How to Be a Scientist.

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As a scientist, you need to be able to do a number of things, including but not limited to:

(1) Choose a good scientific problem to work on.
(2) Write a proposal to get money to work on that problem.
(3) Make figures so that other people will believe your results.

Choosing a project. You need to think about what new knowledge your problem will grant you and how feasible your project is. But both of these qualities are subjective. Knowledge can't really be separated from what is trendy. ("Convince people that your work is hot and sexy and not just bad.") But you should be interested in what you do, too—if only to contage enthusiasm about your work. ⋆⋆ *But for serious*, if you work on something that you truly love, then you will necessarily come up with novel, unique research because your perspective and personal history are unique, rendering the way you pursue knowledge unique, too. So, if you're true to your own interests, you automatically get something original.

Getting Money. Proposals have a basic structure. (1) The first part should explain the background—but stay relevant. Don't throw in too much—and *significance*. Tell people why your project is both timely and important. Boost your project's level of interest with a proper pitch. (2) Specify your aims. There should be two or three of them. You should be able to describe what you'll do succinctly; one or two sentences per aim at most. If all else fails, formulate your specific aims in the form of a question. (3) Next give your research plan. This outlines how you'll actually do your experiments. They need to sound feasible. (4) Lastly, explicitly, clearly, and simply state the impact of your project. This is the most important part. Spoon-feed the key points to your reviewers so that they can parrot them back during committee meetings. Don't make anyone have to think! That's your job. Sprinkle impact sentences up top and throughout. (5) And also pound home the impact and significance in a conclusion. Especially guard against "what if your experiments fail" arguments.

There are generally three types of questions: *what* is there; *how* does it work; and *why* is it the way it is?

Feasibility. What sort of information do you need to convince other people that your aims will work? Tell them how you will make decisions that you don't (yet) have enough information to make or haven't anticipated.

Models. Make sure the model is related to the experiments. The experiments should constrain the model, or the model should inform the experiments, or both. Your experiments may not have high enough resolution to constrain the model. So be sure they're connected somehow.

Convince the Reader with Figures. Visual graphics need to be clear and intuitive. Figures have been standardized, so use those conventions. So be mindful of what the purpose of your graphic is. You can broadly break these tasks down into three groups: (1) To show structure or form, (2) to show process, and (3) compare or contrast something, either qualitatively or quantitatively.

Composition *Arrange things wisely.* People read from left to right and from top to bottom. Additionally, alignment and proximity suggests relatedness. Put things that go together together on the page.

Abstraction *Don't over or under abstract.* Is it really useful to turn each molecule into one of thirty polygons? Perhaps a speculative graph of relative concentrations is more helpful. In general, don't make people have to think.

Color *Don't use more than three colors, unless you have a really, really good reason for it.* Scientists tend to be colorblind because it's X-linked. Use color to highlight the parts that you think are most crucial. Also, be aware of societal conventions surrounding color.

Layering *Layers take advantage of several conventional representations simultaneously.* People aren't good at focusing on more than one thing at a time. But if you can rely on things they automatically understand you can mash them together. Consult cartography.

Iteration *Pick some visual guidelines and stick with them throughout the paper.* Your figure follows some rules to understand it, so make sure all the other figures in your paper follow the rules. Your figure should have at least as much explanatory power as the equivalent space filled with words. You should not have to annotate your figures with a paragraph. Your figure should annotate your text.