Cornell Institute for Biology Teachers

Lab issue/rev. date: 6/27/2011

Title: **HIV Transmission**

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Appropriate Level: Life Science, High School, Honors, or Advanced Placement Biology

Living Environment: **1-Inquiry, Analysis, Design:** 1-Purpose of scientific inquiry:1.1c; 3-Analyzing observations: 3.1, 3.3 **4-Living Environment:** 5- Dynamic Equilibrium: 5.2b, 5.2h

Abstract: This activity can be done easily in a classroom setting. The materials are readily available and are safe for students to handle. Role playing is involved and every student takes an active part. It's FUN! ("Awesome" is the word my 10th graders used!) This is the best way I can imagine to introduce such a sensitive/vital issue in a non-embarrassing way and still get the message across: the HIV virus is transmitted by sharing body fluids, there are specific high risk behaviors, and what you **choose** to do is the greatest determining factor in whether or not you contract the disease. There is a concern that has been expressed by some teachers that this subject needs to be dealt with in a way that all students can feel comfortable. In some schools there may be HIV positive students and many students have personal experience with friends and relatives who are HIV positive.

Time Required: One, or more, 45-minute periods depending on how much discussion you choose to include.

Special Needs: Test tubes, transfer pipettes, silver nitrate solution, sodium chloride solution

Teacher Information

Technical information

There are many different ways of setting up this activity. We describe several different ways and we encourage you to submit others to us.

The Simple Test Tube Method

Set up a test tube rack containing the same number of test tubes as the number of students in the class. (Any container that is easy to pour from is good, but the clear test tubes or 15mL capped tubes are especially good because it is easy to see the silver nitrate reaction.) Fill **one** test tube with a solution of sodium chloride. (Somewhere around a 10% solution is good, but this is not an exact science. The teacher should test the solution to make sure it produces a positive reaction after 5-8 transfers.) This test tube represents the body fluids of an HIV infected person. Fill the other test tubes with **distilled** water (the chlorine in tap water reacts with the indicator, silver nitrate, giving a false positive). Prepare a dropping bottle of silver nitrate solution to serve as the HIV test. **Care must be taken when using silver nitrate.** Make a mental note of who picks up the "special" test tube when the game begins. You may want to make sure that the person who gets the "special" test tube has a behavior card that promotes the spread of HIV virus. Students will share "body fluids" by pouring some liquid from their test tube into the test tube of the person with whom they are sharing "body fluids". The other person will pour some of his liquid back into the test tube of the first person.

Make up a set of role cards (3 x 5 cards each identifying the behavioral role that will be assumed by a participant). You must have one card for each student (a class set). Students **should not** be told who "has" the HIV virus.

The Vial and Role Package

If you have access to culture tubes, they make great containers to hold the "body fluids" and a slip of paper with the "role." You can make a sleeve on the culture tube with tape and hang on it a cut out folded "role." This has the advantage of you being able to choose the "role" for the first HIV infected person.

Here are some of the commonly used roles:

"You practice abstinence": You choose not to exchange body fluids with any other person.

"You are heterosexual and monogamous": You exchange body fluids only with your spouse. (Your spouse is a person of the opposite sex that you choose to marry - the first and only person with whom you exchange body fluids.) You need to exchange body fluids with your spouse at least twice before the end of the activity.

"You are heterosexual and promiscuous": You exchange body fluids freely with as many other persons of the opposite sex as you can.

"You are a prostitute (male or female)": You share body fluids with other persons in exchange for money (assume anyone who asks has the money to pay for your "time").

"You are gay and promiscuous": You exchange body fluids with other persons of the same sex (male). Note: female-to-female transmission has been only rarely documented.

"You are gay and monogamous": You exchange body fluids only with your partner of the same sex – the first and only person with whom you exchange body fluids. You need to exchange body fluids with your partner at least twice before the end of the activity.

"You are bisexual": You exchange body fluids with other persons, both male and female.

"You are an intravenous drug user": You exchange body fluids with other persons when you share contaminated needles. Because the drugs reduce your inhibitions you are more likely to share body fluids with anyone.

"You are a steroid abusing athlete": You share body fluids with other persons when you use contaminated needles.

"You are an alcohol abuser": You are more likely to share body fluids with other persons because alcohol reduces inhibitions.

