IPM Component 3 – STEM

Week 3: Communicating to a general audience

Introduction

Here we will go through how to write about a technical subject for a general audience, i.e. an audience of non-technically minded people. Technical writing/discourse consists of scientific or mathematical English, mathematics and diagrams/graphs/… In these notes we will focus on the scientific/mathematical English found in STEM texts.

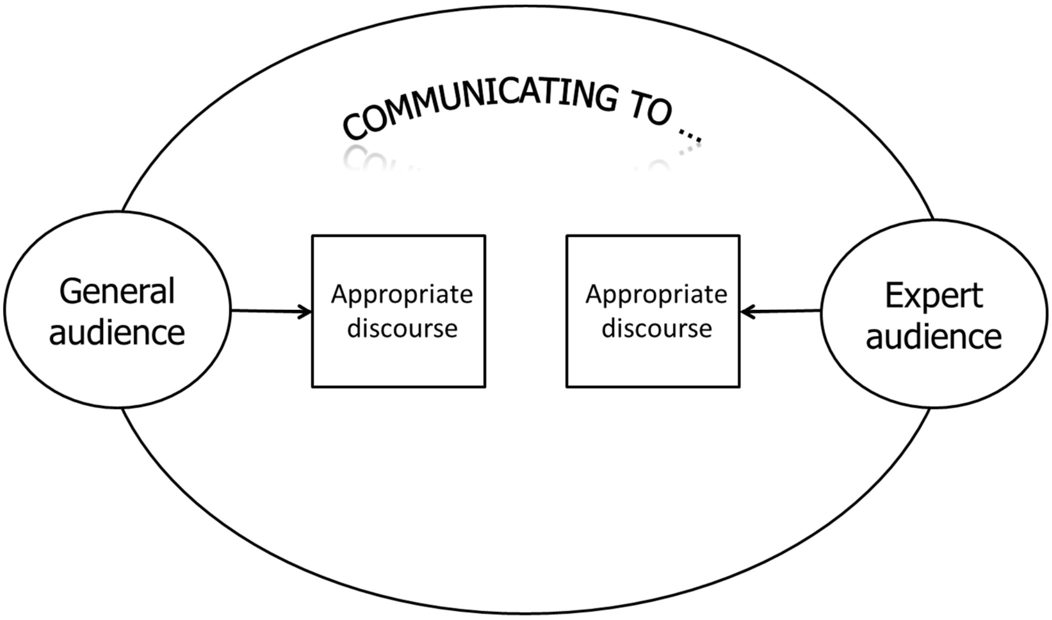
The texts of all STEM disciplines are loaded with scientific meaning. Each text has what I call a density of meaning, and it is this density of meaning which the general audience member does not understand. As an example, consider the following texts:

1. "Theoretical and practical issues concerning the multi-faceted task of mitigating the latero-torsional seismic response of a prototypal frame structure with asymmetric mass distribution are approached"
   (from "Seismic protection of frame structures via semi-active control: modelling and implementation issues", V. Gattulli, M. and F. Potenza (2009), *Earthquake Eng & Eng Vibration,* **8**: 627-645);
2. "In this article, a procedure for the vibration analysis of stiffened panels with arbitrary edge constraints is presented. It is based on the assumed mode method, where natural frequencies and modes are determined by solving an eigenvalue problem of a multi-degree-of-freedom system matrix equation derived by using Lagrange's equations of motion."
   (from "Natural vibration analysis of stiffened panels with arbitrary edge constraints using the assumed mode method", D. Cho, N. Vladimir and T. Choi (2015), *Proceedings of IMechE Part M: Journal of Engineering for the Maritime Environment*, Vol. 229(4) 340–349).

Unless you are a specialist in these disciplines you will not understand the texts above. In the mathematics community it is even possible that an expert in one subdiscipline of mathematics does not understand the mathematical text of an expert in another subdiscipline of mathematics. So, our job as specialists in our field is to pre-empt the general audience member's lack of knowledge, lack of understanding, misunderstandings and gaps in knowledge. As such it is up to us to find ways of explaining to this audience member such technically dense texts.

