical - don't imagine you'll do the learning bit later as you'll have wasted loads of valuable time they could have been learning during the practical.

2. **Don't neglect the pre-lab.** To get the most out of the practical, include a pre-lab which helps students understand the scientific theory, gives them an overview of the method or makes them care about the result of the practical. Or, even better, all three!

3. **Understanding the set-up.** Get students to select the correct diagram from a range of options, rather than being given the diagram, or correct the errors in the diagram before they start.

4. **Ranking errors.** An evaluation does not always need to be a long paragraph, getting students to rank different errors in order of how much they would have impacted the results makes them think just as hard.

5. **Increase the cognitive conflict.** Give students a chance to view the practical as an opportunity to learn something new - present two alternative ideas about what might happen, and the reasons why, and let students work out which explanation is right.

6. **Focus on one area at a time.** Practicals should focus on either planning, developing new practical skills, analysis, evaluation, or presentation. Trying to focus on more than one in too much detail dilutes rather than enhances the learning.

7. **Scaffolding the domain transfer.** This is the biggest challenge for students: connecting the practical and theoretical domains. So get students to match all the correct scientific ideas with the correct practical steps, scaffolding the process for them.

8. **Value graph sketching.** Students don't always need to draw out a graph properly, sometimes sketching the results and then discussing what they show in terms of scientific ideas is just as powerful (and more time efficient).

9. **Ditch the method.** You only really know if students know how to do something if they can do it on their own. When do you leave them to it, make sure you tell them clearly what they will need to submit, such as diagram, results, analysis, etc.

10. **Embed preliminary practical work.** Scientists compare different practical approaches (with small amounts before scaling up). Make this part of the students regular practice before they come back and finalise their practical plans.

11. **Poster competition.** Write-ups don’t always need to be aim, method, results, conclusion, and evaluation. The poster competition is ubiquitous in science research - include it in your teaching too!

12. **The power of predicting.** Set the scene with a powerful pre-lab which gets students using their theoretical understanding to predict their observations, this gives space for higher level discussion on why things don’t always appear as they imagine.

13. **Skills focus.** Practical work isn't all about learning new theoretical ideas, sometimes it's about new techniques. When you do that, keep the learning focused on that, such as getting students to order the steps, or correct some instructions.

14. **Embrace the phones.** Get them to photograph each step in a practical method, and annotate their photo strip with scientific explanations, using target terminology, for what is happening.

15. **What’s the research question?** Get students using logic to match up research questions to the best methods. They can then design their possible research questions for a set of apparatus, and evaluate the pros and cons of different approaches.

16. **Skip the write-up.** Evaluating a lab report instead of writing one can be a great use of time. Focus students on how effectively data is presented, the justification for the claims made in the report, and the next steps the researchers should take.

17. **Put skills back on the map.** Get students to video themselves using practical skills, such as titrating correctly, and talk through how they are doing it. You can assess their skills and build a personal library of practical techniques for each student!

18. **Mix up the graphs.** Students often use the same types of graph repeatedly, such as line graphs in physics. Embed opportunities to analyse other graphs - pie charts, cumulative frequency, box and whisker - and build their numeracy skills.

19. **Bring in some peer review.** Get students to act as reviewers for a school science journal, and comment on the scope, rigour, and methodologies of each other’s practical write-ups. You can even mock up the journal and get the class to write the editorial!

20. **Play the long game.** Look at the whole school year and count the number of practicals focused on each area (planning, evaluation, etc.) and check for balance. If one skill is overemphasised then repurpose some of the tasks to chance the focus.

Suggested further reading

Abrahams, I. and Millar, R. 2008. ‘Does Practical Work Really Work? A study of the effectiveness of practical work as a teaching and learning method in school science’ *International Journal of Science Education*, 30:14, 1945-1969.

Minner, D.D., Levy, A.J. and Century, J. 2010 ‘Inquiry-Based Science Instruction – What is it and Does it Matter? Results from a Research Synthesis Years 1984 to 2002’ *Journal of Research in Science Teaching*, 47:4, 474-496.

Agustian, H. and Seery, M. 2017. ‘Reasserting the role of pre-laboratory activities in chemistry education: a proposed framework for their design’ *Chemistry Education Research and Practice*, 18, 518-532.