

PBL Unit Title: The Bottom Line

Primary Subject Area: Genetics

Interdisciplinary Areas also Covered: Language Arts, Math, and Science

Grade/Age Level: 7th Grade

Description of students' role and problem situation: Students become the stakeholders when they assume the role of key employees at a fictitious biotech company, Genes R Us. Stockholders are clamoring for a new line of services in order to improve the company's bottom line. The major stockholder, Mr. Cash Grubber, sends in a newspaper clipping about "CC" as a suggestion for the direction Genes R Us should take which includes cloning cats.

Educational Objectives: (Indicate if unit is interdisciplinary, but only list the objectives from primary subject area)

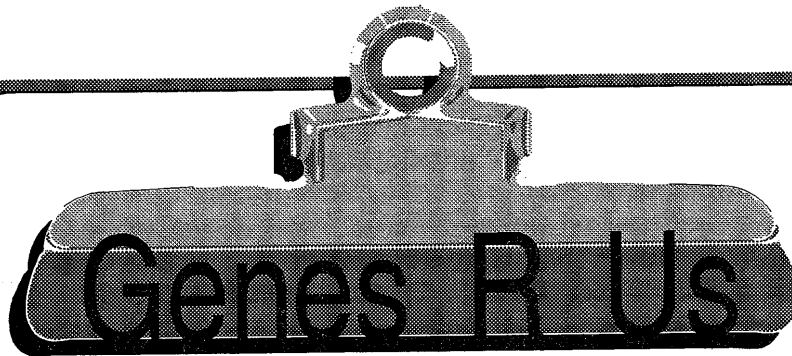
- 2.01 Analyze structures, functions, and processes within plant and animal cells.
- 3.01 Explain the significance of chromosomes, genes, and DNA in cell reproduction and their relationship to inherited characteristics.
- 3.05 Analyze the issues raised by selective breeding and biomedical research.

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School Name: West Cary Middle School

School Location: Cary, North Carolina



Better Living Through Genetics

INTER-OFFICE MEMORANDUM

West Cary Facility - 1000 Evans Rd. - Cary, NC 27513
919-460-3528

TO: Dr. Ima Greeble
Chief of Research and Operations

From: Dr. Ed Beancounter
Chief Executive Officer

Date: June 3, 2002

Re: Bottom Line

As you know, the stockholders have been quite vocal in their dissatisfaction with our past three quarterly financial statements for our facility. We simply must find a new market for our genetic services.

The majority stockholder of Genes R Us, Mr. Cash Grubber, has sent me an interesting news article. Since it covers areas closely related to our present capabilities, I am forwarding it to you for ideas for a new market for our services. Please assemble a planning team, which will include the company ethicist, research scientists, medical staff, accountants, legal experts, physical lab facility representatives, and anyone else you think should be included to consider the direction and feasibility of cloning services at Genes R US.

The Executive Board will meet during the annual stockholders' meeting on June 13, 2002 at 5:30 PM in the Richardson Room. I would like for your team to present its recommendations at this meeting.

Company reports successful cat clone

By GINA KOLATA
THE NEW YORK TIMES

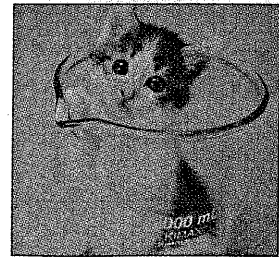
Scientists in Texas have cloned a cat, opening the door to what some expect will be the first large-scale commercial use of cloning — to reproduce beloved pets.

The effort was supported by Genetic Savings & Clone of College Station, Texas, and Sausalito, Calif., a company that wants to offer cloning to dog and cat

owners. It is investing \$3.7 million in the project.

The work will be published in the Feb. 21 issue of *Nature*, a British science journal, but the journal released the paper Thursday because the result, although not the details of the study, had become public. News of the company's success was reported Thursday in *The Wall Street Journal*. It was, some said, long expected.