Questions:

1) What is it that makes the communication of scientific text an expert-audience type of communication?
2) What is it that makes the communication of scientific text a general-audience type of communication?
3) What are the factors involved in trying to communicate scientific meaning to a general audience? What elements make up scientific communication for your audience? How do these differ between expert and general audiences?



A main starting point is related to identifying the technical/scientific terminology of our discipline. Then we need to know how such terminology is used within a sentence. Then we need to know how mathematical or scientific sentences are constructed, using such terminology, such that these sentences convey scientifically correct meaning. Then we need to be able to explain the meaning of such terminology and sentences at a level of discourse the general audience can understand.

So, consider the following example:

1. The distribution of force across a section is called stress;
2. If force acts across a section, and if this force is distributed, then stress will result;
3. Stress is the distribution of force across a section;
4. The force of a cross section is the stress of distribution.

All these sentences are grammatically correct in terms of normal English. However, the last sentence is totally meaningless whereas the first three are scientifically meaningful (and could act as a basic definition of mechanical stress)

However, despite the seemingly simple meanings of the terms “distribution”, “force”, “section” and “stress”, which the general audience member might understand in general terms, we then end up combining these terms to form collocations such as “distribution of force” and “cross section”. This already increases the density of meaning. And when we put these two collocations together into a scientifically meaningful sentence such as

“The distribution of force across a section is called stress”

It is likely that the general audience member will not have the same sharp, concrete understanding of the scientific meaning of this sentence as does a mechanical engineer.

Mathematical terminology

Supposing a member of the public comes to a lecture on mathematics. How would I distinguish between their understanding of terms such as “average” or “infinity” from the mathematician’s understanding of these terms? Well, I would have to know the audience’s general understanding of these terms and clarify the difference between this and the mathematical meaning of these terms. For example,

1. “Average” = average (general audience), i.e. $(1+2+2+5+5)/5=3$
   = mean, mode, median (expert audience), i.e. $(1+2+2+5+5)/5=3$ (mean) or $(1+2+2+5+5)/5=2$ (median) or $(1+2+2+5+5)/5=$ 2 or 3 (mode)

- The mean is the usual average of a list of numbers. I.e. it is the sum of all the numbers in a list, divided by the number of numbers in that list.
- The mode is the value that appears most often in a list of numbers.

- The median is the number which separates the upper half of a list of numbers from the lower half of that list. i.e. it is the middle number of a list of numbers when that list is put in ascending order.

2. "Infinity" = a very big number (general audience), i.e. 1,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000

 = something which has no finite size; something which is undefined; something which cannot be counted in a finite number of steps. (expert audience), i.e. 1, 2, 3, 4, 5, …, implying a sequence with no end or uncountably many.

3. "Theory" = speculation; an opinion, where your opinion is as good as mine, and our opinions can be different (general audience)

 = a conclusion arrived at in a finite number of mathematical steps, each step being logically correct from the previous step according to the rules of mathematics. A theory is factually correct and cannot be disproved.

 (expert audience)

4. "Solution" = the answer to a problem (general audience)

 = all the necessary mathematical steps needed, to get from the question to the final answer, this latter being the very last step of the solution.

 (expert audience)

5. "Dimension" = size (general audience), i.e. 1cm × 2cm or 10m × 1.5m × 0.5m

 = the number of independent (orthogonal) axes. E.g. n-dimensional space (expert audience), i.e. $(x_1, x_2, x_3, \dots x_n)$ or 1-D, 2-D, 3-D, 4-D, …, n-D (a set of mutually perpendicular axes).

6. "Integer" = a number (general audience)

 = integer, as opposed to rational numbers, real numbers or complex numbers.

 (expert audience)

Collocation of mathematical terminology

Not all technical terms are individual words. Some terms are composed of two (or more) words joined together to form one scientific term. These combined terms are called collocations. For example,

- Differential equation
  - Ordinary differential equation, partial differential equation;
  - 1^{st} order differential equation, 2^{nd} order differential equation;
  - Differential equation with constant coefficients or with variable coefficients;

- Continuous functions
  - Piecewise continuous functions;
  - Piecewise continuously differentiable function;
  - Bounded piecewise continuously differentiable function.

- Non-empty set
  - Non-empty set of real numbers;
  - Non-empty set of real numbers that is bounded above;
  - Non-empty set of real numbers that is bounded above and has a supremum.

