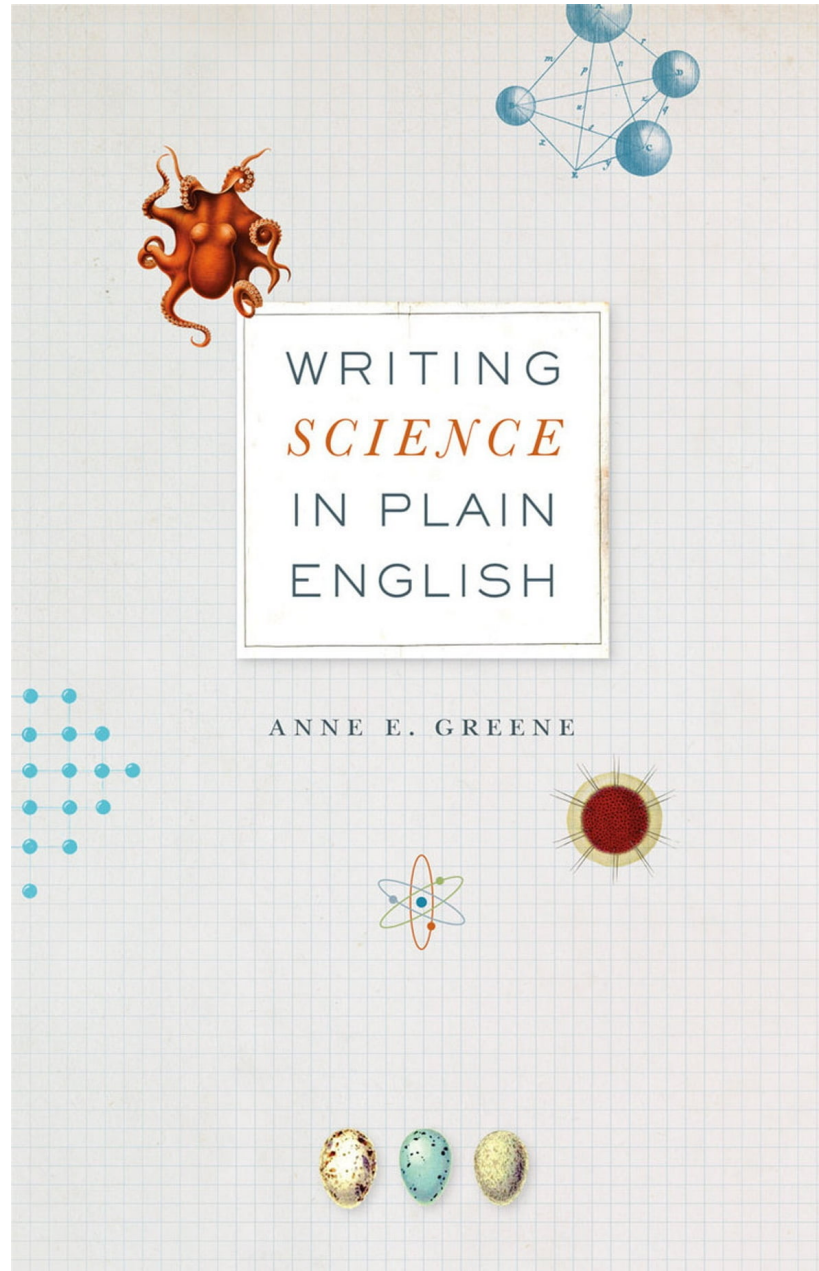


# Writing Science in Plain English



- Anne E. Greene is a biologist and teaches scientific writing in the Wildlife Biology Program at The University of Montana
- Main text is 86 pages
- Exercises at the end of most chapters
- Appendix for definitions

*\*This presentation is mostly direct quotes from this book*

# Why write science in plain English?

- "Scientific writing is unnecessarily dry, difficult to read, obscure, and ambiguous." - David Porush
- "Obscure, convoluted, jargonistic, or impenetrable." - Editor of Science Signaling
- Poor scientific writing:
  - Hinders the flow of ideas across disciplines
  - Makes it difficult to apply discoveries from one field to another
  - Causes decline in science literacy and gap b/w scientists and general public

# What this talk will cover

- Before you write
  - Audience
  - Register
  - Tone
- Tell a story
  - Abstract nouns
  - Strong verbs
  - Place subject and verb close together
- Active vs. passive voice
- Choose your words with care

