

Teaching Science Students to Communicate: A teaching resource

‘Template’ activity packages to assist the easy integration of explicitly-taught communication skills into undergraduate science courses

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Introduction

This teaching resource contains five science communication activities designed for undergraduate science classes and suitable for workshop, practical, or tutorial settings. The activities specifically target development of skills for communicating science with non-scientific audiences as well as scientific content knowledge. The communication skills targeted in these activities are conceptual as well as practical; as such they are highly applicable and transferable to other contexts – including communication with scientific audiences.

Activities are deliberately designed to integrate learning of discipline-specific science content with learning communication skills. All activities have been trialled and evaluated in undergraduate science courses in a selection of different year levels and disciplines at a single university – for full details of evaluation see Mercer-Mapstone & Kuchel (2015). We would love to hear from you if you are interested in implementing and evaluating a version of these activities in your own science teaching context, and can assist with provision of evaluation instruments and information to facilitate adaptation of the activities to your context.

Communication skills targeted in the activities below have been derived systematically, from consensus among experts, and specifically for the context of undergraduate science degrees (see Mercer-Mapstone & Kuchel, 2015a for full details). The process involved a review of academic literature from the disciplines of science, communication, science communication and education to distil a core list of skills which was then modified and validated through consultation with experts from the same disciplines. Only a selection of the twelve communication skills identified through this process are represented in the activities below.

The skills explicitly targeted in the teaching activities below are:

Core skills for effective science communication

- ✓ Identify and understand a suitable target audience
- ✓ Use language that is appropriate for your target audience
- ✓ Separate essential from non-essential factual content in a context that is relevant to the target audience
- ✓ Consider the social, political, and cultural context of the scientific information
- ✓ Use/consider style elements appropriate for the mode of communication (analogies, metaphors, similes, and diagrams)
- ✓ Consider the levels of prior knowledge in the target audience

Each activity package has all, or a combination of:

- **Teacher notes** outlining a step-by-step process for teaching and running the activity, including questions the teacher might ask students; suggestions on facilitating class discussions; and worked examples.
- **Instructional student handouts** outlining explicitly what skills are targeted in the activity; why those skills are relevant to the student; and what students are required to do in the activity.

- **Activity worksheets** to be filled out by students, in pairs or groups, often including a worked example.

Also included:

- **A summary** of the activity outlining the communication skills targeted in the activity, the teaching documents supplied, the format of the task, and a brief description of the aims and outcomes of the activity.
- **Detailed marking criteria** that are constructively aligned to specifically assess the communication skills targeted in each activity.

References

Mercer-Mapstone, L.D. & Kuchel, L.J. (2015a). Core skills for effective science communication: a teaching resource for undergraduate science education. *International Journal of Science Education, Part B: Communication and Public Engagement*.

Mercer-Mapstone, L.D. & Kuchel, L.J. (2015). Integrating Communication Skills into Undergraduate Science Degrees: A Practical and Evidence-Based Approach . *Teaching and Learning Inquiry*.

Summary Table of Activities

Description and details of the five activities designed support explicit teaching of science communication skills. Duration of activities can be adapted to suit teaching times and timing given here is an indication of the minimum time allowances that would best suit each activity. For example, to change time allocation for some activities you can add or remove the number of iterations students do to practice/complete the activity.

Activity Name: Science Communication Speed Dating

Duration (minutes): 15

Communication Skills Taught:

Consider a target audience

Use language that is appropriate for your target audience

Separate essential from non-essential factual content in a context that is relevant to the target audience

Teaching Documents: Teaching notes for delivery

Format: Oral

Description: This activity was used as an ‘icebreaker’ at the start of the course and as an introduction to science communication. Students were asked to pair up and over four rounds were given four science concepts to explain verbally to their respective partners who enacted being a specified non-scientific target audience. Each round lasted two minutes and then the roles reversed in the pairs so that each had a chance to do the explaining. At the end of the speed dating round there was a class discussion about what the most important considerations were in regards to communicating science to non-scientific audiences which meant students were actively engaged in the learning rather than just receiving the information outright. The activity made students communicate science and then allowed them to analyse the results of this interaction, as well as getting them to recall scientific information. It was a good way to warm up the class in the first tutorial and helped students to realise that science communication is perhaps not as easy as some might think. This helped reinforce the importance of learning these communication skills.

Activity Name: Target Audience Analysis: Video

Duration (minutes): 20

Communication Skills Taught:

Identify and understand a suitable target audience

Consider the social, political, and cultural context of the scientific information

Consider levels of prior scientific knowledge in the target audience

Teaching Documents: Teaching notes for delivery, Student handout

Format: Multimedia, written

Description: Students were asked to watch a three-minute science video and then as a class to discuss what some of the main considerations which might have influenced the authors in making the video. They then worked in pairs on a worksheet that guided them through the process of audience analysis for who they considered to be the

target audience of the video. This activity gets students to actively engage in the process of audience analysis rather than just being told outright, and introduces them to some of the central considerations of communication.