Such language adds an extra level of density of meaning to the text, and therefore the scientific idea being expressed. As experts we are then able to read these collocations in a “wholistic” manner and understand not only each individual term but collections of terms and the sentence as a whole. So when communicating to a general audience our job is to find a way of describing/explaining individual terms, collocations of terms and whole sentences. This is not easy.

Scientific terminology and collocation

Supposing a member of the general public comes to a public lecture on the subject of mechanical vibrations and heard the words below. How would you distinguish between their understanding of the terms below from the expert’s understanding?

Force	Viscosity	Damped	Spring
Mass	System	Equation	Motion

How would you bridge the gap in the way a general audience member would understand the scientific meaning of these terms from the way experts would understand these terms?

But further still, these terms would not be used in isolation. Some of these terms can be combined to form compound terms/collocations with specific scientific meaning. For example,

Spring-mass	Viscously damped
Spring-mass system	Equations of motion

Such language adds an extra level of density of meaning to the text, and therefore the scientific idea being expressed which we would have to explain/describe to the general audience member without impairing the integrity of the underlying scientific meaning.

Exercise: Fill in the table below

Single term or collocated terms from your discipline	**General audience's understanding (Lay meaning)**	**Expert audience's understanding (Scientific meaning)**

Mathematical and scientific discourse

Sentences are not just collections of words. As I mentioned earlier we need to know how such terminology is used within a sentence in order to make the sentence technically meaningful. Examples of meaningful sentences which are replete with technical terms include,

1. Mathematics: "Each non-empty set of real numbers that is bounded above and has a supremum". (from *Real analysis: A first course*, R. A. Gordon (1997), Addison-Wesley.

   This is actually the modern definition of a real number. Here, individual terms along with collocations have been used in the correct order within the sentence. This then produces not only a grammatically correct sentence from the point of view of mathematical English, but also a mathematically correct description of a real number.

   So as experts we need to know what I call the *hierarchy of meaning*, In other words, which terms collocate and which do not, and how to construct phrases where terms and collocated terms are correctly organised in order to form a mathematically correct English sentence. Then we, as experts know to consider the following:

   - A set;
   - A non-empty set;
   - A non-empty set of real numbers;
   - Bounded;
   - Bounded above;
   - A non-empty set of real numbers that is bounded above;
   - Supremum;

   and finally

   - A non-empty set of real numbers that is bounded above and has a supremum.

   As experts we then need to be able to interpret and describe these for the audience.

   As experts we also know not to consider

   - A non-set;
   - A empty set of non-real numbers;
   - A bounded supremum;
   - Real numbers above a supremum,

   etc., since these are all mathematically meaningless.

2. Mechanical engineering: "If a force $F(t)$ acts on a viscously damped spring-mass system […], the equation of motion can be obtained using Newton's second law […]." (from *Mechanical Vibrations* by S. S. Rao).

   As for item 1. above we would be the experts who would know the hierarchy of meaning of the text above. As such we need to be able to interpret and describe these for the audience.

   - Force;
   - Viscous;
   - Viscously damped;
   - A spring-mass;
   - A spring-mass system;
   - A force acts on a viscously damped spring-mass system,

   etc. And as experts we also know not to consider

   - Viscous spring-mass;
   - A system of viscous damping;
   - Viscous equations;

   or

   - The motion of a viscous law obtained from a spring-force system.

3. Chemistry: "While ethane rotates towards eclipsed conformation, electrons in the C-H bonds on two different carbon atoms experience repulsion which introduces the barrier." (from "Hyperconjugation not steric repulsion leads to the staggered structure of ethane", V. Pophristic and L. Goodman, *Nature* **411**, p565-568 (2001))

   I have no idea what this means. If you are a chemist your job would be to explain this to me in a way that I could understand it without impairing the integrity of the underlying scientific meaning. But I know enough to know what the hierarchy of meaning has to be:

   - Ethane;
   - Rotates;
   - Ethane rotates;
   - Eclipsed;
   - Eclipsed conformation;
   - Ethane rotates towards eclipsed conformation

   etc.