# A few definitions

## **Nouns**

- Name persons, places, things, or ideas
- Act as subjects and objects in sentences

## **Verbs**

- Show action or state of being

## **Adjectives**

- Describe or modify nouns or pronouns

## **Adverbs**

- Modify verbs, adjectives, other adverbs, or whole sentences

## **Prepositions**

- Show position in space and time (in, under, above, below, at, after, before, until, for, with, by, on, of, as, like)

## **Subject**

- What you write your sentence about. (Ask "who?" or "what?" in front of the verb)

## **Object**

- A noun that receives the action of the verb. (Ask "who?" or "what?" after the verb)



# Before you write

*Decide who you are writing for, how formal you should be, and the attitude you want to project*



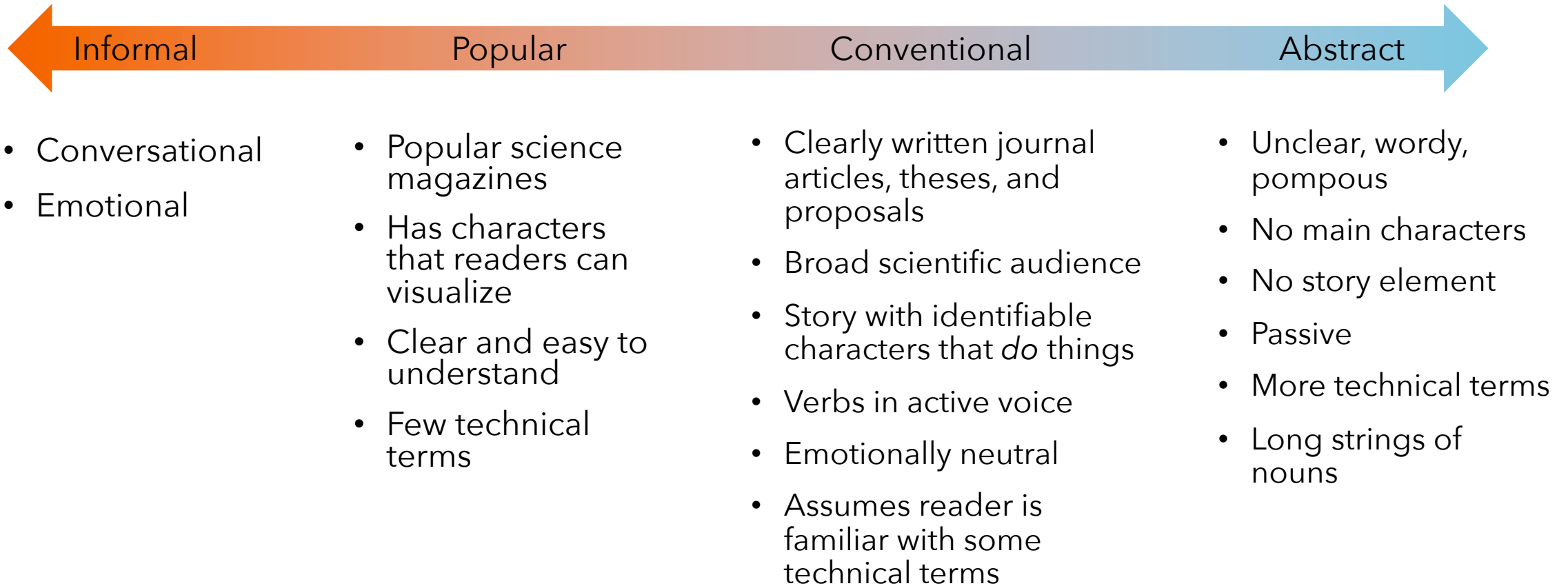
# Audience

- Put yourself in their shoes
- They are trying to understand you, but don't know what you know
- If you are unsure of your audience, err on the conservative side
- Envision a larger audience - one that is not as well informed as you are - and write for them.



# Register

Describes where your writing falls on the continuum from informal to formal





# Register

*Informal*



Have you ever wondered, “How the heck do porcupines manage to mate with all those spines everywhere?” Well, the answer to that question is pretty hard to figure out because...