HIV Testing

Allow sufficient time for the exchange, test each student by adding a drop of silver nitrate to each test tube. The teacher will assume the role of the doctor and administer an HIV test to each student at the end of the activity (the doctor may want to wear a lab coat, rubber gloves, and a stethoscope). A white precipitate indicates a positive test; no precipitate is a negative test.

Other solutions may be used: phenolphthalein in the "HIV positive" test tube (test with sodium hydroxide, the positive result is a bright pink solution); a glucose solution in the "HIV positive" test tube (test with Benedict's solution or test tape).

Class Discussion

Before tabulating the results of the test, have students speculate about the types of behavior most likely to result in an HIV+ test.

After getting results from the "HIV Test," students try to figure out lines of transmission.

The chart in the student handout should be reproduced on the chalkboard. Determine the numbers of students for each behavioral role and the number of "HIV positive" students for each behavioral role. The students then can assign risk levels for each behavior.

The students can do an epidemiology study to trace the route of infection back to the original source.

Class discussion topics may include:

How is the virus spread?

Who is at risk?

Who is not at risk?

What can we do to protect ourselves?

How can we get this message to others?

Teacher Comments

I recently did this activity with my Regents Biology class under the unit on blood. I judged it to be a great success. I haven't received any complaints from irate parents, but just to be safe I discussed with my principal ahead of time what I intended to do, and she approved wholeheartedly. No moral judgments, no lectures - just information and the opportunity to ask questions. So far I've only received very positive feedback from students.

Suggestion

The next day in class repeat the activity, only this time all of the role cards say "Your choice: Whether you choose to exchange body fluids with any other person or not is your decision."

It may also be powerful to run the activity in the context of Sub-Saharan Africa or Southeast Asia, areas where HIV prevalence reaches almost 1/3 of the population. The role cards would reflect the culture in which you have chosen to set the activity. For example, in many parts of Asia the spread of HIV is primarily through prostitution, and in Africa there is a high incidence of mother-to-child transmission. In either case instead of only having 1 "infected" student at the beginning of the activity up to 1/3 of the class would carry the HIV virus. This would help to demonstrate how HIV has become a raging epidemic in parts of the world.

Depending on your classroom situation, you may wish to change the type of virus being transmitted to either a different real virus/disease or a disease that you have completely made up. For example, you could use different hand washing criteria as "roles" that influence the spread of a cold or talk about what may be different about the HPV (human papillomavirus) - males do not know they have it and cannot be tested.

If you would like to attempt to keep track of the epidemiology of the disease, you can use the "dance card" on the next page. The epidemiology can become confusing very quickly, so we do not recommend allowing your students more than three exchanges. Also, it can be useful (although not realistic), to have your students transfer 1 ml of their bodily fluids to a tube after each exchange for later testing.

Your Name:		Your Role:	
	Partner Name	Your number on partner's card	Sample infected?
1			**Yes/No**
2			**Yes/No**
3			**Yes/No**

Your Name:		Your Role:	
	Partner Name	Your number on partner's card	Sample infected?
1			**Yes/No**
2			**Yes/No**
3			**Yes/No**

HIV Transmission

New York State Learning Standards

Standard 1: Inquiry Analysis and Design

Key Idea 1: The purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.

1.1- Elaborate on basic scientific and personal explanations of natural phenomena and develop extended visual models and mathematical formulations to represent one's thinking.

1.1c- Science provides knowledge, but values are also essential to making effective and ethical decisions about the application of scientific knowledge.

Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena.

3.1- Use various methods of representing and organizing observations (i.e., diagrams, tables, charts, graphs, equations, matrices) and insightfully interpret the organized data.

3.3- Assess correspondence between the predicted result contained in the hypothesis and actual result, and reach a conclusion as to whether the explanation on which the prediction was based is supported.

Standard 4: Living Environment

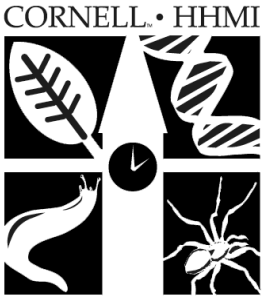
Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.

5.2- Explain disease as a failure of homeostasis

5.2c- Viruses, bacteria, fungi and other parasites may infect plants and animals and interfere with normal life functions.