Our job would then be to describe/explain any one of these texts in such a way that the member of a general audience would be able to develop some understanding of the scientific meaning of such text.

Example 1

As an example, consider trying to describe the text given in 1. above. I could develop my description as follows:

> Consider the number $\sqrt{2}$. In decimal form this is 1.414213562… this is called a real number, as distinct from rational numbers (such as 1.4142) or integers (such as −5 or 3). Notice that the decimal part of the real number continues forever. There are an infinite number of decimal digits to $\sqrt{2}$. Now, the number 2 can be said to act as a upper barrier to 1.414213562… Similarly, the numbers 1.9, 1.8, 1.7, 1.6 etc act as upper barriers to 1.414213562… on the other side of 1.414213562… we have numbers like 1, 1.1, 1.2, 1.3, etc which can be said to act as lower barriers to 1.414213562… In mathematics we don't use the word "barrier" but the word "bound". So, the sequence of numbers 2, 1.9, 1.8, 1.7, 1.6 etc. all act as upper bounds, and $\sqrt{2}$ is said to be bounded above by these numbers.

Now look at how much I have had to write in order to explain just the technical terms of "real number", "bound" and "bounded above". Continuing, I can say:

> We should be able to see that the upper bounds get smaller and smaller. We get to the point of being able to say that 1.42 is an upper bound. But is this the smallest upper bound? No, because I can say that 1.415 is an upper bound that is smaller than 1.42. is 1.415 the smallest upper bound? No, because 1.4143 is smaller still, and also acts as an upper bound to 1.414213562… So we see that the process of finding smaller upper bounds can continue. Does it continue forever? No. There will come a time when we have found the smallest upper bound. This is called the "supremum" and this smallest upper bound is in fact defined to be the number $\sqrt{2} = 1.414213562\ldots$

Again look at how much I have had to write in order to explain just the single technical term of "supremum". I would then have to continue my description in order to explain the phrase "Each non-empty set of real numbers", but I will stop here for now. Notice that I have used examples and diagrams to help in my explanation. Examples and diagrams are probably two of the most important aspects of a description for a general audience.

This example is to show you the extent one can go to (may have to go to) in order to explain the mathematical meaning of just one sentence. In fact, the description above is what I would include in any notes I would give to 1st year mathematics students.

Question: As non-mathematicians, how do you react to my description? Does it make sense to you? Do you have an understanding of what "… real numbers that is bounded above and has a supremum" means?

Example 2

As another example, consider trying to describe the text given in 2. above. I could develop my description as follows:

> Suppose you are driving along a road which has potholes in it, and you drive over one of these potholes. Some shock absorbers tend to have two aspects which cushion the reaction of the car driving over the pothole. One is a coiled spring made of some suitable material (metal, carbon fibre, or other), and the other is some kind of oil inside the cylinder part of the shock absorber.
>
> Now, suppose the coiled spring is made of metal. The type of metal used, and the number of coils in the spring, will determine how springy the shock absorber is. Using one type of material and/or a certain number of coils, and you will get a soft, spongy reaction when you drive over the pothole. This means that after you have driven over the pothole you could keep bouncing down the road for ages.
>
> Using another type of metal, and a different number of coils in the spring, may mean that there is no bounce at all as you drive over the pothole. It is as if you had no suspension at all on the car, and this would make for very uncomfortable drive.
>
> The viscosity of this oil relates to how "thick" it is. The more viscous it is, the "thicker" it is, and therefore the "harder" it reacts against impact, the more quickly it acts to absorb or stop any rebound, and the more quickly it will stop the car bouncing up and down. This then makes it less comfortable for the driver.
>
> The less viscous the oil is, the less quickly it acts to absorb or stop rebound, and the less quickly it will stop the car bouncing up and down. In other words the car will bounce up and down for longer, and will make for a more spongy feeling for the driver.

The degree of viscosity of the oil then determines the degree of springiness of the oil. Taken together, the coiled spring and the oil are considered as one single spring-mass system, this having one overall, total, springiness.

We want to study the way the car bounces up and down as a result of the type of shock absorber used. The equations which relating to the car's bouncing up and down can be found from Newton's second law of motion. This says that when a force acts on an object, the object accelerates in the direction of the force. If the mass of an object is held constant, increasing force will increase acceleration.