*Abstract*



The assessment of strong directional tendencies of the North American porcupine (*Erethizon dorsatum*) in the Great Basin of northwestern Nevada was made in relation to sex-specific behavioral heterogeneity during ...

# Register

*Popular* ✓

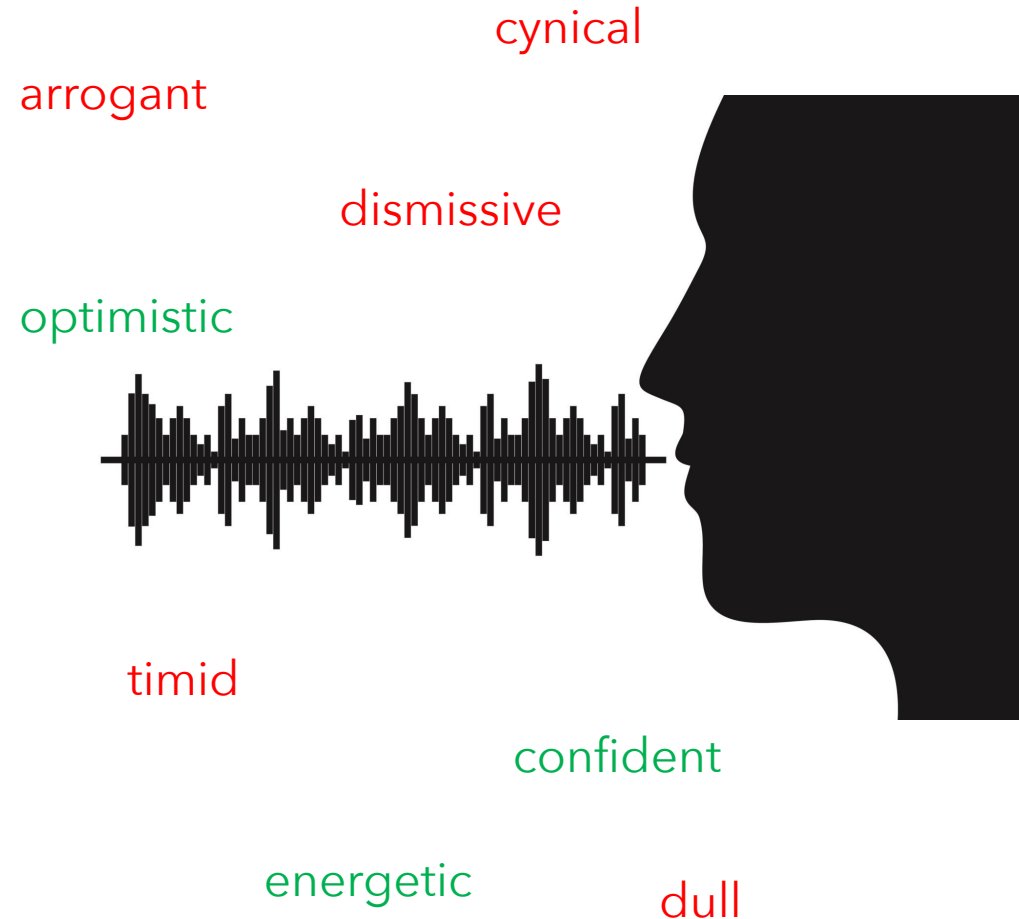
**Porcupines are arboreal creatures and in the Nevada region, they live and mate in thick riparian vegetation in which it is impossible for researchers to move quietly. So, although ...**

*Conventional* ✓

**I tracked the movements of North American porcupines (*Erethizon dorsatum*) in the Great Basin of northwestern Nevada. I related these movements to breeding activities during the late summer and fall of 1991 and 1992.**

# Tone

- Tone is the writer's attitude toward themselves, their subject, and their audience
- Influences how the audience feels about you and your subject
- Persuade: adopt a tone that projects confidence rather than doubt



# Tone

Weak, tentative



1. Horned beetles could provide an opportunity to combine studies of trait development with experiments looking at sexual selection and the evolutionary significance of enlarged male weapons (horns). After almost ten years of research, the PI may now have the opportunity, if funded, to piece together disparate parts of the research program, offering opportunities to train young scientists, and possibly providing a picture of the evolution of unusual animal shapes.