"The commercial future of cloning is absolutely in animals," said Dr. Arthur Caplan, an ethicist at the University of Pennsylvania. "To put it bluntly, human cloning will turn out to be of interest only to the vain or the desperate, and companies know this. There is no commercial company that I'm aware of that is really interested in human cloning.



cc, above, is a genetic copy of a female laboratory cat.

PHOTO COURTESY
OF GENETIC SAVINGS & CLONE

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CLONE

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But on the animal side, there is tremendous interest."

There is also opposition, as well as ethical questions.

The Humane Society of the United States issued a statement Thursday objecting to the cloning of pets because "it serves no compelling purpose, and it threatens to add to the pet overpopulation problem."

Caplan said he had two concerns. "Are you preying on grief and desperation that pet owners often have when they lose a pet to promise them something more than cloning can deliver?" he asked.

And, he added, if cloning creates animals that suffer and die young, can it be justified? Some cloned animals have grown up and appear to be perfectly normal, but others have died in infancy of severe medical problems such as lung and heart defects. A variety of animals, including sheep, goats, cows, mice and pigs, have been cloned.

The cloned cat, called cc, for Carbon Copy, is a genetically identical copy of a 2-year-old female laboratory cat, Rainbow, that was not anyone's pet. But Rainbow and cc do not look alike, illustrating that identical twin cats may not have identical coats.

The reason, said Dr. Stephen O'Brien, a cat geneticist at the National Cancer Institute in Frederick, Md., is that coat color in cats is determined by the way the color-containing cells separate and replicate during embryo development, a process that is only partially genetically determined.

Dr. Duane Kraemer, one of the cat-cloning team members and a pro-

fessor of veterinary medicine at Texas A&M University, said he is glad the clone does not look like the original. "We've been trying to tell people that cloning is reproduction, not resurrection," he said. "This is a good demonstration of that."

Researchers at Texas A&M, led by Dr. Mark Westhusin, slipped cells from adult cats into cat eggs from which genetic material had been removed. When cloning works, the adult cell takes over the development of the egg, using its genes to direct the development of an embryo, then a fetus, then a newborn that is a genetic match of the adult that provided the original cell.

The cat-cloning project failed at first, when researchers used cells from a male cat, but it succeeded on the second try with Rainbow's cells. In the end, researchers transferred 87 embryo clones to surrogate mothers and got one live kitten, cc. She was born Dec. 22 and is healthy and normal, the researchers report. The success rate was comparable to cloning success rates for other species.

But the company's dog-cloning project, which began several years ago and is directed by the same researchers, still has not succeeded, Kraemer said. One reason, he explained, is that scientists have much more experience working with cat eggs and embryos. Dogs, he said, are much more difficult to clone.

Unlike cats, which ovulate when they are mated, making it easy to time the production of eggs, dogs are unpredictable. They "ovulate whenever they get around to it," Kraemer said. And unlike other mammals, dogs excrete immature eggs from their ovaries, making it hard to obtain the mature eggs needed to start the cloning process.

"For some reason or other, when we try to mature their eggs in the laboratory, it doesn't work," Kraemer said. "Cat reproduction is just a lot more cooperative."

Lou Hawthorne, the chief executive of Genetic Savings & Clone, said cat cloning was almost an afterthought for the company.

"We had thought this was something that mostly dog owners would be interested in," Hawthorne said. But, he added, after the company heard from thousands of pet owners and did some market research, it realized that the cat-cloning market could be huge.

For now, Hawthorne said, the company is storing tissue from cats and dogs, for a fee, so that owners can try to have their pets cloned in the future. And it will consider trying to clone the cats of carefully selected customers.