Activity Name: Jargon translation

Duration (minutes): 30

Communication Skills Taught:

Consider a target audience

Use language that is appropriate for your target audience

Separate essential from non-essential factual content in a context that is relevant to the target audience

Teaching Documents: Teaching notes for delivery, Student handout

Format: Written

Description: This activity guided students through an easily-applied, step-by-step process for translating complex scientific language into language that was understandable and accessible for different, non-scientific target audiences. Students work through one example as a class and then practice this by taking complex science definitions and translating them for pre-specified audiences on a worksheet in pairs. This activity allows course coordinators to teach/include scientific content that is relevant to their courses as well as equipping students with a skill that will be applicable in many situations throughout their degree and career.

Activity Name: Communicating with Style: Analogy, Metaphor, and Simile

Duration (minutes): 30

Communication Skills Taught:

Consider a target audience

Use language that is appropriate for your target audience

Separate essential from non-essential factual content in a context that is relevant to the target audience

Create/use style elements (analogy, metaphor, and simile) appropriate for the mode of communication

Consider levels of prior scientific knowledge in the target audience

Teaching Documents: Teaching notes for delivery, Student handout

Format: Oral, Written

Description: This activity started with an introduction to analogy, metaphor, and simile: explaining how they are used, their strengths and weaknesses, and why they are useful for science communication. Students were then given three complex scientific concepts and asked to explain each concept to three different, pre-specified, non-scientific audiences using an analogy, metaphor, or simile that simplified the explanation and made the science accessible to the target audience.

Activity Name: Effective Data Visualisation Through Infographics

Duration (minutes): 20

Communication Skills Taught:

Use language that is appropriate for your target audience

Separate essential from non-essential factual content in a context that is relevant to the target audience

Create/use style elements (diagrams) appropriate for the mode of communication

Teaching Documents: Teaching notes for delivery, Student handout

Format: Multimedia, Written

Description: This activity started with a class analysis of two diagrams: one the original table from the scientific literature, and the other an infographic visualisation of that data. Students worked as a class to create a list of what makes an engaging infographic and to decide what to do and what not to do when visualizing data for a non-scientific audience. Students were then presented with a data set and asked to work in groups of four to draw their own infographic which visualised the given data in the most effective way on a sheet of butcher's paper. Prizes were given for the best infographics. This activity gets students to actively engage in the process of data visualisation rather than just being told outright, and teaches students to synthesize data sets and to apply some of the basic skills of effective science communication. This activity also worked well as a class 'icebreaker'.

Activity One: Science Communication Speed Dating

TEACHING NOTES

This activity is designed to throw students in the deep end by giving them a hands-on introduction to science communication, and also to help them meet some of their peers. This activity is designed to stimulate students to actively think about what considerations they need to make when communicating science to non-scientific audiences – rather than just having the lecturer give them the answers straight away. It's a good way to break the ice and then segue into your introduction to the elements of communication that you are going to teach.

NB: Quotation marks indicate verbal instructions

Skills developed in this activity include:

Identify and understand a suitable target audience

Use language that is appropriate for your target audience

Consider the levels of prior knowledge in the target audience

Separate essential from non-essential factual content in a context that is relevant to the target audience

INSTRUCTIONS – to direct students

“Get into pairs and introduce yourselves if you haven't met before.

To start with, the tallest of the pair will be the scientist, and the shortest of the pair will be the audience.

We are going to go through rounds of communicating science. I will give you a scientific concept, and a specific target audience.

For the scientist: you have two minutes to explain the scientific concept I give you in a way that you think will most help your specific audience understand the science.

For the audience: your job is to write down any words or concepts that the scientist says that you think your specific audience might not understand. This means putting yourself into the mindset of the specified audience.

For each round you will swap the roles of scientist and audience. I will time the two minute period and tell you when to start and stop explaining. Any questions?”

Round One

Scientific concept: [insert a science concept appropriate to your course]

Target audience: A scientist of a different discipline

Round Two (swap roles)

Scientific concept: [insert a science concept appropriate to your course]

Target audience: A first year university student studying philosophy

Round Three (swap partners)

Scientific concept: [insert a science concept appropriate to your course]

Target audience: A retired business consultant

Round Four (swap roles)

Scientific concept: [insert a science concept appropriate to your course]

Target audience: A ten year old child

(You can do as many rounds as you have time for)

➔ Once you have finished all the rounds you planned, get everyone's attention so that you can have a class discussion to analyse the processes used in the activity.

“We're going to run through a quick brainstorming activity now. Put your hand up if you have an answer to either of the following questions: (put on power point slide if available).

1. When you were explaining each of the scientific concepts, what were some of the things you had to consider when you were communicating with different target audiences?
2. As an audience, what were some of the things you noticed that the scientists did well or could have done better?"