Excitement, confidence



2. Horned beetles provide an unusual opportunity to combine studies of trait development with experiments exploring sexual selection and the evolutionary significance of enlarged male weapons (horns). By building on almost ten years of research directed towards this goal, the PI now has the opportunity to forge a truly integrative research program, offering unique possibilities for inspiring and training young scientists, and providing a comprehensive picture of the evolution of some of nature's most bizarre animal shapes.





# Tell a story

*We can hang complex ideas on the scaffolding of good, simple stories and make our science as exciting to our audience as it is to us*

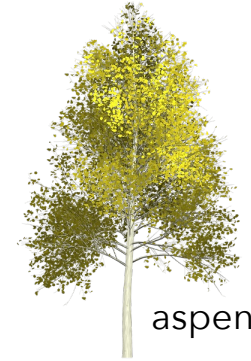
# Make characters subjects and their actions verbs

*Tangible, concrete nouns*

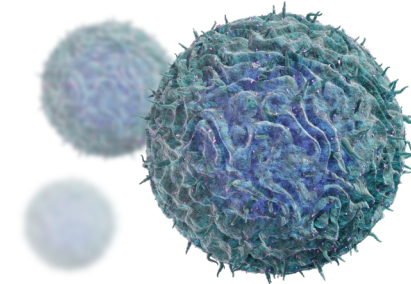
- The more concrete the characters and the more vigorous their actions, the better the story



sandstone



aspen trees



T cells

# Limit the use of abstract nouns

- Rather than choosing concrete characters as subjects, many scientific writers choose **abstract nouns**
- Abstract nouns come from verbs and sometimes adjectives
- Abstract nouns name intangible things such as ideas, emotions, or qualities

<i>Verb</i> ✓	<i>Abstract Noun</i> ✗
understand	understanding
observe	observation
interpret	interpretation
assume	assumption
predict	prediction
manipulate	manipulation
demonstrate	demonstration
develop	development
exclude	exclusion
respond	response
<i>Adjective</i>	<i>Abstract Noun</i>
efficient	efficiency
accurate	accuracy
applicable	applicability



A photograph of a man with a beard and a white long-sleeved shirt looking towards a woman whose back is to the camera. The man has a confused expression. Two thought bubbles are overlaid on the image. One is connected to the woman and the other to the man. An arrow points from the text 'Person using abstract nouns' to the woman.

I sound sophisticated!

I'm bewildered and in a daze

Person using abstract nouns





Tête, 1913, Pablo Picasso



Girl with a Pearl Earring, 1665, Johannes Vermeer

Subject is an abstract noun

Verb, but does a poor job describing what the subject does

The behavioral manifestations of stress responses have been shown to vary greatly between individuals in rodents, pigs, birds, fish, and humans. (21 words)

Objects of the preposition

Verbs in disguise:

- Behave -> behavioral (adjective)
- Respond -> responses (object of a preposition)
- Vary -> to vary (infinitive, acts as an object)



Change behavioral to behave:

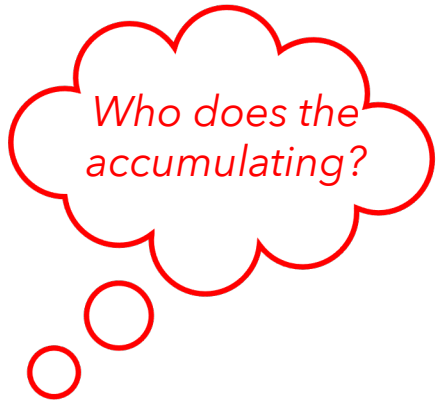
Individual rodents, pigs, birds, fish, and humans behave very differently in response to stress. (14 words)



You can revise many sentences that have abstract nouns as subjects by substituting the scientist(s) themselves

abstract

The accumulation of data sets from across the northern hemisphere has enabled us to address both the utility and cause of C and N isotope differences in ECM and SAP fungi. (31 words)



More abstract nouns

Abstract noun back to verb form

We accumulated data sets from across the northern hemisphere to address why C and N isotopes differ in ECM and SAP fungi. (22 words)