5.2h- Disease may also be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for many years

HIV Transmission



Rules of the Activity

1. Each student gets a test vial half filled with fluid. The fluid represents body fluids (for example, blood, semen, or vaginal secretions). One of the vials contains the "HIV" and the rest contain distilled water.

2. A role card is attached to each vial. This identifies a behavioral role (telling when and with whom you can exchange body fluids).

3. When you exchange body fluids, use your pipette to remove some of your fluid and deposit in the vial of the other person. You should receive back an equal amount of their fluid.

4. You must ask the other person for permission to exchange fluids. You may NOT tell the other person what your role is.

5. You can exchange fluids **only** if the exchange is in keeping with your behavioral role, as stated on your role card.

6. After a short period of time exchanging fluids, it will be time to "get tested for HIV." The teacher will assume the role of a doctor who will administer an "HIV test" to each student.

Analysis

1. Did you test positive for HIV?

2. What was your behavioral role?

3. Were you able to trace the route of infection back to its original source?

4. Describe the method you used to trace the route of infection.

5. From the class data fill in the following table and determine the risk for each of the roles.

Role	Number who practiced this behavioral role	Number who tested "HIV Positive"	Risk of contracting HIV (low risk, some risk, or high risk)
Practice abstinence			
Hetero - Monogamous			
Hetero - Promiscuous			
Prostitute (male or female)			
Gay - promiscuous			
Gay - monogamous			
Bisexual			
Intravenous drug user			
Steroid abusing athlete			
Alcohol abuser			

6. Describe one other role you feel should be added to the list of roles "played" in this HIV Transmission simulation.

7. Describe one way this activity could be modified to more accurately reflect today's society?

8. State three things you learned from this activity.

CDC FACT SHEET

HIV and AIDS among Gay and Bisexual Men

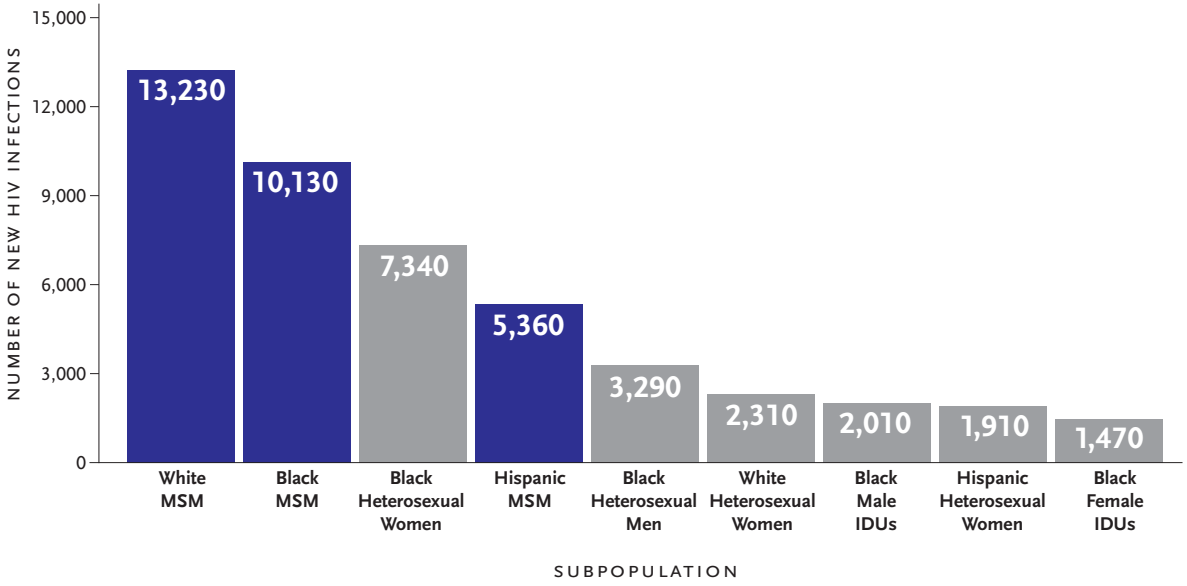
Gay and bisexual men — referred to in CDC surveillance systems as men who have sex with men (MSM)[1] — of all races continue to be the risk group most severely affected by HIV. Additionally, this is the only risk group in the U.S. in which the annual number of new HIV infections is increasing. There is an urgent need to expand access to proven HIV prevention interventions for gay and bisexual men, as well as to develop new approaches to fight HIV in this population.