- ➔ Make a list of students' answers on the board – include every suggestion. Ask students to expand on an idea if necessary. Encourage quiet students to contribute. Don't fill silence by answering this yourself.
- ➔ Ask guiding questions such as “when you were listening to the explanation – as the specified audience – did you understand everything your partner said? If not, why not?”
- ➔ The concepts you want to have on the board at the end of this brainstorm are:
 - Consideration of the target audience – for example ‘putting yourself in the shoes of the target audience’
 - Appropriate language for the target audience
 - Prior knowledge in science of the target audience
 - Content is relevant to the target audience and essential to the explanation

This way, students develop their own knowledge and are actively engaged in doing so. It is more likely that students will feel more confident and retain the information better when this is the case!

Activity Two: Who are you talking to? – Audience Analysis

TEACHING NOTES

The following activity will help your students develop the science communication following skills:

- Identify and understand a suitable target audience
- Consider levels of prior scientific knowledge in the target audience
- Consider the social, political, and cultural context of the scientific information

NB: Quotation marks indicate verbal instructions

“It’s really important that whenever you communicate science you have a very clear idea of who you are communicating with. Without knowing this, you won’t be able to adapt the way you communicate in order to present your message effectively.

Science communicators often fall into the trap of saying they want to communicate to a ‘general audience’. In reality, we try to avoid this term because it could mean anyone from a 5 year old boy to a career businessman. To be successful is getting your message across, it’s important to be clear about whom exactly you want to communicate with.

You will view a science video. Watch it carefully. At the end, I want you to answer the questions: Who do you think was the intended target audience of this video? Who might be most interested in this video?

In answering this question, thinking about some of the following communication concepts and what audience they might be appropriate for:

- The language the presenter used
- The complexity of the scientific content included in the explanations,
- The types of images, video, and music used
- The style elements included such as humour”

Show a short video on a science topic relevant to your course. Some useful resources can be found on the YouTube Channel ‘Veritasium’: <https://www.youtube.com/user/1veritasium>. This is followed by the following class discussion.

“Ok so let’s brainstorm some ideas.

Firstly, where do you think this video might be shown?

➔ Write down answers

Based on where it might be shown, who is likely to be watching?

➔ Write down answers

Of the people watching, who might be most interested in the video?

- Write down answers
- Define a target audience

Group Instructions:

In pairs, please work through the following audience analysis activity on the worksheet. Use the audience we defined as a class.”

Whenever you communicate science in any context, make sure to work through the processes you learnt today. This will ensure your science communication is clear and effective!”

You can summarise at the end to see if everyone arrived at the same answers for each category. In facilitating this questions ask students how and why they arrived at those conclusions, and if they differ from others, why is that?

You can also alter the categories on the student activity to change the complexity of the analysis.

STUDENT HANDOUT & ACTIVITY

The following activity will help you develop the science following communication skills:

- Identify and understand a suitable target audience
- Consider levels of prior scientific knowledge in the target audience
- Consider the social, political, and cultural context of the scientific information

It’s really important that whenever you communicate science you have a very clear idea of who you are communicating with. Without knowing this, you won’t be able to adapt the way you communicate in order to share your message effectively.

WHAT YOU WILL DO

You will view a science video. Watch it carefully. Who do you think was the intended target audience of this video? Who might be most interested in this video?

We will brainstorm the answers to these questions as a class, so think about some of the following communication concepts and what audience they might be appropriate for:

- The language the presenter used
- The complexity of the scientific content included in the explanations,
- The types of images, video, and music used
- The style elements included (e.g. humour)

As a class we’re going to define who we think is likely to be the intended target audience.

Group Instructions:

In pairs, please take 5 minutes to work through the following audience analysis activity on the worksheet. Use the audience we defined as a class.

AUDIENCE ANALYSIS WORKSHEET

Now that you have a specific audience lets break down and analyse the specific details of that audience.

What demographic might the majority of your audience be within the following categories?

There are no definite answers to these questions but this process will get you thinking about who exactly you are communicating with.

- Age bracket: 10-15 / 15-20 / 20-30 / 30-45 / 45-60 / 60+
- Gender: Mainly female / mainly male / both
- Potential political agenda/beliefs

For example, what political party is this audience most likely to agree with?

- Cultural or religious background:

For example, will your target audience have strong Christian beliefs?

- Prior training in science:

Junior school / High school / University Undergraduate / University Post-Graduate

- Stage of career or education

- Geographical location

Activity Three: Language and Jargon Translation

TEACHING NOTES

This activity is a follow on from audience analysis and should be done to develop communication skills once a target audience has been identified or explained. This can be given as either a take home work sheet, or something you work through together in class. Either way it's a good idea to introduce the concepts involved and work through an example with the students as a class.

NB: Quotation marks indicate verbal instructions;

Do not hand out student worksheets until the end of the class example below.

You can follow this structure as an introduction:

“In the following activity we are going to learn to use some skills that are central to effective science communication:

- Understand a target audience
- Use language that is appropriate for your target audience
- Consider the levels of prior knowledge in the target audience
- Separate essential from non-essential factual content in a context that is relevant to the target audience

The following quote was taken from an editorial published in the scientific journal, Nature:

"It is often seen as a badge of academic credibility to express short simple ideas in long ponderous phrases; why else would anyone choose to write a sentence such as "To elucidate these issues, we utilized the caprine model" instead of "We studied these questions using goats"?"