Here the fall of the car into the pothole is the acceleration being referred to. What force causes this acceleration? Gravity, pulling the car down into the pothole. Since gravity is (more or less) constant, the heavier the car, the more it will affect driving comfort.

Again look at how much I have had to write in order to explain such a short sentence of "If a force $F(t)$ acts on a viscously damped spring-mass system [...], the equation of motion can be obtained using Newton's second law [...]."

Question 1: If you are not an engineer how do you react to my description? Does it make sense to you? Do you have an understanding of what "If a force $F(t)$ acts on a viscously damped spring-mass system [...], the equation of motion can be obtained using Newton's second law [...]" means?

Question 2: How far should one go in describing the original text? How much more or less detail should be included? Apart from more description, what else could I have included in my description?

Exercise

The following two descriptions are different to the detailed one given above. Which of these two descriptions are suitable for a general audience, and which are not? Why?

Version 1

A spring-mass system is configured as a viscously damped system. A force $F(t)$ acts on this system. We can use Newton's laws to obtain the equations of motion of this system.

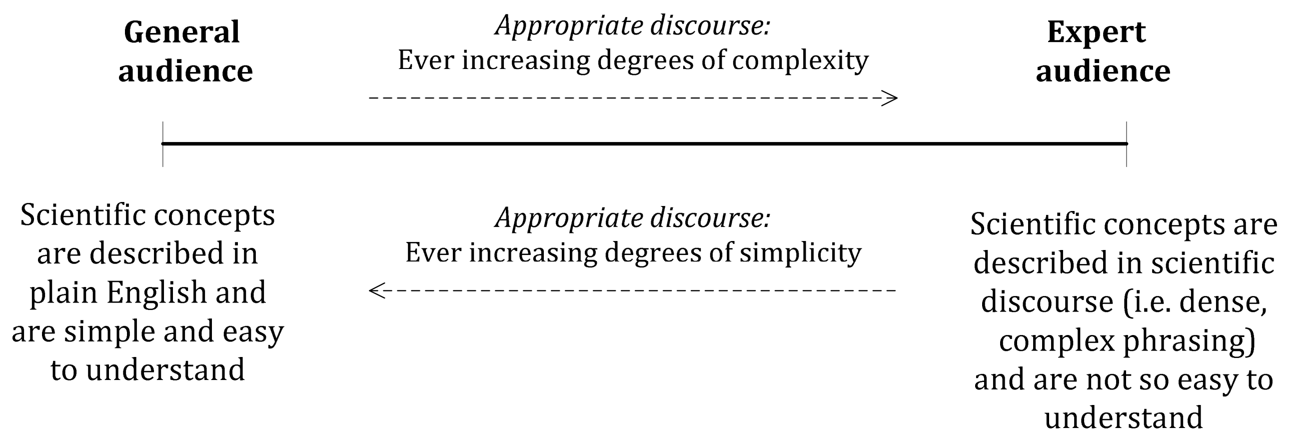
<u>Version 2</u>

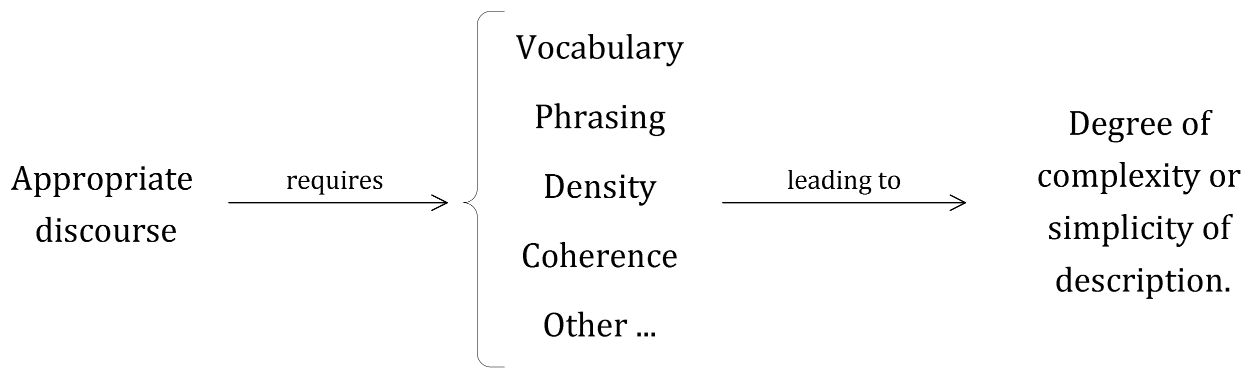
Consider an object consisting of the two separate elements of a mass and a spring (or something with spring-like qualities.) Such an object is called a spring-mass system.