A Snapshot

- MSM account for nearly half of the more than one million people living with HIV in the U.S. (48%, or an estimated 532,000 total persons).
- MSM account for more than half of all new HIV infections in the U.S. each year (53%, or an estimated 28,700 infections).
- While CDC estimates that MSM account for just 4 percent of the U.S. male population aged 13 and older, the rate of new HIV diagnoses among MSM in the U.S. is more than 44 times that of other men (range: 522–989 per 100,000 MSM vs. 12 per 100,000 other men).
- MSM is the only risk group in the U.S. in which new HIV infections are increasing. While new infections have declined among both heterosexuals and injection drug users, the annual number of new HIV infections among MSM has been steadily increasing since the early 1990s.

Estimates of New HIV Infections, 2006, by Race/Ethnicity, Risk Group, and Gender for the Most Affected U.S. Subpopulations*

Gay and bisexual men of all races and black heterosexuals account for the greatest number of new HIV infections in the United States.



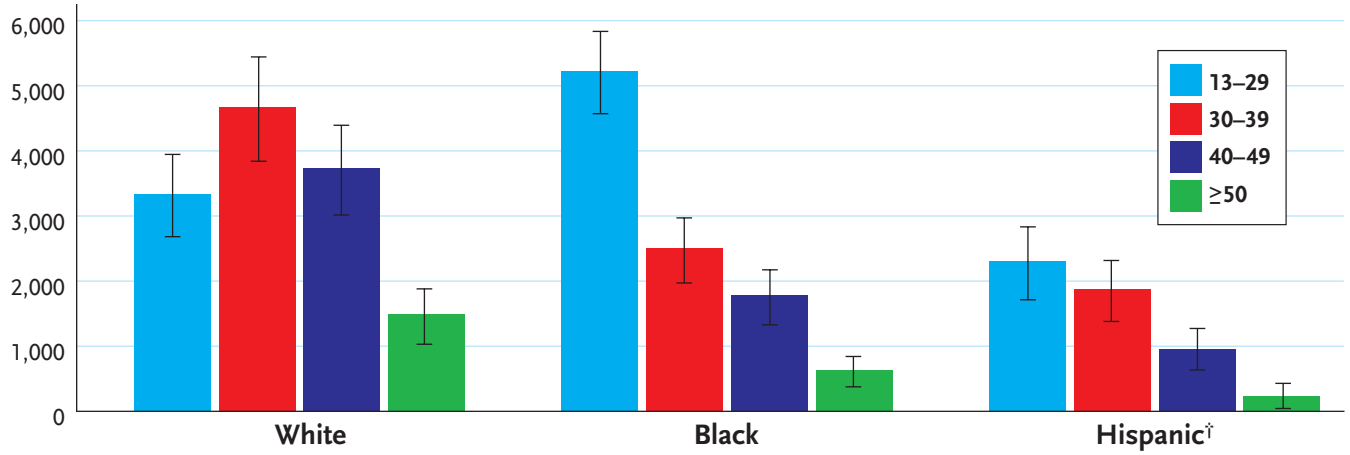
*Subpopulations representing 2 percent or less of the overall U.S. epidemic are not reflected in this chart.

[1] The term men who have sex with men is used in CDC surveillance systems. It indicates the behaviors that transmit HIV infection, rather than how individuals self-identify in terms of their sexuality.

MARCH 2010

- According to the latest estimates, white MSM represent a greater number of new HIV infections than any other population, followed closely by black MSM — who are one of the most disproportionately affected subgroups in the U.S.
- The primary ages at which MSM become infected differ by race:
  - **Young Black MSM:** Most new infections among black MSM occur among young black MSM. In fact, there are more new HIV infections among young black MSM (aged 13–29) than among any other age and racial group of MSM. The number of new infections among black MSM in this age group is roughly twice that of their white and Hispanic counterparts (5,220 infections in blacks vs. 3,330 among whites and 2,300 among Hispanics).
  - **White MSM in their 30s and 40s:** Most new infections among white MSM occur among those aged 30–39 (4,670), followed by those aged 40–49 (3,740).
  - **Young Hispanic MSM:** Among Hispanic MSM, most new infections occur in the youngest (13–29) age group (2,300), though a substantial number of new HIV infections also occur among those aged 30–39 (1,870).