Scientists often fall into the trap of believing that the more jargon they use, the more professional they sound. Another common belief is that you can't be scientifically accurate without using jargon. Both of these beliefs aren't always true but unfortunately they have made translating 'science language' into 'general language' into a very difficult task.

So as you begin to communicate science, keep in mind a specific target audience. Adapt the language you use to ensure that audience can understand everything you say. Here are some examples of questions you should consider:

How much jargon should you use? Would you use the term: Lacrimation or crying? Herbivore or plant eating? Sessile or not moving?

Will you use acronyms?

What prior knowledge in science will your audience already have?

What scientific content will you need to explain? What scientific content can you assume your audience will understand?

We're going to work through an activity together as a class which will get you started on thinking about the answers to some of these questions.

I've written a scientific definition on the board. [*See worked example below – you can adapt this to be relevant to your discipline*]

I want you to think about how you might translate this concept to make it understandable and clear to a grade 8 school student named Jimmy. Jimmy is your target audience. [*You can change this audience to be relevant to your context – remembering to keep it as a 'lay' audience*]

Have a think about how much prior knowledge in science Jimmy is likely to have. Which words do you think he might not understand?

→ Underline or circle each word mentioned by the class

So now that we have a list of words that we know we shouldn't use, let's start translating them.

→ Work through the list of words by asking students to break them down into very simple language.

Now we can use these simplified words to rephrase the original scientific explanation simply by replacing the jargon with our new simple language.

→ Rewrite the original explanation on the board.

→ Hand out the worksheets and either ask the students to work through the concepts on the worksheet in pairs or give it as a take-home exercise. They can do this using the process we used in class.

Now that we have done an example of this process as a class, I'll hand out some worksheets with more concepts for you to translate." [*HERE YOU CAN INTEGRATE you course content and discipline-specific concepts, and define any audience you like on the worksheet – remembering to keep it as a 'lay' audience*]

WORKED EXAMPLE

Scientific concept: The Greenhouse Effect

Write the below (or another) scientific explanation on the board. Using the steps above, work through this as a class to simplify the example – below gives an indication of how this might look.

SCIENTIFIC EXPLANATION

The greenhouse effect is the **phenomenon** whereby the earth's temperature rises which is caused by the presence of **chemical compounds** in the earth's **atmosphere** called greenhouse gases, such as **water vapor, carbon dioxide, and methane**, which trap **short-wave infrared solar radiation**.

Temperature rises = warms

Phenomenon = effect

Chemical compounds = chemicals or gases

Short-wave infrared solar radiation = heat from the sun

Atmosphere = the air surrounding the earth

Called greenhouse gases = unessential content

Water vapor, carbon dioxide, and methane = unessential content

SIMPLE EXPLANATION

The greenhouse effect keeps the earth warm. This effect is caused by chemicals in the air that surrounds the planet which trap heat from the sun.

STUDENT HANDOUT & ACTIVITY

Jargon translation activity

The following activity will help you to:

- Consider a target audience
- Use language that is appropriate for your target audience
- Consider the levels of prior knowledge in the target audience
- Separate essential from non-essential factual content in a context that is relevant to the target audience

This quote was taken from an editorial published in the scientific journal, Nature:

"It is often seen as a badge of academic credibility to express short simple ideas in long ponderous phrases; why else would anyone choose to write a sentence such as "To elucidate these issues, we utilized the caprine model" instead of "We studied these questions using goats"?"

Scientists often fall into the trap of believing that the more jargon they use, the more professional they sound. Another common belief is that you can't be scientifically accurate without using jargon. Both of these beliefs aren't always true but unfortunately they have made translating 'science language' into 'general language' into a very difficult task. So as you begin to communicate science, keep in mind a specific target audience. Adapt the language you use to ensure that audience can understand everything you say. Here are some examples of questions you should consider:

- How much jargon should you use?
 - Lacrimation or crying? Herbivore or planting eating? Sessile or not moving?
- Will you use acronyms?
 - Carbon dioxide vs CO₂?
- What prior knowledge in science will your audience already have?
- What scientific content will you need to explain? What scientific content can you assume your audience will understand?

The following activity is designed to help you get started on the process of jargon translation. In the first column are scientific concepts that a [NUMBER] year [DISCIPLINE] student can be expected to understand.

Your job is to explain each concept to two audiences:

1. The first audience is a scientist of the same discipline.
2. The second audience is a non-scientific audience of [SPECIFY].
 - For example, this could be a 10 year old child, a financial businessman, a journalist. Be imaginative!

Consider the above questions as you explain and translate these concepts. Keep sentences short and your word count to an absolute minimum. The first row is filled out for you to remind you of the process we applied during the in-class worked example.

