**Genetics Lesson 7:**

**How to write good arguments**

**Teacher notes**

This document includes teachers’ notes for two activities added to Genetics Lesson 7. We added these activities on the basis of our discussion last month of how to help students improve their writing.

Argumentation Activity Part 1 is a set of PowerPoint slides that introduce students to characteristics of good arguments. The slides also are aimed at helping students understand why it is valuable to elaborate arguments when writing.

Argumentation Activity Part 2 is a one-page worksheet. Students identify four good points and one bad point about a nucleus essay.

The documents you need are:

PRACCIS Genetics Lesson 7 Argumentation Activity Part 1 SHORTENED

PRACCIS Genetics Lesson 7 Argumentation Activity Part 2

**ACTIVITY 1**

***GENERAL NOTES:***

*At any or many points in this PowerPoint presentation, you may want to have students very briefly discuss the questions in groups or in pairs before you go over the questions as a class.*

*Also, especially, for arguments of poorer quality, be sure to emphasize that even though students do not like these arguments, these are the kinds of arguments they themselves give!*

*If students become good at identifying which criterion is not met, you don’t have to go through each and every criterion when discussing the arguments.*

**Slide 1:**

One of the things that scientists do is carefully explain the arguments why they believe their ideas. Today, you’ll start learning how to write good arguments that carefully explain why you believe your ideas. By carefully explaining the arguments why you believe your ideas, you’re more likely to be able to persuade others to believe your ideas, too.

**Slide 2:**

Here are four important criteria for writing good arguments. Good arguments meet all of these criteria. There are other criteria, too, that you have noted in your lists. Most of your lists include these four criteria. Arguments that are not so good fall short of one or more of these criteria.

The first criterion is that the argument tells what your position is.

The second criteria is that the argument tells what the evidence for your position is.

The third criterion is that the argument is accurate; it tells the truth.

The fourth criterion is that the argument explains WHY the evidence supports your idea.

**Slide 3:**

Here’s a good example. Let’s imagine that we have a police case in which someone named Sarah is accused of stealing money. Here’s a good argument to believe that Sarah really stole the money: “I think she stole the money because of what the security officer showed us. He told us that there was a video camera in the room, and he showed us the videotape, and you can clearly see Sarah taking the money. The video shows the Sarah’s face very clearly”

Let’s look at why this one meets all the criteria.

* First, it tells what position the argument supports
* Second, it tells what the evidence is. It talks about the videotape evidence.
* Third, it is accurate. It tells what really happened, what the videotape really showed.
* Fourth, it explains why the evidence supports the idea that Sarah stole the money. It said that the video camera caught Sarah stealing the money, and the video camera was in the room, and you could clearly see Sarah, so it had to be her.

Because this argument is quite detailed, you can understand clearly why she is probably guilty. This argument is persuasive. And it is understandable.

**Slide 4:**

Here’s the next one. See if you can tell if it is a good argument or not. “I think that the EAT-NOTHING-BUT-PICKLES DIET is effective because scientists in Florida did an experiment.”

Let’s go through each criterion.

* Does it tell the position? YES.
* Does it tell what the evidence is? YES.
* Is it accurate? CAN’T TELL: There’s no information!! When people claim that a study supports their idea, the scientists who did the study often point out that their study doesn’t really show that idea at all. In this case, maybe there was a study that showed that adding pickles to some people diets was a good thing, but that doesn’t mean that it’s good to eat NOTHING BUT pickles.
* Does it explain how the evidence supports the position? NOT AT ALL. We want to know much more about the study, and why they think this.

Would this persuade you to go on the NOTHING-BUT-PICKLES diet? It shouldn’t persuade you, because this isn’t a good argument.

But in your essays, many of you wrote arguments like this. The instructions model is better because of Evidence 4, or something like that.

**Slides 5:**

Here’s another. “I think that eating vegetables cures cancer because I read a study about diet and cancer.”

Let’s go through each criterion.

* Does it tell the position? YES.
* Does it tell what the evidence is? YES.
* Is it accurate? WE CAN’T TELL. NOT ENOUGH INFORMATION.
* Does it explain how the evidence supports the position? NO. NOT ENOUGH INFORMATION.

Again, this is not at all persuasive, because it doesn’t tell us anything about the study, or why the person who wrote this thinks that the study shows that eating vegetables cures cancer.

**Slide 6:**

Let’s try another. “I think that eating vegetables prevents cancer because I read a study about diet and cancer. It showed that people who eat the same diet as in Greece and Italy—lots of vegetables, fruits, fish, and olive oil—are less likely to get colon cancer than people who eat a diet with more meat. This shows that people who ate vegetables were protected against cancer.”

Let’s go through each criterion.

* Does it tell the position? YES.
* Does it tell what the evidence is? YES.
* Is it accurate? AS FAR AS WE CAN TELL, IT IS ACCURATE.
* Does it explain how the evidence supports the position? IT IS FAIRLY DETAILED, AND BECAUSE IT IS DETAILED, WE CAN SEE WHAT THE PROBLEM IS WITH IT.
  + FIRST, THE EVIDENCE IS ABOUT COLON CANCER, NOT CANCER.
  + SECOND, THE EVIDENCE IS ABOUT PREVENTING CANCER, NOT CURING IT.
  + THIRD, THE EVIDENCE IS ABOUT MORE THAN VEGETABLES. THE STUDY SHOWS THAT A COMBINATION OF VEGETABLES, FRUITS, FISH, AND OLIVE OIL PREVENTED COLON CANCER. NOT JUST VEGETABLES.

