

1. 1

Love science and scientific exploration. This is perhaps the most important step, as **a love for science will motivate you to study, learn, and develop your ideas with passion and curiosity.**^[1]

- No matter the profession, almost no one will be good at their job if they don't go home at the end of the day feeling fulfilled by the work and feeling like they've contributed to something bigger than themselves.
- If you love science and exploration, you are already one big step closer to becoming a good scientist, as it is always better to be yourself and do work within a niche that you enjoy and find **fascinating.**^[2]

2. 2

Experiment with new ideas. A significant fraction of **scientific discovery is the result of hard work and serendipity,** or more bluntly, sheer luck. From the discovery of penicillin by Fleming to the discovery of new ionization techniques such as MALDI, luck has frequently played a large role in scientific discovery. So, **don't be afraid to tinker or play around with new ideas or with a new approach to an existing theory.** You never know when experimentation and luck will collide to create a significant discovery.^[3]

- Often big discoveries come from noticing an inconsistency or oddity and then working hard to figure out what caused it. Avoid focusing on developing "genius" by approaching experiments the way you think they should be done and be willing to pursue the unusual or a new approach to a problem.
- Maximize your exposure to chance occurrences and events, and don't ignore little inconsistencies in your work. Instead, consider them and pursue them further to see where the unexpected might lead.

3. 3

Be patient and detail oriented. Almost no scientific discovery just happens or occurs, in fact, as a scientist you need to have the **patience to go through years of work, performing experiment after experiment,** to prove your theory and verify your results.^[4]

- It's important to also notice tiny observations and record them promptly. Categorizing and analyzing data is a huge part of being a scientist, so ensure you can do this efficiently and correctly.

4. 4

Be open-minded but consider all the facts and hypotheses. A good scientist will accept whatever outcome their work has and **not try to force the results of an experiment into a predetermined opinion or theory.** It is also essential that to bear in mind the facts and hypotheses from work done by other scientists as a resource to inform the results of your experiments.^[5]

- A good scientist will have **good ethics and will not give false results** or shade an experiment to fulfill the expected outcome. They should be open to the solutions made by others in their field, even when they conflict with their own theories.^[6]

5. 5

Be open to failure. Though you may think a scientist should be brilliant, skilled in mathematics, and incredibly precise, one of the most important skills a good scientist should have is a willingness to fail.^[7]

- In today's scientific world of limited scientific funding and competition for tenure-track jobs or a secure income, young scientists will likely be rejected more than accepted in the early stages of their career. It's important to be prepared for failed experiments and time spent on research that does not get funding or lead to a definite theory.
- Time that is seemingly wasted on a theory that goes nowhere may later prove to be time well spent. Through failure, you can build a strong work ethic, develop a creative approach to scientific study and be prepared for the moment when you succeed, rather than fail.

Part Two of Two: Developing Your Scientific Skills

1. 1

Take charge of your ideas. Challenge yourself to come up with one idea related to your project a day. Though some of them will be bad or not as useful as others, many will be good and could lead to a new experiment or theory.^[8]

- Don't be passive or shy about your ideas. As a scientist in a competitive field, you need to create your own opportunities by owning your ideas and working hard to develop them further.

2. 2

Set goals. Take out a piece of paper or open a Word doc on your computer and create a list of goals based on the project you are investigating or experimenting with.^[9]

- Prioritize your goals by ranking them in order of importance. Though you may be tempted to go off on a tangent or deviate from your list of goals (which is also part of the exploratory nature of scientific discovery), try to hone in on experiments that will get you closer to completing your goals.
- As with any work, there are only so many hours in a day, so make smart decisions about how you spend your time achieving your scientific goals. This helps you develop your time management skills and use your time efficiently and effectively.^[10]

3. 3

Collaborate and build strong partnerships. Debunk the idea of a lone genius toiling away at secret experiments, and look around the lab, the department, or in the field for someone you think you might want to work with and learn from. More often than not,

you will do better work if you collaborate with someone else, or seek the advice of a mentor.^[11]

- In the scientific world, you will be expected to be able to work well independently and as part of a team, so having good participation and communication skills will only help you further your career and be successful.^[12]
- Examine your projects for areas where you don't have the time or expertise to push them forward, and be willing to partner with someone to develop your project.^[13]
- Not only will building strong partnerships with other colleagues, peers, and professionals be mutually beneficial, it will also keep you humble and help you put your project or idea into perspective by sharing it with someone else.^[14]

4. 4

Practice your writing and reading skills. Create a writing process that works for you, like going into an area with peace and quiet or putting on Classical music to help you focus, and stick to it. Try to do a little writing every day, and put your ideas or thoughts down on the page so you get into the habit of recording your ideas, which could later end up in a published paper or in a lecture about your latest scientific theory.

- It's important to also read up on the work being done in your field of study, whether it's a more specific publication like *Astronomical Journal* or a more general one like *Science Today*. Stay informed on the current topics in science and consider how you can build on the work of others in your field.

5. 5

Develop your presentation skills. Avoid a dry, boring talk full of complicated data and try to tell a story that is personal while also being informative and valuable.^[15]

- One technique is to start by discussing the reasons why you are doing scientific work, then lead into details about your failures and false starts, and then end with a dramatic conclusion that will leave the audience thinking about a theory or field of study in a new way.
- A good scientist should be capable of **explaining scientific ideas to a person who is not a scientist**.^[16] So always consider your audience and try to demonstrate your enthusiasm for your field of study without being overly complicated or hard to understand.

6. 6

Maintain a balance between hard work and rest. Though hard work is essential to being a good scientist, it's important to strike a balance between professional work and personal down time.^[17]

- It may be tempting to spend 20 hours a day in the lab, developing your ideas, but sometimes the best thoughts come when the mind is at rest, or engaged in other activities that challenge your brain in a different way.
- Making time for a hobby or activity outside of scientific work will allow you to de stress and perhaps also lead to a fresh perspective on a theory or thought you have been working on or struggling to solve.^[18]