Tip: After defining the concept for the first scientific audience, go through and underline any words that your non-scientific audience might not understand. **Make a list of these and then translate each word into clear and simple language** which you can then use when you write the second explanation for your non-scientific audience.

Tip: Separate essential content from non-essential content. What prior knowledge does your audience already have? What information does your audience absolutely need to know to understand the concept? What information isn't relevant and could be removed? Go through your scientific explanation and cross out any unessential content before re-writing the explanation for your non-scientific audience.

REMEMBER THESE SIMPLE STEPS:

1. Identify jargon and make a list.
2. Translate those jargon words into simple, everyday language.
3. Remove any words or content which aren't absolutely essential to the concept explanation.
4. Rewrite the original, scientific explanation by replacing jargon with your translations, and removing unessential content.
5. Voila! You're on your way to being an excellent science communicator!

Scientific concept	Explanation for a scientist	Explanation for a grade 8 school student
[Insert science concepts here]		
[Insert science concepts here]		
[Insert science concepts here]		
[Insert science concepts here]		

Activity Four: Communicating with Style – Analogy, Metaphor, and Simile

TEACHING NOTES

NB: Quotation marks indicate verbal instructions

“Communication style elements such as metaphor, simile, and analogy are really powerful tools for making science communication engaging, relatable, and simple.

For example, the use of one of these elements might mean that instead of using a whole paragraph to explain a concept, you can communicate the information to your audience using just a sentence or two.

All of these concepts utilise imagery to describe or explain a new concept – and as they say, a picture is worth 1000 words.

So what’s the difference? They’re all relatively similar but there are a few differences which are useful to know when you’re deciding which style element is the best to use for a particular situation.

Metaphor

A metaphor is a figure of speech that uses **one thing to mean another** and makes a comparison between the two. So, when someone says “He’s become a shell of a man,” we know not to take this literally, even though it’s stated directly as if this person had actually lost his internal substance.

Simile

A simile compares two different things in order to create a new meaning. In this case, we are made explicitly aware that a comparison is being made due to the use of “like” or “as” (He’s *like* a shell of a man).

Analogy

An analogy is comparable to metaphor and simile in that it shows how two different things are similar, but it’s a bit more complex. Rather than a figure of speech, an analogy is more of a logical argument.

An analogy will often demonstrate how two things are alike by pointing out shared characteristics, with the goal of showing that they are similar in other ways as well.”

Which to use?

Write the following phrases on the board:

- The man was quiet like a mouse.
- He was a bear of a man.
- Blood vessels are like road systems.

Ask students what each of the examples means to them. What words come to mind when they read that phrase?

Explain each as the following – students should lead to these explanations themselves with their answers to the above question.

“*Simile*: (the man was quiet like a mouse) very few other words come to mind; it’s direct; it’s immediate; **it’s simple**.

Metaphor: (he was a mouse of a man) many words come to mind; many different connotations; makes you think. It draws you in. **It’s engaging**.

Analogy: (blood vessels are like road systems) descriptive; fewer words come to mind; but it gives you a concept to relate to; a concept which conveys more than the word alone – it gives you something to **relate to**.”

Caution:

“When using these style elements however, there are a few things to be cautious of.

You need to first acknowledge the limitations of the phrase you are using. When we compare two different things we need to be clear about which parts we are saying are similar, and which parts are different.

If we’re not clear in doing this, our audience may either misunderstand the point, or develop misconceptions which are inaccurate or incorrect.

For example: saying that someone has a moustache like Hitler has very different connotations to drawing a direct comparison and saying that someone is like Hitler.

Also, be sure to continue the analogy, metaphor, or simile throughout the explanation and not to get lost about the direction in which it is going. If your description is unclear, you’ll end up making the explanation more confusing rather than less so.

Lastly, make sure the description you’re using is relevant to your audience. Using an analogy involving characters on jersey shore to an old man who doesn’t have a television is just going to make him even more confused and lose his interest completely. As always with science communication, tailor everything to suit your audience!

So now we’re going to do a class activity where you’ll work in pairs. Your job is take **one** of the science concepts on the hand out and explain it to each of the **three** audiences outlined. In your explanation you must use a metaphor, simile, or analogy that is relevant to your target audience. That means explaining the same concept, three times, in three different ways.

If you finish one concept, move onto the others.”

You can add concepts from your discipline-specific course as the science concepts, and alter the audiences if you need to – remembering to make the relatively ‘lay’ audiences and different enough that students have to think of different example for each audience. You can also alter the number of concepts and audiences depending on your time allocation.

STUDENT HANDOUT & ACTIVITY

This activity will help you develop the following science communication skills:

- Identify and understand a suitable target audience
- Consider levels of prior scientific knowledge in the target audience
- Use/consider style elements appropriate for the mode of communication (such as humour, anecdotes, analogy, simile, metaphors, rhetoric, images, body language, eye contact, and diagrams)

Communication style elements are really powerful tools for making science communication engaging, relatable, and simple. They are often really useful at cutting down the word count as well as the jargon we use to explain complex science.