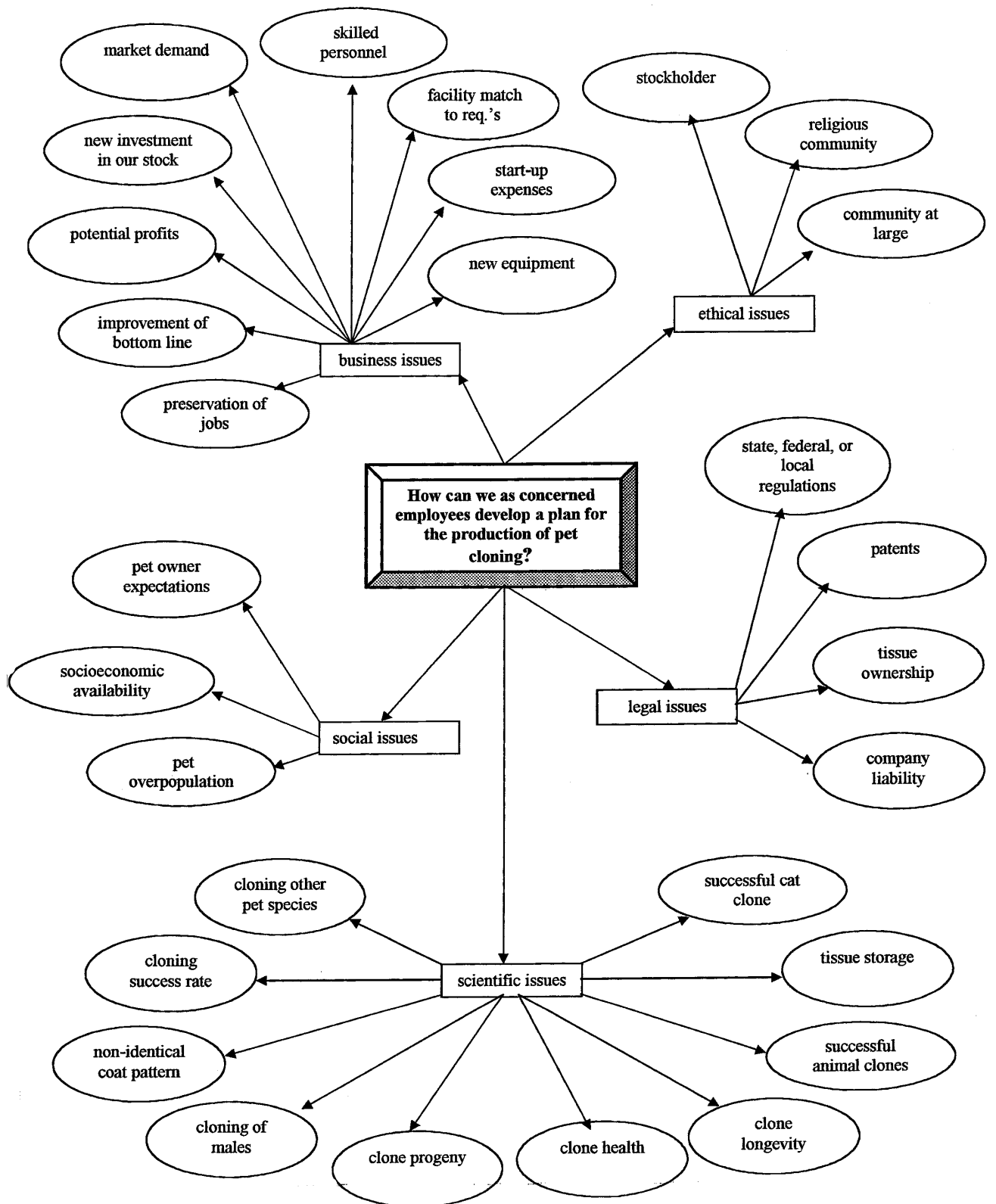
"They will have to understand that we are in a research mode for at least the next year," he said. "They will have to be patient and realize that they would be expected to bear some of the research costs," he said. Hawthorne said he could not estimate what cat cloning would cost.

Cloning experts say that if their experience is any guide, Genetic Savings & Clone will not lack for interested pet owners.