Estimated Number* of New HIV Infections in Men Who Have Sex with Men, by Race/Ethnicity and Age Group, United States, 2006



* Incidence estimates are adjusted for reporting delays and reclassification of cases reported without a known risk factor for human immunodeficiency virus (HIV) but not for underreporting

† Non-Hispanic whites and non-Hispanic blacks are referred to as white and black, respectively. Persons of Hispanic ethnicity might be of any race

Note: The "I" bars denote the data range for each confidence interval

- A study of MSM in five U.S. cities found extremely high levels of infection among MSM, and many of those infected did not know it.
  - Overall, one in four MSM participating in the study was infected. Black MSM were twice as likely to be infected with HIV than other MSM.
  - Among all of those who were infected, about half were unaware of their HIV status. Results were particularly alarming for black MSM and young MSM, with more than two-thirds of infected black MSM, and nearly 80 percent of infected young MSM (aged 18–24), unaware that they were infected.
- AIDS continues to claim the lives of too many MSM. Since the beginning of the epidemic, more than 274,000 MSM with AIDS have died.

Complex Factors Increase Risk

- **High prevalence of HIV:** The high prevalence of HIV among gay and bisexual men means MSM face a greater risk of being exposed to infection with each sexual encounter, especially as they get older. For young black MSM, partnering with older black men (among whom HIV prevalence is high) may also lead to increased risk.
- **Lack of knowledge of HIV status:** Studies show that individuals who know they are infected take steps to protect their partners. Yet many MSM are unaware of their status and may unknowingly be transmitting the virus to others. Additionally, some MSM may make false assumptions or have inaccurate information about their partner's HIV status. It is critical to ensure that sexually active MSM get tested for HIV at least annually, or more frequently as needed.
- **Complacency about risk:** Among young MSM in particular, complacency about HIV may play a key role in HIV risk, since these men did not personally experience the severity of the early AIDS epidemic. Additional challenges for many MSM include maintaining consistently safe behaviors over time, underestimating personal risk, and the false belief that because of treatment advances, HIV is no longer a serious health threat. We must reach each generation of MSM and develop programs that can help MSM remain uninfected throughout the course of their lives.
- **Social discrimination and cultural issues:** For some MSM, social and economic factors, including homophobia, stigma, and lack of access to health care may increase risk behaviors or be a barrier to receiving HIV prevention services.
- **Substance abuse:** Some MSM use alcohol and illegal drugs, contributing to increased risk for HIV infection and other STDs. Substance use can increase the risk for HIV transmission through risky sexual behaviors while under the influence and through sharing needles or other injection equipment.

HIV: Protect Yourself

Be smart about HIV. Here's what you can do to reduce your risk of infection:

Get the facts — Arm yourself with basic information: Are you at risk? How is HIV spread? How can you protect yourself?

Take control — You have the facts; now protect yourself and your loved ones. There are three essential ways to reduce your risk:

1. Don't have sex (i.e., anal, vaginal or oral)
2. Only have sex (i.e., anal, vaginal or oral) if you're in a mutually monogamous relationship with a partner you know is not infected
3. Use a condom every time you have anal, vaginal or oral sex. (Correct and consistent use of the male latex condom is highly effective in reducing HIV transmission.)

Put yourself to the test — Knowing your HIV status is a critical step toward stopping HIV transmission, because if you know you are infected, you can take steps to protect your partners. Also, if you are infected, the sooner you find out, the sooner you can receive life-extending treatment. In fact, CDC recommends that everyone between the ages of 13 and 64 be tested for HIV. Because other STDs can play a role in the acquisition of HIV, knowing whether you are infected with either is critical in reducing your risk for infection.

Call 1-800-CDC-INFO or visit www.hivtest.org to find HIV and STD testing locations near you.

Start talking — Talk to everyone you know about HIV – friends and family, coworkers and neighbors, at work and at places of worship. Have ongoing and open discussions with your partners about HIV testing and risk behaviors. Talking openly about HIV can reduce the stigma that keeps too many from seeking the testing, prevention and treatment services, and support they need.