Replaces utility and cause



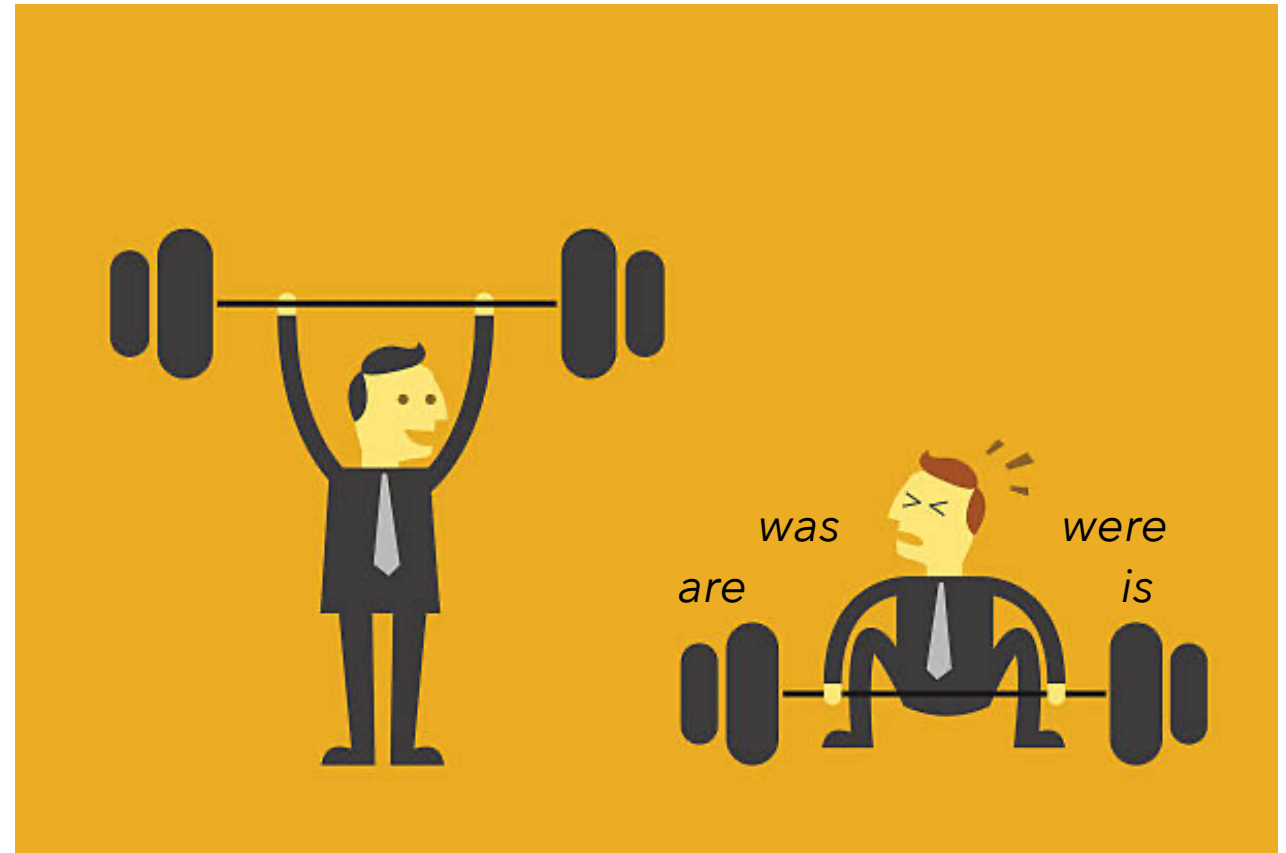
Subject (scientists)



# Use strong verbs

- When we change verbs into abstract nouns, we rob our sentences of strong verbs
- Strong verbs enliven a reader's interest by making connections between the characters in a sentence and the things they act upon
- We often substitute weak verbs that describe our characters' actions poorly or not at all

**Be** and **have** are especially weak verbs





**Understanding seasonal habitat ranges and their distribution is critical for Greater Prairie Chicken conservation and management. (16 words)**



- Introduce a concrete character as the subject
- Convert the abstract nouns back into strong verbs