IT IS REALLY GOOD THAT THIS PERSON SPELLED OUT THE EVIDENCE CLEARLY SO THAT WE CAN SEE WHAT’S WRONG WITH IT. Now we can fix the argument to make it better.

The key point, once again, is that elaborated arguments allow us to evaluate the quality of scientific ideas. Elaborated arguments permit the public criticism that drives our ideas forward.

**Slide 7:**

This slide shows the argument with these problems fixed: “I think that eating a diet rich in vegetables, fruits, fish, and olive oil can help prevent colon cancer because I read a study about diet and colon cancer. It showed that people who eat the same diet as in Greece and Italy—lots of vegetables, fruits, fish, and olive oil—are less likely to get colon cancer than people who eat a diet with more meat. It might be important to eat all these foods, because people did not get cancer as much when they ate all these kinds of food.”

Let’s go through each criterion.

* Does it tell the position: YES.
* Does it tell what the evidence is? YES.
* Is it accurate? AS FAR AS WE CAN TELL, IT IS ACCURATE.
* Does it explain how the evidence supports the position? YES.

BECAUSE THE ARGUMENT WAS DETAILED IN THE LAST SLIDE, WE CAN USE THE EVIDENCE TO FIX THE MODEL. NOW THE MODEL AND THE ARGUMENT FIT WELL TOGETHER.

**Slide 8:**

*This is a critical point.*

*Elaborated arguments allow for open criticism, and ideas can be improved if they are not yet good enough.*

*And when the arguments are more elaborated, they are more understandable, and they are more persuasive.*

**Slide 9:**

Here’s another argument. What do you think about this. “I think that students with large feet are more knowledgeable than students with small feet because researchers have proved this in many studies.”

Let’s go through each criterion.

* Does it tell the position: YES.
* Does it tell what the evidence is? NO. JUST STATES THAT THERE ARE MANY STUDIES? WHAT KIND OF STUDIES? WE KNOW NOTHING.
* Is it accurate? WE CANNOT TELL WITH THE EXPLANATION PROVIDED.
* Does it explain how the evidence supports the position? NO.

This seems like a really bad argument, but because there is no information, it’s hard to tell why.

This argument looks silly, but lots of you wrote arguments like this in the Nucleus lesson essays. You didn’t elaborate the arguments. You just wrote. “I think Model A or B is better because of the study we read.”

**Slide 10:**

Try this one: “I think that students with large feet are more knowledgeable than students with small feet because I have two friends, and the friend with large feet knows a lot more.”

Let’s go through each criterion.

Does it tell the position? YES.

Does it tell what the evidence is? YES.

Is it accurate? NO. A SAMPLE SIZE OF TWO IS TOO SMALL TO TELL ANYTHING. It’s not good evidence.

Does it explain how the evidence supports the position? YES, BUT IT ISN’T ACCURATE, SO IT DOESN’T MATTER.

But because the person has written their argument in more detail, we can see what is wrong with it! That is really helpful.

**Slide 11:**

Give it one last try. “I think that students with large feet are more knowledgeable than students with small feet because researchers have done studies that show this. For example, one study showed that second graders have an average shoe size much smaller than ninth graders, and second graders performed worse on tests than ninth graders. This shows that bigger feet make people more knowledgeable.”

Does it tell the position? YES.

Does it tell what the evidence is? YES.

Is it accurate? YES, BUT….

Does it explain how the evidence supports the position? YES, BUT IT IS A FALLACIOUS ARGUMENT, OBVIOUSLY. THE REAL UNDERLYING FACTOR IS AGE, WHICH IS THE CAUSE OF BOTH LARGER FEET AND GREATER KNOWLEDGE. BUT,

Once again, we can work out the flaw in the argument because the argument was stated clearly and in detail. Clear arguments help us critique each others’ ideas better, and this helps us make better arguments, and choose better models.

**Slide 12:**

*These are the points that students should have understood through the practices conducted in class.*

**Slides 13 and 14:**

*Now have students do this activity in pairs.*

Here are two student responses to the nucleus essay: “Explain why your model is a good model. Explain what evidence supports the model and explain in detail how the evidence supports the model.”

Example #1: “The instructions model is better because of Evidence 2.”

Example #2: “The instructions model is better because of Evidence 2. In Evidence 2, they put the gene from the glowing jellyfish into the nucleus of a cat, and the cat produced the proteins that made the cat glow. This shows that the gene produced the protein.”

Very quickly, discuss in pairs which explanation is better and why. Use the criteria you just practiced.

The first one is typical of what many students wrote. The second one is of course much better.

**Slide 15.**

Students can also quickly consider which way of writing about criteria for good models is better. The second one is more detailed and helps the reader understand better what it does to “explain” better.

**ARGUMENTATION ACTIVITY PART 2**

Argumentation Activity Part 2 follows immediately after Argumentation Activity Part 1.

|  |
| --- |
| Some good points of this essay are (students may come up with others):  1. The student explains in detail how it meets the criterion of showing each step of the process (“by drawing arrows between each thing that happens in each of the three steps”).  2. The student clearly explains evidence 2 and explains how the evidence supports the model.  3. It says that the model is supported by “all the good evidence” that they read about.  4. The student writes about 3 pieces of evidence.  5. The student explains clearly why Evidence 4, which seems to contradict the model on the surface, should not be taken seriously.  6. It clearly tells what the student’s position (model) is.  A bad point:  1. The student doesn’t tell what Evidence 5 is, or how evidence 5 supports the instructions model. |

After students develop ideas in pairs, lead a short discussion in which you draw out the strengths and weakness above.