There are various configurations of a spring-mass system, one of which is viscous damping. In other words the spring-mass system is configured in such a way as to contain a resistance to motion due to the inclusion of viscous fluids which act to attenuate the motion of the system.

The way in which this type of spring-mass system behaves, i.e. the way it moves and reacts, can be studied according to Newton's second law which says that the acceleration of the spring-mass system is proportional to the force applied to it.

It might then be said that our description cannot by simple enough, or that we cannot elaborate enough the technicality of the text and the ideas it conveys. The degree of complexity or simplicity of the description of a scientific text might then be illustrated as the diagrams below.





The non-redundancy of technical discourse

Let us start with an example:

1) What Bill doesn't know about rocket fuselage engineering isn't worth knowing.

2) Bill isn't worth knowing.

Clearly these two sentences mean different things, and the removal of the phrase "doesn't know about rocket fuselage engineering" is not redundant.

Recall that mathematical/scientific text have a great density of meaning. in other words, many scientific words are wrapped with a few normal English words, the whole sentence being scientifically coherent, i.e. having a coherent scientific meaning.

What this means is that every mathematical/scientific term, compound term or phrases is necessary for the correct description of the object or phenomenon we are trying to describe. None of these terms or phrasings can be omitted. This is what I mean by "non-redundancy". Redundancy means that we have information which is either unnecessary or does not add anything new to the meaning of the text. Such information can be left out without affecting the accuracy, correctness, precision, etc. of the meaning of the text (the most basic form of redundancy is repetition). Mathematical/scientific text is non-redundant discourse because (99% of the time) we cannot omit any technical language without affecting the accuracy, correctness, precision, etc., of the meaning of the text.

Let us see what happens if we do omit technical language from a mathematical/scientific text.

Example 1

Consider the text "The distribution of force across a section is called stress". What happens if we omit one of more terms of this text?

- "Force across a section is called stress". The key term omitted is "distribution", implying that stress might exists on a section when the force is applied only at one point or location of the section, not across the whole of the section.
- "The distribution across a section is called stress". The key term omitted is "force". The question then is, "the distribution of what?" Force can be said to be an action of some kind, so the altered sentence is clearly missing the type of action which is to be distributed. It is the particular action of a force which relates to stress, since some other action may not be related to stress.

- "The distribution of force is called stress". The key terms omitted is "across a section". Here we can ask, Where is the force applied? Force is always applied somewhere to something, and this has to be specified.

This brings up the question of the extent to which we can simplify the language of a scientific text without making the simplified text misleading or inaccurate. We have to get across the essential scientific meaning of the text, but how much detail should we leave out, and/or how much detail should we go into?

- Do we explain everything the text describes?
    - i.e. the use of force? The fact that it is distributed? Where the force is applied?
- How much detail do we go into?
    - What is the true nature of forces? What is the difference between constant forces or variable forces in terms of stress?
    - Does the distribution of force have to be homogeneous (i.e. evenly spread across the section)? Or can there be parts of the section where there is no force and other parts where there is a force?
- Do we explain only what we consider the basics and leave out the more subtle aspects or alternative aspects?
    - What could subtle aspects of mechanical stress be? I cannot answer this since this is not my area of expertise.

This is where writing becomes a skill and an art: the ability to pitch a description at a level of simplicity or complexity without compromising scientific meaning.

Example 2

Consider the text "If a force $F(t)$ acts on a viscously damped spring-mass system […], the equation of motion can be obtained using Newton's second law […]." What happens if we omit one of more terms of this text?