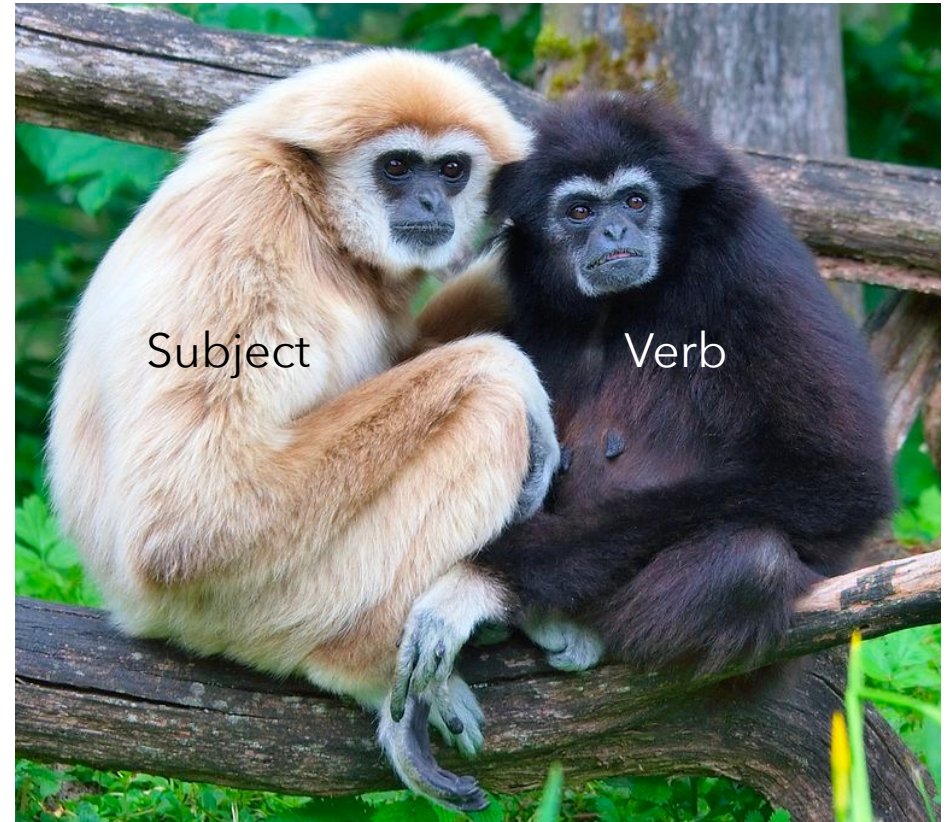
**Before we can conserve and manage Greater Prairie Chickens, we must understand their seasonal habitats. (15 words)**



A crisper, more direct sentence

# Place subjects and verbs close together

- Readers identify the subject then immediately look for the verb that describes what that character is doing.
- The closer the verb is to the subject, the clearer the sentence.
- If there are more than 6 or 7 words b/w the subject and verb, readers forget what the subject was and have to go back.



- 25 words between subject and verb!
- People ignore the words in between

**Part of our evidence establishing that the p65 product was derived from uncleaved FAT1 and not from the further proteolytic processing of the cleaved FAT1 heterodimer was obtained by the use of the furin-defective LoVo cells. (36 words)**



**We established that the p65 product was not derived from the further proteolytic processing of cleaved FAT1 heterodimer. Instead, by using furin-defective LoVo cells, we discovered that p65 was derived from uncleaved FAT1. (33 words)**





# Favor the active voice

Voice describes whether the subject of the sentence is *doing* the action or receiving the action.





# Active vs. Passive

- When the subject of a sentence *does* the action, the verb is in **active** voice.
- When the subject *receives* the action, the verb is in **passive** voice.

*Active voice*

**The biologist counted the caribou. (5 words)**

- The subject is the *biologist*, and the verb is *counted*.
- The biologist does the counting, so the verb is **active**.

*Passive voice*

**The caribou were counted by the biologist. (7 words)**

- The subject is *caribou*, and the verb is *were counted*.
- The caribou received the counting, so the verb is **passive**.

# Active vs. Passive

## Active voice

- Sentences in active voice reflect the way we speak to each other every day
- Easy to follow
- Fewer words
- Have a direct *character-action-goal* order
- Forces you to name the characters of your stories

## Passive voice

- Characters go unnamed
- Typically a *be* verb before a form of the main verb that often ends in *-ed* or *-en*.
- Many have a *by* phrase, which explains who is doing the action
- These extra words can make sentences 30% longer than active sentences!