Dr. George Seidel, a cloning researcher at Colorado State University, said he has heard from pet owners from the very start, even though he cannot help them.

He remembers one woman who called him about her cat, named Stinky. "Stinky had died and she had put it in her freezer three weeks earlier," Seidel recalled. "She asked me what we could do. I said, 'I don't think you've got any hope there. Take Stinky out of the freezer and bury it.'"

Problem Map



Sample Know and Need to Know Boards

What We Know

Scientists in Texas have successfully cloned a cat

Genetic Savings and Clone has invested \$3.7 million in dog and cat cloning project

Dr. Arthur Caplan stated that there is tremendous interest in commercial cloning of animals

Cloning pets raises ethical issues:

some cloned animals have suffered and died in infancy of severe medical problems such as heart and lung defects

may add to pet overpopulation problem

May not serve purpose to which it was intended-replicate a beloved pet

Sheep, goats, cows, mice and pigs have already been cloned.

The cell donor, Rainbow, does not look like her genetic copy, Copy Cat, a.k.a. "cc"

Coat color in cats is only partially genetically determined. The way the color containing cells separate and replicate during embryo development in utero are events not totally controlled by genetics.

In cloning, genetic material is removed from the cat egg cells and replaced by genetic material from an implanted adult cell. The adult cell's genes take over control of the egg's development through embryo, fetus, on to the newborn which is genetically identical to the adult which donated the implant cell.

Cells from a male cat failed on the first try; cells from the female, Rainbow, succeeded on the second try.

87 embryo clones were transferred to surrogate mothers; only one live kitten, cc, was born.

This success rate is comparable to cloning success rates for other species.
cc. is healthy and normal

What We Need to Know

Has cloning been tried on other pets besides dog and cats? If so, what is the success rate?

What are the laws that govern cloning?

What are the ethics in selling a clone that may not appear to be identical to the original pet?

Are clones identical in every way to the original?

Is it even ok to clone animals at all?

Is it ok to create living things that may suffer and die in infancy?

What about the embryos that don't make it?

What are the long-term effects of cloning on the health and well being of the cloned animal?

Is there a way we can manipulate the separation and replication of the color-containing cells to produce an identical coat?

Do we have the kind of specialized personnel we will need on staff to do this?

How much will it cost to hire and retool our lab and production facility for this venture?

Does the cat tissue donor have to be female?

Is this type of enterprise going to bring PETA and other such organizations down on us?

Does G S &C have this market tied up already?

That's the West Coast, is there enough interest in this sort of thing here in the East?

What about our so-called Bible Belt?

Genetics Savings and Clone has not been successful in their cloning attempts with dogs.

Cats ovulate when mated so that timing production of eggs is easy.

Dogs ovulate unpredictably and also excrete immature eggs from their ovaries.

Mature eggs are needed to start the cloning process.

Laboratory attempts to mature dog eggs have been unsuccessful.

Genetics S & C has done market research and realized the cat-cloning market could be huge.

Genetics S & C is storing cat and dog tissue for a fee, for owners who want to try to clone them in the future. G S & C will consider trying to clone cats from selected customers.

No estimate from G S & C as to cost of cat cloning.

Another cloning researcher, Dr. George Seidel at CSU, has also been contacted by pet owners even though he is not in the business.

Should we concentrate on research for dog cloning instead of cat cloning?

What's involved with tissue storage?

Who owns leftover tissue and embryos?

Has G S & C been sued or involved in any legal actions taken by their customers? What kind of liability is involved?

Should we survey the stockholders before we do anything to see if they have any ethical reservations about our company doing something like this?

Wouldn't it be better to encourage people to adopt some of the animals that already exist instead of creating clones for wealthy people?

Is this too creepy-too much like playing God for average people to stomach? What if they start a campaign against our company and organize a boycott of all our products and services?

What exactly does Genes R Us do?

Can cloned animals reproduce normally in the natural way? Are their offspring (children) normal? Can their offspring produce healthy progeny (grandchildren)?