WHAT YOU WILL DO

Your job is take **one** of the following physics concepts and explain it to each of the **three** audiences outlined. In your explanation you must use a metaphor, simile, or analogy that is relevant to your target audience. That means explaining the same concept in three **different** ways.

Choose **one** of these concepts:

1. [Insert relevant science concept here].
2. [Insert relevant science concept here].
3. [Insert relevant science concept here].

Explain this to each of the following audiences. For each audience, use a different metaphor, simile, or analogy that is relevant to them. This means applying your audience analysis skills.

1. A ten year old girl from England
2. A thirty year old businesswoman from Hong Kong
3. A seventy year old retired male electrician from Sydney

Activity Five: Engaging Infographics – Effective Data Visualisation

TEACHING NOTES

NB: Quotation marks indicate verbal instructions

Don't hand out worksheets at the start – wait until you have done the following introduction.

“Making data interesting is hard. Unless you're the one who has slaved to collect and analyse that data, chances are most people won't be engaged in a dataset.

Scientists are taught how to communicate their data to other scientists through tables and graphs that are wordy and dense in information. Looking at those graphs may be extremely overwhelming or incomprehensible to people who aren't familiar with the language of science.

But it's not impossible to make data interesting for non-scientists. There's been a recent trend in the creation of 'infographics' which you have likely seen on social media, advertising, billboards, and many other places too. An infographic is a highly effective way of communicating large sets of data in a way that is interesting, engaging, and generally – pretty to look at.

Infographics can be large or small, with simple or complex data, but “*The best infographics convey a lot of information in a lot less space than it would take to write about the topic or have regular graphs of the data.*”

I am going to show you an infographic compared to the original data from which it came. [See **supplementary 1 below**] We're going to brainstorm some ideas about why this infographic might be a more effective way of communicating that scientific information – especially to people who aren't scientists.

Why might the tables on the left not be very interesting?

➔ Write down answers

And what are some of the good aspects of the infographic on the right?

➔ Write down answers

So if we were to write a list for someone about to start creating an infographic, what might be some of the points you would include for how to make an engaging infographic?”

➔ Write list that should look something like this: (ask guiding questions)

What makes an engaging infographic?

1. A clear message: what do I want the reader to understand?
2. Less is more: use space wisely
3. Show, don't tell: 90per cent of information sent to the brain is visual
4. No raw data: interpret the data to make interesting statements
5. Don't strain the brain: make data and text clear – easy to see, read, and understand
6. Symmetry is satisfying
7. **KISS**: Keep it simple, stupid! That applies to language, design, data, everything!

“Now we’re going to pass round a worksheet with some scientific data on it. This data is a general example from social media but the skills you’ll apply in this activity are widely applicable to all kinds of data – including the data you’ll use for your assignments this semester.

Working in groups of 4, you will have 20minutes to visualize that data using pens and a piece of butcher’s paper. You can use as much or as little of the data presented on the sheet.

Don’t worry about colours and other finer design factors. What we really want is a simple, engaging, effective, and creative infographic that accurately conveys data!

Feel free to have a quick look online for ideas – just google ‘infographics’ for some other examples.

Remember to keep in mind everything we discussed earlier about what makes a good infographic.”

- ➔ If there is time, place all the different infographics somewhere that people can see and then either vote on the best one or get one of tutors to decide. You could also have a class critique where students offer constructive feedback on each infographic.

For this activity you can alter the time given to draw the infographic or the group size. You will also need the following materials:

Multi-coloured marker pens and butchers paper – enough for one page per group.

A prize, if you choose to have judging of the infographics.

A dataset – this can be any sort you like but usually fairly simple data in a table is a good idea. For example, you could use energy and water consumption per household in the states of Australia. This should be printed and provided to the groups with the student handouts.

SUPPLEMENTARY 1

Impact of Vaccines in the 20th & 21st Centuries

Comparison of 20th Century Annual Morbidity & Current Morbidity

Disease	20 th Century Annual Morbidity*	2010 Reported Cases [†]	% Decrease
Smallpox	29,005	0	100%
Diphtheria	21,053	0	100%
Pertussis	200,752	21,291	89%
Tetanus	580	8	99%
Polio (paralytic)	16,316	0	100%
Measles	530,217	61	>99%
Mumps	162,344	2,528	98%
Rubella	47,745	6	>99%
CRS	152	0	100%
<i>Haemophilus influenzae</i> (<5 years of age)	20,000 (est.)	270 (16 serotype b and 254 unknown serotype)	99%

Sources:

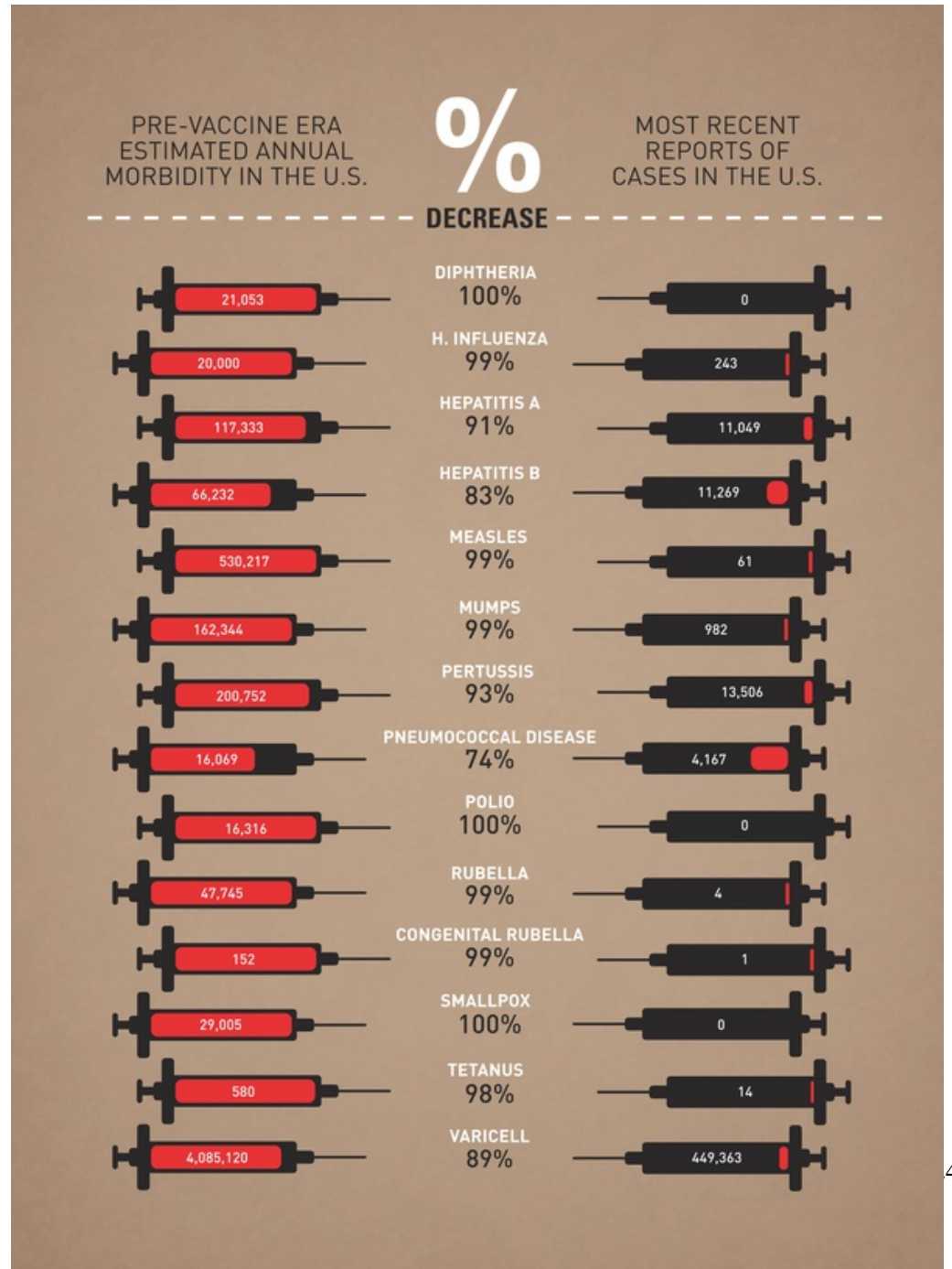
- * JAMA. 2007;298(18):2155-2163
- † CDC. MMWR January 7, 2011;59(52):1704-1716. (Provisional MMWR week 52 data)

Comparison of Pre-Vaccine Era Estimated Annual Morbidity with Current Estimate

Disease	Pre-Vaccine Era Annual Estimate	2008 Estimate	% Decrease
Hepatitis A	117,333*	11,049	91%
Hepatitis B (acute)	66,232*	11,269	83%
Pneumococcus (invasive)			
All ages	63,067*	44,000 [†]	30%
<5 years of age	16,069*	4,167 [†]	74%
Rotavirus (hospitalizations <5 years of age)	62,500 [§]	7,500 [‡]	88%
Varicella	4,085,120*	449,363	89%

Sources:

- * JAMA. 2007;298(18):2155-2163
- † CDC. Active Bacterial Core surveillance Report; *S. pneumoniae* 2008. (www.cdc.gov/abcs/survreports/spnew08.pdf)
- ‡ 2008 Active Bacterial Core surveillance
- § CDC. MMWR. February 6, 2009 / 58(RR02); 1-25
- ‡ New Vaccine Surveillance Network



STUDENT HANDOUT & ACTIVITY

Making data interesting is hard. But it's not impossible. Infographics are just one option for representing data and they are a highly effective way of communicating large sets of data in a way that is interesting, engaging, and generally – pretty to look at. In the following exercise you will learn to:

- ✓ Apply some of the science communication skills we have already learnt in a new and challenging format
- ✓ Synthesise, interpret, and present data and statistics

“The best infographics convey a lot of information in a lot less space than it would take to write about the topic or have regular graphs of the data.”