The *be* verb

Hypothesis receives the act of supporting

This hypothesis is supported by the observation that the timing of spring runoff is significantly different between natural and modified basins (Moore et al. 2011). (passive, 25 words)



Cut out the *be* verb (*is*)

Moore et al. (2011) support this hypothesis, observing that the timing of spring runoff is significantly different between natural and modified basins. (active, 22 words)

Reduce prepositional phrase *by the observations to* observing



Clearer, more direct, shorter

- Survivorship, mortality, feedbacks = abstract nouns
- 8 words separate subject and verb
- "plant-soil biota feedbacks" = long, incomprehensible string
- Who are the characters in the story and what are they doing?

Subject is an abstract noun  
 The variation in survivorship referred to as density-dependent mortality has also been related to negative plant-soil biota feedbacks described for a temperate (Parker and Clay 2000; Parker and Clay 2002) and tropical tree species (Hood et al. 2004). (passive, 37 words)

passive, weak verb (*has been related*)



- Use the scientists as concrete subjects
- Use stronger, active verbs
- Try to break up long string "negative plant-soil biota feedbacks"

Parker and Clay (2000, 2002) found that density dependent mortality in a tropical tree species was related to negative feedbacks between plants and soil biota. Hood et al. (2004) found a similar relationship in a temperate tree species. (active, 37 words)



# Proper uses of passive voice

- To keep the same or similar subjects in a series of sentences in a paragraph
- Passive voice can help you compose a sentence where the action that was done is important, but who did it was not

I cooled the samples on ice, returned them to Arizona State University, and froze them until I used them. (19 words)

Active



Samples were cooled on ice, returned to Arizona State University, and frozen until used. (14 words)

Passive





# Choose your words with care

Reduce the temptation to use Latin- or  
French-based words



# Use short words instead of long ones

- Your message will be clearer and have more impact



subsequent vs. next

temporal vs. in time

terminate vs. end

## *Long Words*

## *Short Words*

implement

put

adhere

stick

develop

make

retain

keep

utilize

use

terminate

end

ascertain

find

facilitate

help

endeavor

try

transmit

send

initiate

start

alteration

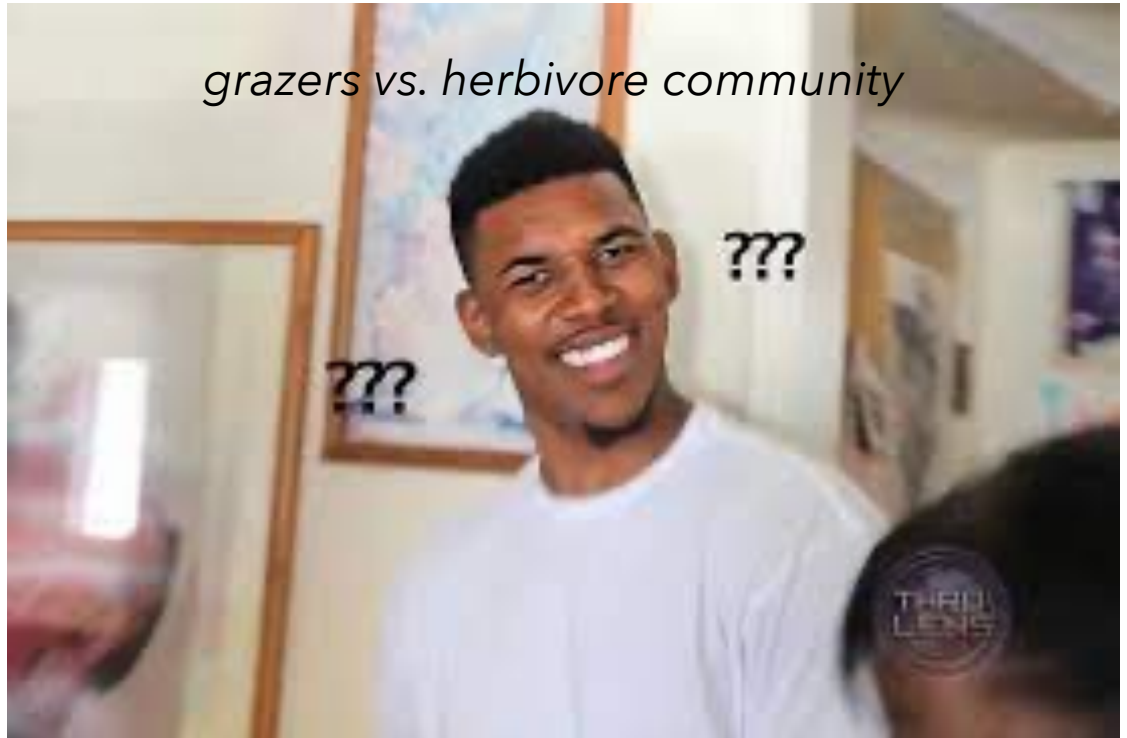
change

investigations

work

# Keep terms the same

- Many scientists believe repeating the same term for an important character makes their writing boring or repetitive
- Using different terms risks confusing the readers who think they mean different things
- Consistent terms are essential for navigating new, complex information