- Consider omitting the term "viscously damped": Since viscous damping refers to effects of friction, omitting "viscously damped" suggests that we are referring to a spring-mass system which is frictionless. This would be a serious scientific error if the system we are studying happens to undergo friction.
- Consider omitting the term "system": In this case we are referring only to one single spring-mass, and not a system of these. If, for example, you are studying the vibration

characteristics of a car then you are making a serious scientific error in not considering the car as multiple spring-masses, i.e. as a spring-mass system.

- Consider omitting the terms "using Newton's second law": In this case we are not specifying how the equations of motion can be obtained. In fact, there is at least one other way of obtaining equations of motion, this being using Lagrangian mechanics (i.e. using something called the Lagrangian) which is a method based on the energy of the system. Newton equations of motion as not based on the energy of the system but on the forces acting on the system. This is something very different to Lagrangian mechanics. So there could be a confusion as to which approach is being used here.

Again, we can ask how much detail should we go into in order to get across the essential scientific meaning of the text:

- Do we explain everything the text describes?
    - i.e. the use of force? The meaning of spring-mass and a spring-mass system? The fact that spring-masses are idealised representation of the object under study? do we explain what viscous means? What damping means? Do we present the equation for Newton's second law?
- How much detail do we go into?
    - Do we elaborate on damping by explaining over-damped, critically damped of underdamped systems?
    - Does we elaborate on the nature of viscosity?
    - Do we give an example of deriving the equations of motion using Newton's laws?
- Do we explain only what we consider the basics and leave out the more subtle aspects or alternative aspects?
    - Do we ignore viscosity and/or damping?
    - What subtle effects are there to viscously damped systems? I cannot answer this since this is not my area of expertise.

This is where writing becomes a skill and an art: the ability to pitch a description at a level of simplicity or complexity without compromising scientific meaning.

Example 3

Consider the text “Each non-empty set of real numbers that is bounded above and has a supremum”. What happens if we omit one of more terms of this text?

- Consider omitting the terms “real numbers”: Set are collections of objects. Numbers are just one type of object which we group together in sets. But we could group together other things. And even with numbers we can ask, what type of numbers are you grouping? Whole numbers? Positive integers? Rational numbers? Etc. If we don’t specify which type of objects we want to study we don’t know how to manipulate them, operate on them or otherwise analyse them.
- Consider omitting the term “above”: This is just a standard English word but its use is crucially important because we can also talk of numbers bounded below. And when we omit the word “above” or “below” and just say “bounded” we mean that the object is bounded both above and below. Also, for the word “supremum” to make sense we have to use the word “above” otherwise there would be a significant error in accuracy of description.
- Consider omitting the term “supremum”: This word is also crucially important. Mathematically speaking, without a supremum there is no such thing as a real number! there would only be upper bounds (any upper bound we care to choose), not the least or smallest upper bound.

Again, we can ask how much detail should we go into in order to get across the essential scientific meaning of the text:

- Do we explain everything the text describes?
    - i.e. all the individual mathematical terms, and the phrasing of these terms?
- How much detail do we go into?
    - Do we develop the idea of sequences of numbers (this being relevant to the idea of boundedness)?
    - Do we go into the idea of convergence and limits (this being relevant to the definition of real numbers)?
- Do we explain only what we consider the basics and leave out the more subtle aspects or alternative aspects?
    - Do we ignore the idea of sets (it is possible to talk about real numbers without referring to sets).

- Do we discuss the subtle difference between upper bounds and least upper bounds? It looks like we have to since "supremum" means the same thing as "least upper bound" and without a supremum there is no real number.
- Do we talk about Dedekind cuts (which is a different definition of real numbers)?

This is where writing becomes a skill and an art: the ability to pitch a description at a level of simplicity or complexity without compromising scientific meaning.

Quote

The following is an excerpt from Robert Boyle (1627 – 1691), a professional scientist, a contemporary of Newton, and a first rate physicists of the 17th century. In 1660 he tried to explain the idea of the springiness of air.