What does Genetic Savings and Clone Charge for an attempt? Does that include all charges till a healthy clone is produced?

What about the surrogate mother pets?

Are there any patents on this that will affect what we plan to do?

Curriculum Alignment

Three objectives from my major area of 7th grade science:

- Competency Goal 2, Objective 2.01 Analyze structures, functions, and processes within plant and animal cells
- Competency Goal 3, Objective 3.01 Explain the significance of chromosomes, genes, and DNA in cell reproduction and their relationship to inherited characteristics
- Competency Goal 3, Objective 3.05 Analyze the issues raised by selective breeding and biomedical research

At least three objectives from interdisciplinary areas:

Language Arts: Competency Goal 1: The learner will use language to express individual perspectives in response to personal, social, cultural, and historical issues.

(1.03) Interact in group settings...

Competency Goal 2: (2.01) Respond to informational materials that are read, heard, and/ or viewed....

(2.02) Develop informational products and/or presentations that use and cite at least three print or non-print sources....

Mathematics: Competency Goal 1: (1.08) Analyze and select appropriate operations, models, strategies and methods to solve a variety of multi-step problems using positive rational numbers, integers and their inverses. Use calculators and computers where appropriate.

Five significant learner characteristics listed:

- critical toward society
- refining reasoning skills
- beginning to understand abstract concepts
- care about their personal situation
- technologically oriented
- want what is real
- impressed with making large amounts of \$\$, large dollar amounts in general

Sample Problem Statement

How can we as concerned employees of Genes R Us, develop a plan to offer pet cloning services by June 13, 2002?

How can we as concerned employees of Genes R Us, develop a plan for the production of pet cloning services, by June 13, 2002?

How can we as concerned employees of Genes R Us, determine whether we should offer cloning services of any kind, by June 13, 2002?

How can we as concerned employees of Genes R Us, determine the feasibility of offering pet cloning services, by June 13, 2002?

Additional Conditions:

- includes a close estimate of start-up costs and best estimate of return anticipated from this investment within a specified time frame.
- is legal in all U.S. States
- includes feasibility and close estimates of success rates for pet cloning
- indicates or makes recommendations for or against specific pets to be cloned
- includes surveys or other market analysis which indicate positive or negative reception to our new services of pet cloning

Resources

BOOKS

Cronkite, Donald. (2000). Cells and Heredity. Needham, Massachusetts: Prentice Hall.

HUMAN RESOURCES

Dr. Joseph W. Polli, Research Scientist, Glaxo/Wellcome, RTP, NC.

West Cary PTSA volunteer list, Teachers Workroom, West Cary Middle School, 1000 Evans Road, Cary, NC 27513

NEWSPAPER ARTICLES

Company reports successful cat clone. (2002, February 15). The News & Observer, p. A1.

Funding delayed for scientist's lab. (2002, May 15). The News & Observer, p. B3.

VIDEOS

The Discovery Channel School. (1999). Assignment Discovery Series. The Clone Age [Video]. (Available from Discovery Channel Education, Division of Discovery Communications, Bethesda MD.)

The Discovery Channel School. (1997). Assignment Discovery Series. Genetics [Video]. (Available from Discovery Channel Education, Division of Discovery Communications, Bethesda MD.)

Schlessinger Media. (2001). The Human Body in Action Series. Genetics and Heredity [Video]. (Available from Library Video Company, P.O. Box 580, Wynnewood, PA 19016)

WEB SITES

Bridges, Andrew. Likely explanation for clone deaths emerges. (2002, May 26). newsobserver.com @ <http://newsobserver.com/24hour/science/v-print/story/414704p-3304040c.html>

Genetics Savings and Clone Pet Division. (2000). http://www.savingsandclone.com/company_location.cfm?div=Pets

The Gene Scene, All About Cloning. <http://ology.amnh.org/genetics/cloning/index.html>

Genetic Science Learning Center. <http://gslc.genetics.utah.edu/>

The Missyplicity Project. <http://www.missyplcity.com>

Capstone Performance Description

The PBL Problem: How can we as concerned employees, develop a plan for the production of pet cloning for presentation to the Executive Board by June 13, 2002?

