

## Designing Effective Projects: Teaching Thinking Examples of Teaching Thinking in the Secondary Classroom

### Teaching Thinking to Secondary Students

In the unit, [What's in Your Genes?](#), that uses the [Showing Evidence Tool](#), senior secondary students use their knowledge of biotechnology applications to influence legislation for or against its usage. At various points in the unit, there are opportunities for explicit instruction in the thinking skills students will need to complete the project.

In the opening activity, students discuss an Essential Question, Just because we can, should we? that raises ethical questions about medical science breakthroughs. Doing this requires the ability to predict the possible consequences of a medical treatment and to determine the ethical dimensions of those consequences.

### Thinking Skills Mini-Lesson: Predicting Consequences

#### Introduction

"An important skill is predicting the consequences of a particular scientific practice and thinking about the ethical implications of those consequences. You're going to have to do this for your projects, so we're going to start with suggestions about some ways to do this. "Let's talk about the idea of cloning pets. People who have beloved pets can now pay a lot of money to have their cat or dog cloned. To think about the ethical implications of cloning pets, we can follow these thinking processes:"

1. Why would this be a good thing?	<i>People can get very attached to their pets and are often devastated when they die. It would spare the people the heartbreak of losing a beloved pet and make them happy by letting them have the same pet virtually as long as the person lives and can afford to have it cloned.</i>
2. What doesn't science know about this practice yet?	<i>We don't know how long, in general, the pets will live We don't know what kinds of health problems cloned animals would have.</i>
3. What if the practice: <ul style="list-style-type: none"> <li>• Was only affordable by the very rich?</li> <li>• Was easy and cheap and everyone could do it?</li> <li>• Was not regulated by the government or some other group?</li> </ul>	<i>People could just clone the animals they liked and then nobody would adopt kittens and puppies. People could let their pets die (or even kill them) when it was convenient because they could have a duplicate made whenever they wanted.</i>
4. What are some things that people might not know about the topic?	<i>A cloned animal would not be exactly the same as the original one. It just has the same genes.</i>
5. Is there a slippery slope with the technology?	<i>Cloning animals could be a step to cloning humans which most people believe is a really bad idea.</i>
6. Does it violate any fundamental ethical beliefs?	<i>Some people think it's wrong to artificially create life.</i>

"Can anyone think of any other questions we could ask about a scientific breakthrough that would help us consider the ethical dimensions of a scientific breakthrough?"

“Now, I’d like you to work through these 5 steps with a partner on the subject of organ transplants.”

The teacher coaches students as they work with the questions for 5-10 minutes. After they complete the activity, they have a discussion.

The teacher asks students the following:

“Did you need to change any of the questions in order to make more sense of the organ transplant topic? What kinds of topics might require different kinds of questions? Would these same questions work with issues that were national rather than personal, like adding chemicals to water? How might you change the questions with different kinds of topics?”

Finish the lesson by asking students to choose a topic for their project and use the questions to think about the ethical dimensions of the scientific breakthrough they select.

### Thinking Skills Mini-Lesson: Determining the Credibility of an Internet Source

“Everyone knows that all kinds of information can be found on the Internet. Some sites may look authentic yet contain bad information, while others, may be less flashy but prove to be a valuable resource. Here are some steps you can follow to help determine how credible a Web site is. I’m going to model following these steps with the Web site, [www.clonaid.com/news.php](http://www.clonaid.com/news.php)”

1. Read the URL carefully. Look for edu, gov, org, or com.	<i>This URL has a “com” in it so that means it is a business. That means it’s probably biased because they’re going to try to sell me something.</i>
2. Look for links such as, About Us, History, or Mission, that tell you about the organization behind the Web site.	<i>The History button says that this company is headed by a person with Ph.D.s in physical and biomolecular chemistry, but it doesn’t say where she got her degree. She was a marketing director for a chemical company. That makes me wonder if this is more about marketing than science. The page also says that they moved from the Bahamas to where cloning is legal, but it doesn’t say where they are now. That sounds pretty suspicious.</i>
3. Look for the last update.	<i>The only thing I can find that’s anything like a date is a letter to UN representatives of the 59<sup>th</sup> General Assembly which is 2004-2005, I think. I don’t see any dates on any other information.</i>
4. Look for links and documentation of information.	<i>There is a lot of information that sounds scientific, but I don’t see any place that tells where this information comes from.</i>

“Now I’d like you to look at one of the following two Web sites and discuss them with a partner using the four steps.”

[www.humancloning.org/](http://www.humancloning.org/)\*  
[www.ornl.gov/sci/techresources/Human\\_Genome/elsi/cloning.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/elsi/cloning.shtml)\*

The teacher coaches students as they look at the Web sites and evaluate them. After a few minutes, they discuss how the process worked for them.

The teacher asks:

“How did the steps work for you? Did you come to a conclusion about the site from thinking about those topics? Did you change the steps at all to make them work better for your site? When might you use this strategy?”