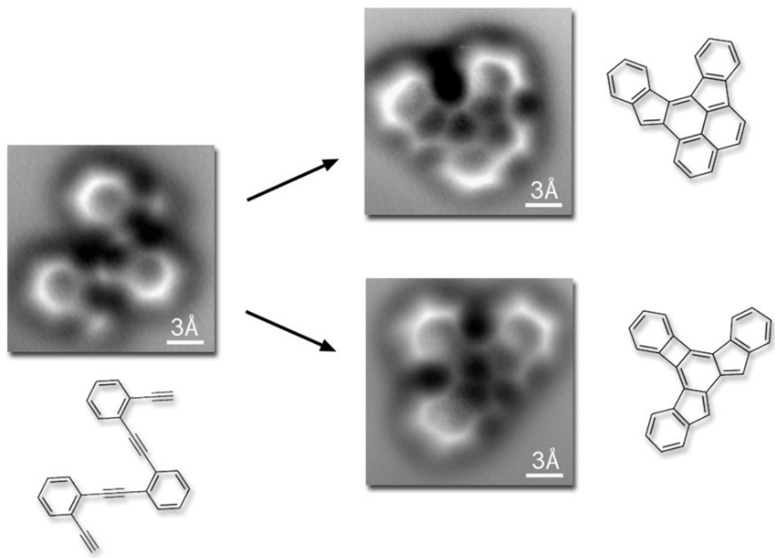
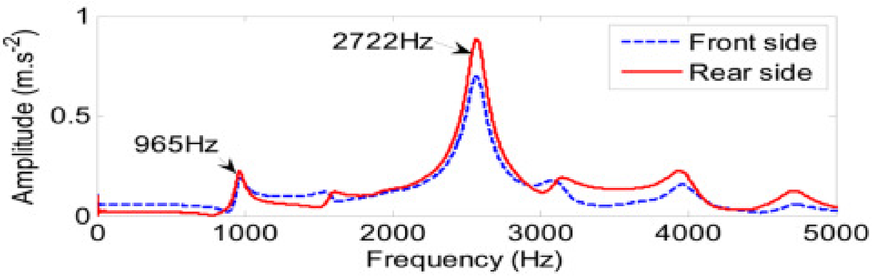
> "Of the structure of the elastic particles of the air, diverse conceptions may be framed, according to several contrivances men may devise to answer the phenomena: for one may think them to be like the springs of watches, coiled up, and still endeavouring to fly abroad. One may also fancy a portion of air to be like a lock or parcel of curled hairs of wool; which being compressed … may have a continual endeavour to stretch themselves out, and thrust away the neighbouring particles […]
>
> Only I shall here intimate, that thought the elastic seem to continue such, rather upon the score of its structure, than any external agitation; yet heat, that is a kind of motion, may make the agitated particles strive to recede further and further .. and to beat off those, that would hinder the freedom of their gyrations, and so very much add to the endeavour of such air to expand itself."

Robert Boyle (1660),
taken from *Words, Science and Learning*, Clive Sutton, p75

Discussion points

1) Can a text describing scientific concepts written for a general audience still communicate scientifically?
2) What are the limitations in trying to communicate science to a general audience? What are the freedoms in trying to communicate science to a general audience?

3) To what extent is it possible to communicate to a general audience the scientific concepts illustrated in the following table without losing the detail, depth, and integrity of the concept?

Mathematics:	$F = ma$ $\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{f(x+\delta x) - f(x)}{\delta x}$ $\frac{1}{\mu_0 \varepsilon_0} \oint_C \mathbf{B} \cdot d\mathbf{l} = \frac{1}{\varepsilon_0} \iint_S \mathbf{J} \cdot d\mathbf{S} + \frac{d}{dt} \iint_S \mathbf{E} \cdot d\mathbf{S}$
Photographs and diagrams:	
Graphs:	

Exercise

Find one technically dense sentence, or short paragraph, of your own discipline and rewrite (i.e. describe, explain, elucidate, etc.)_this for a general audience. Your text need not be anything complicated to you. You can choose something from a 1st year undergraduate textbook. To what extent will you need/want to do the following

Use technical words?	Use pictures, diagrams, graphs, photos, …?
Rewrite it in your own (non-technical) words?	Know the type of questions the audience need to ask but don't know to ask? These questions you will then need to answer.
Use examples?	Repeat/re-describe ideas or concepts you have already explained?

etc? Note that I am a member of the general audience when it comes to understanding your discipline, so if you rewrite the text well I should be able to understand it.