Conditions include, but are not limited to: start-up costs, a close estimate of \$ for anticipated return on investment within specified time frame, legality and ethics, feasibility and success rates, recommendations for or against specific pets to be cloned, surveys/market analysis.

How Students Will Share the Solution to the Problem: The students play their roles of employees at Genes R Us, a fictitious biotech company whose motto is "Better Living Through Genetics." In character they will present their plan for the production of pet cloning to the Executive Board of Genes R Us during a stockholders' meeting. Prior to presentation planning, the students will have copies of the assessment rubrics that will be used by the Board members, the teacher, and by themselves and their group members. The students must decide the best way to present their solutions. Some of the components must be oral. Other components of the presentation may include charts and graphs for costs and survey results shown on the overhead or on a flip chart, power point/HyperStudio, copies of written financial reports, etc.

Since drama and role-playing are critical to the Capstone Performance, the setting requires special attention. The classroom tables have been arranged in a half circle with name placards at each seat. The permanently affixed demo table at the front of the room is disguised with a tablecloth. A flower arrangement is strategically placed to camouflage the demo faucet; the ring stand has been stowed out of sight. A tray holding a water pitcher and a stack of white paper cups rests to one side of the table podium with microphone (borrowed from the drama teacher). The board says "Welcome to the 5th Annual Genes R Us Stockholders Meeting." A photocopy of the meeting agenda is at each place. The Executive Board sits to one side of the room at its own covered table with placards, small flower arrangement, and water tray. Presenters sit to the other side of the room at their uncovered tables with placards. Stockholders sit at their placards behind these in the half circle. Other props will be required by the student presenters according to their plan for presentation. Students will make arrangements well in advance with the teacher to get overhead projectors, VCR players, or whatever they require for their presentations.

Close attention to the roles and the players must be paid. The Executive Board members recruited from the PTSA volunteer list should include people who possess some knowledge in the following fields: business, accounting, marketing, legal, veterinary, biotech, scientific research, genetics, SPCA, and religion or ethics. Depending on their field of expertise, each will be given a rubric to use to assess the students' presentation. The roles of Mr. Cash Grubber, majority stockholder; Mr. Ed Beancounter, Chief Executive Officer; and Dr. Ima Greeble, Chief of Research and Operations each have a few lines to be spoken in order to run the meeting, but do not have to be played by adult volunteers.

The student presenters will be playing roles appropriate to their group positions. People who functioned in business, marketing, accounting, legal, and ethical roles should "dress the part" by wearing ties, skirts, or business casual as appropriate to the individual. Scientific and medical types could wear lab coats or business attire. Students playing other roles should remember to dress as an adult in that role would dress. Student presenters will also be filling out self-assessment and group assessment after the performance.

Stockholders can be recruited from other classes on the teacher's middle school team. For example, the third period math class may attend the third period science class presentation. In any case, everyone present in the class during the presentation is a stock holder and will have a vote in deciding whether or not Genes R Us will adopt the production plan for production pet cloning services as presented by the student group. The voting process could be by a show of hands or could be developed into an assessment by use of a ballot with questions on it.

The teacher's role during the presentation is to be the invisible background observer. She /he will be assessing the performance of the student presenters according to the Capstone Performance Rubric for The Genes R Us PBL.