**In relatively unproductive ecosystems like deserts, grazers and predators are so rare as to be negligible, and competition for resources structures plant communities. In more productive systems like grasslands, a large effective herbivore community can be supported and grazing determines plant biomass. (42 words)**

**In relatively unproductive ecosystems like deserts, plant biomass is limited by a lack of resources. In more productive systems like grasslands, plant biomass is limited by herbivores. (27 words)**



**In relatively unproductive ecosystems like deserts, grazers and predators are so rare as to be negligible, and competition for resources structures plant communities. In more productive systems like grasslands, a large effective herbivore community can be supported and grazing determines plant biomass. (42 words)**



**In relatively unproductive ecosystems like deserts, plant biomass is limited by a lack of resources. In more productive systems like grasslands, plant biomass is limited by herbivores. (27 words)**



# Rethink technical terms

- Use specialized technical terms only when you are sure that all your readers will understand them (i.e. *DNA* and *3-D*)
- When in doubt, be conservative and define your technical terms or leave them out



# Omit needless words

- Our goal as writers should be to express our ideas with no surplus words, omitting what our readers can easily infer

**Inhalation of vapor phase particulate matter  
chemical contaminants from biomass combustion  
in domestic settings is a significant contributor to  
local disease burden. (22 words)**



**Domestic wood smoke causes local health  
problems. (7 words)**



# Redundancy

- Most needless words that inflate scientific writing are redundant
- Can be cut with no harm to the message
- Don't repeat yourself using slightly different wording
- Don't put excess detail
- Try to substitute a word for a phrase

<i>Wordy Phrase</i>	<i>Shorter Substitute</i>
in this study we assessed	we assessed
conduct an investigation of	investigate
were responsible for	caused
played the role of	were
in order to	to
for the following reasons	because
during the course of; during the process of	during
a majority; most of the	most
undertake an examination of	study
various lines of evidence	evidence
the analysis presented in this paper	our analysis
in the absence of	without
located in; located at	in; at
in the vicinity of; in close proximity to	near
in no case; on no occasion	never
<hr/>	
at the present time; at this point in time	now
an example of this is the fact that	for example

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# Vary the length of your sentences

- A string of long sentences (30+ words) is difficult to get through
- A string of short sentences (10 words or less) is choppy
- A string of medium-length sentences (15-25 words) is monotonous
- We tend to write medium to long sentences and to maintain the same sentence length throughout the whole document

This sentence has five words. Here are five more words. Five-word sentences are fine. But several together become monotonous. Listen to what is happening. The writing is getting boring. The sound of it drones. It's like a stuck record. The ear demands some variety.

Now listen. I vary the sentence length, and I create music. Music. The writing sings. It has a pleasant rhythm, a lilt, a harmony. I use short sentences. And I use sentences of medium length. And sometimes when I am certain the reader is rested, I will engage him with a sentence of considerable length, a sentence that burns with energy and builds with all the impetus of a crescendo, the roll of the drums, the crash of the cymbals--sounds that say listen to this, it is important.

So write with a combination of short, medium, and long sentences. Create a sound that pleases the reader's ear. Don't just write words. Write music.

-Gary Provost

# Summary

- Before you write: think about register, tone, and audience
- Tell a compelling story: make concrete characters the subjects which *do* strong verbs (favor active voice and not abstract nouns)
- Choose your words with care: use short words, minimize technical terms, omit needless words, and vary the lengths of your sentences



# Don't have time to go over...

- Old information and new information (where to put it in sentences)
- Make lists parallel
- Design your paragraphs
  - Issue
  - Development
  - Conclusion
- Arrange your paragraphs
  - Chronological order
  - General to specific
  - Least important to most important
  - Problem to solution
  - Compare and contrast
  - Transition words revisited