HIV doesn't have to become part of your life. Each of us can and must be part of the solution.

Visit www.actagainstaids.org for more information about HIV and what you can do to stop HIV.

If you are a member of the news media and need more information, please visit www.cdc.gov/nchhstp/Newsroom or contact the News Media Line at CDC's National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (404-639-8895 or NCHHSTPMediaTeam@cdc.gov).

More Hope For Genetic Fix For HIV - The Scientist

Genetically modifying the stem cells of HIV patients may one day prove to be an effective, one-time therapy against the hard-to-kill virus, according to the results of a proof-of-principle trial published this week in *Science Translational Medicine*.

In contrast to the widely used highly active antiretroviral therapy (HAART), which patients must continue for their entire lives to control the virus, such a genetic treatment has the potential to be "a single administration therapy," said bioengineer David Schaffer of the University of California at Berkeley, who was not involved in the trial, "where you introduce [a gene] into somebody's cells, and it stays there the rest of their lives. [That] has the potential to be a major plus," eliminating many of the toxic effects and financial costs of HAART.

Because of these potential advantages, gene therapy -- the integration of new genetic material into a patient's genome -- has been proposed as a treatment for HIV. In past clinical trials, however, the new genetic material has failed to persist more than 8 months or a year. But taking advantage of a golden opportunity in which a handful of HIV patients had to undergo bone marrow transplants, molecular geneticist John Rossi of the City of Hope cancer center in California and his colleagues introduced three different therapeutic genes into patients' blood stem cells, then found evidence of those genetic elements in the blood up to 24 months later.

"It showed us that you can introduce genes into somebody's blood cells, and it can stay around for years," said Schaffer, who wrote a perspective about the paper.

"That's a major finding," Rossi added. While the number of cells expressing those genes was too low to provide any therapeutic benefit, it's "proof of principle" that gene therapy may provide long-term HIV treatment, he said.

These results come in the wake of a recent report on the miraculous "Berlin patient," who appeared to be cured of HIV after receiving a bone marrow transplant as a treatment for leukemia from an individual with a mutation in the CCR5 gene, which codes for a coreceptor used by HIV to enter cells. Although "we don't really know what resulted in the 'cure' that that patient had," said immunologist Carl June of the University of Pennsylvania School of Medicine, who did not participate in the study, it is a "really intriguing" idea that the CCR5 mutation could have played a role in preventing the virus from coming back.

Finding marrow donors that are a match to HIV patients and have such a mutation, however, is not easy, he added. But a clever twist -- manipulating patients' own cells to carry such therapeutic mutations -- "is going to, in principle, allow that to happen."

The trial patients had contracted AIDS-related lymphoma, and were thus in need of a marrow transplant -- in this case, from themselves. Blood stem cells were extracted from the patients' bone marrow, then reinjected into their bodies after they had undergone chemotherapy to destroy the malignant cell population. Before the cells were reinjected, however, the researchers inserted three therapeutic genes, including one that targets CCR5, into some of the cells that rendered them HIV-resistant.

"The idea was that any single agent that you put as an antiviral agent is probably not going to be effective [because the] virus would mutate around [it]," Rossi said, "but the combination of all three would make it very difficult for the virus to escape."

In addition to demonstrating the long-term expression of these genetic elements, the researchers found no

evidence of adverse effects associated with the manipulation.

The next step is to determine how many blood cells must be genetically modified in order to truly beat back HIV, said hematologist Gero Hütter of Charité University Medicine Berlin in Germany, who co-authored *The New England Journal of Medicine* article about the Berlin patient, "but today it's not clear how high this proportion should be." Indeed, "determining that's going to be really tricky," Rossi said. "It may vary from individual to individual [and] we don't have animal data that would suggest" an answer. But they're working on it, he said, using humanized mouse models as well as non-human primates. Eventually, he said, if done right, a successful gene therapy treatment "could eliminate the daily need for antiretroviral therapy."

Related stories:

- Stem Cells and Gene Therapy
[September 2007]
- Lentiviral vectors appear safe for gene therapy
[7th November 2006]
- HIV gene therapy
[31 December 2002]