Capstone Assessment Instrument		
Criterion	Best Performance	Mediocre Performance
Visual aids are:	Appropriate to the purpose	Some not well matched to purpose
	Clear/easy to read	Some not clear/easy to read
	In sufficient quantity	Not enough present for purpose
	Grammatically correct	Contains 2 to 3 errors
	Spelled correctly	Contains 2 to 3 errors
	Business-like in appearance	Some do not appear businesslike in appearance
	Accurate as to content	Contains 1 to 2 inaccuracies
During oral presentation, speakers	Speak clearly	Some speech inarticulate
	Stay in character of their role	Had 1 or 2 lapses into middle-school behavior
	Are dressed appropriately for role	One or two non-business clothing articles, etc.
	Use only standard, business-like or professional language	Used slang 2 to 3 times
	Maintain audience eye contact	Sometimes maintained audience eye contact
	Make no distracting gestures	Some squirming, hand motions, hair twirling, etc.
	Correctly use visual aids	Did not seem to understand visual aid purpose once or twice
Presentation organization	Captures interest during introduction	Has an introduction
	States and explains problem	Problem stated with some explanation
	States and explains solutions	Solution stated with some explanation
	Provides procedure for fielding questions	A clear procedure not in evidence
	Provides closure	Closure present, but not clear
Evidence of content comprehension	Authentic problem statement	Authentic problem statement
	Questions answered correctly	Most questions answered correctly
	Explanations contain accurate information	Explanations contain mostly accurate information
	Information can be verified	Could not support claims once or twice
	Solution is viable and fact-based	Solution is viable with only a few supporting facts
Evidence of teamwork	Assigned equally active roles in the presentation to each member	One or two people do not seem to be involved
	Perform as a cohesive team	One incident occurs (squabbling, dominating, etc.)

Sample Coaching Questions

Key to Question Type: C = cognitive, M = metacognitive, E = epistemic cognitive

Meeting the Problem:

- C What are some of the types of job at Genes R Us?
- M What are some strategies you could use to define the problem?
- E What do you think will happen to you as employees if you don't develop a plan to develop a new market for Genes R Us? (evaluate and judge things not readily in evidence)

Know / Need to Know:

- C Has Genetic Savings and Clone successfully cloned a dog?
- M What could you do or where could you go to find out what Genetic Savings and Clone does about the surrogate pet mothers?
- E What are the ethics in selling a clone that may not appear to be identical to the original pet?
- E Is it even okay to clone pets at all? Why or why not?

Writing Problem Statements:

- C To whom must you present your recommendations?
- M Why do you think the problem you've written is the one to choose to do. (make thinking visible)
- E How do you feel about what you're proposing to do in the problem statement? (must define what "good" or "bad" means)

Information Gathering and Sharing:

- C How can you verify the success rate for cat cloning? (show where the facts are stated)
- M How did you decide who is going to do which job?
- M Now that you know that a cat clone's coat pattern and color are not always identical to the original, does this change your thinking about cloning?
- E Why do you think pet cloning is a valuable service to society? (must define "valuable")
alternate question: Why do you think pet cloning is not a valuable service to society?

Generating Possible Solutions

- C How much will the capital investment be in this solution?
- M What are some of the strengths and weakness of your solution to clone only cats? (analyze)
- E How do you think the consequences of our pet cloning service will affect our community? (make judgment because of the consequences)

Alternative Solutions Rudimentary Document

One possible solution that students may proffer would include words to the effect that Genes R Us will offer cat cloning services.

Pros	Cons
Market surveys show positive response to this service- lots of potential customers	Past surveys on other things have taught us that what people say they will do now is not always what they will actually do later
Our present animal research facilities will require minimal capital investment	It may be difficult to find homes for the surrogate mothers
We know it can be done because Genetic Savings and Clone has already done it.	It took 87 embryo implants to produce one live kitten
Grieving cat owners could have a replica of their beloved pet	Very high probability that cloned cat's coat color and pattern will be different from the original cat

Consequences: Since the projected cost per cat clone is anticipated to stabilize around \$20,000, this service will only be affordable to wealthy grieving cat owners.

With 87 surrogate mothers per attempt available for adoption, cat cloning services may add to the pet overpopulation problem.

Another possible solution that students may proffer would include words to the effect that Genes R Us should not offer pet cloning services of any kind.