– Marketing Land

Infographics can be large or small, with simple or complex data, but the good ones all follow similar design rules. Some of these are listed below:

What makes an engaging infographic?

A clear message: what do I want the reader to understand?

Less is more: use space wisely

Show, don't tell: 90% of information sent to the brain is visual

No raw data: interpret the data to make interesting statements

Don't strain the brain: make data and text clear – easy to see, read, and understand

Symmetry is satisfying

KISS: Keep it simple, stupid! That applies to language, design, data, everything!

WHAT YOU WILL DO

You'll receive a worksheet with a range of scientific data collected on social media statistics.

Working in groups of 4, you will have 20 minutes to visualize that data given the materials provided. Don't worry about colours and other finer design factors. You can use as much or as little of the data provided as you like. What we really want is a simple, engaging, effective, and creative infographic!

Remember to keep in mind everything we discussed earlier about what makes a good infographic!

Science communication marking criteria

	Outstanding (no faults)	Excellent (minor faults that are easily fixed)	Good (minor faults that need some work)	Poor (many faults that need extensive work)	Fail (all skills absent)
Identify and understand suitable target audience	Audience is clearly identified and highly suitable and relevant.	Audience is clearly identified and suitable but could have been more relevant.	Audience is identified but this could have been done more clearly. Audience could have been more suitable and relevant.	Consideration has been given to audience but this is not clearly identified. Audience could have been much more suitable and is not particularly relevant.	No consideration given to audience.
Use language that is appropriate for the target audience	All language is suitable for the target audience.	5% of the language is unsuitable for audience.	5-20% of the language is unsuitable for audience.	20-50% of the language is unsuitable for audience.	More than 50 % of the language is unsuitable for audience.
Consider the levels of prior knowledge in the target audience	All concepts used are appropriate for and can be understood by audience.	Most concepts used are appropriate for and can be understood by audience.	Some concepts used are appropriate for and can be understood by audience.	Few concepts used can be understood by audience.	None of the concepts can be understood by audience.
Consider the social, political, and cultural context of the scientific information	Student has correctly and thoroughly identified and considered all political, cultural, and social issues relevant to the scientific information	Student has correctly identified and considered most political, cultural, and social issues relevant to the scientific information	Student has correctly identified and considered some political, cultural, and social issues relevant to the scientific information	Student has correctly identified and considered only the minimal political, cultural, and social issues relevant to the scientific information	No political, cultural, and social issues relevant to the scientific information have been identified
Use appropriate stylistic element that is relevant to the audience - <i>Infographic or diagram</i>	Diagram used is <ul style="list-style-type: none"> • relevant to format of publication, • content and message is very clear, • has high aesthetic impact, • all elements of the diagram are relevant, clear, and appealing to the audience. 	Diagram used is <ul style="list-style-type: none"> • relevant to format of publication, • content and message is clear, • has aesthetic impact, • the majority of the elements of the diagram are relevant, clear, and appealing to the audience. 	Diagram used is <ul style="list-style-type: none"> • somewhat relevant to format of publication but could have been better chosen, • content and message require more clarity, • has some aesthetic impact, • the majority of the elements of the diagram are relevant, clear, and appealing to the audience 	Diagram used is <ul style="list-style-type: none"> • not really relevant to format of publication, • content and message require a lot more clarity, • has little aesthetic impact, • the majority of the elements of the diagram are not relevant, clear, and appealing to the 	Diagram used is not relevant to format of publication and no thought has been given to impact, clarity, or appeal.

			but this could be improved.	audience.	
6) Use appropriate stylistic element that is relevant to the audience - <i>Analogy, simile, or metaphor</i>	The element chosen is <ul style="list-style-type: none"> • suitable for the content, • relevant to the audience, • conveys the information clearly • greatly enhances the explanation by making the science simple and easy to understand and relate to, • no excess information/confusion. 	The element chosen is <ul style="list-style-type: none"> • suitable for the content, • mostly relevant to the audience, • conveys the information clearly • enhances the explanation by making the science simple and easy to understand and relate to, • only minor excess information/confusion. 	The element chosen <ul style="list-style-type: none"> • could have been more suitable for the content, • is mostly relevant to the audience, • conveys the information but could have been clearer, • is only partially relevant to audience., • displayed some excess information/confusion. 	The element chosen <ul style="list-style-type: none"> • could have been more suitable for the content, • was not relevant to the audience, • conveys the information but does not simplify the concept due to excess information/confusion. 	The element chosen was not suitable, clear, or relevant, and creates confusion.
7) Separate essential from non-essential factual content in a context that is relevant to the target audience	Communication contains only essential content and effectively enhances the audiences' understanding of the science.	Communication contains mostly essential content and enhances the audience's understanding of the science.	Communication contains some essential content and but also includes content that is irrelevant which may confuse audience.	Communication is dominated by non-essential content which is confusing for the audience.	All essential content is missing.