Pros	Cons
This requires no capital or personnel investment	The downward trend of our bottom line will continue
This will not offend the beliefs of animal rights and or religious groups	Some other company will do it and realize all the profit
This decision will release us to explore other markets for expansion for our genetic services	Potential for valuable knowledge or spin-offs discovered in research for pet cloning will be lost
Not cloning will preserve genetic variation in pet species	Special characteristics of a unique pet will be lost

Consequences: Lay offs at Genes R Us will contribute to the unemployment problem.

Because not pursuing a hugely profitable line of business goes against the American mindset, many people will examine their own beliefs about cloning.

My preference is that Genes R Us would not offer pet cloning services of any kind. My reasons reflect my personal values. I strongly believe that cloning would be done only for therapeutic reasons, not for the reproduction of individuals, animal or human, which are genetic copies of the original. Genetic variety is extremely important to the survival of any species. I fear that if we clone animals for agricultural reasons or to replace lost pets, we will circumvent this nature process. What would happen if a plague were to hit a population that had no genetic variety and therefore, no possibility of having a "wild" gene that confer resistance?

In addition, I think we have a duty to educate the public about how a clone can never be an exact copy of the original. The clone would have the same genetic code, but it could never experience the same environment and conditions as the original. These are just as important as the genetic code in the formation of an individual. I agree with the researcher in the article when he commented that he thought it was fortunate that the clone, cc, does not look like the original cat, Rainbow, even though she is genetically identical to Rainbow. The dissimilar appearance should help people to understand that cloning is not resurrection.

Rudimentary Rubric for Debriefing Session

Review of Student Generated Solutions:

Student groups present their solutions orally to the stockholders (classmates) and the Executive Board of Directors (panel assembled from professionals on the PTSA volunteer list and from teacher contacts in the community) during a mock meeting of the board and the stockholders of a fictional company, Genes R Us. Everyone will hear each group's solution presentation and see its visual aids.

Rating of Solutions:

As each group presents, predesignated group members record the pros, cons, and consequences of their solution onto chart-sized Post It sheets. Each group has its own set of sheets. These charts remain posted under a chart of the written solution statement on the chalkboard at the front of the room where everyone can see them. Each group has prepared the solution statement in advance and has practiced the order of posting on the pros, cons, and consequences. The person who has been designated by the group moderates by directing questions from the board and stockholders to the appropriate "expert" group member.

One Best Solution:

When the group presentations are complete, Mr. Ed Beancounter (student), CEO of Genes R US, calls for a vote by hands on the solutions. Each person present has a vote. There will be runoff voting until only one solution remains. To this solution, Mr. Beancounter will call for and add components from other solutions that are suggested by the stockholders and the board to the Post It sheets on the board. Alterations to the chosen solution may also be made as well as deletion of some of its components. The process concludes when one "best" solution has been formulated by class participation. Mr. Beancounter may write the formulated solution onto its own Post It sheet as necessary.

Coaching by Teacher:

The teacher has been "invisible" up to the point when Mr. Beancounter begins to write revisions to the "best" solution. At this point she/he may need to raise her/his hand to ask coaching-type questions about issues or concerns that need to be addressed for the solution that is being amended. It is really important that the teacher has asked the kinds of coaching questions during the PBL process so that ethics have been considered and the accuracy of the scientific content and business practices has already been checked and accounted for. If not, then such issues will have to be addressed now in such a way that the students resolve the issue. The teacher should make a note of these for the next time the PBL is done.

Most likely, the coaching questions will be specific to the consequences of the "best" solution, which has been formulated by the class. The consequences will depend on the solution. If the solution includes some form of producing pet cloning services at Genes R Us, then questions concerning the ethical treatment of the animals involved as well as impact on our society must be asked. What kind of effect will our company's decision have on society? Where will this decision take us? Coaching questions for any type solution should be framed to elicit thinking about consequences and suggestions about them from the students.