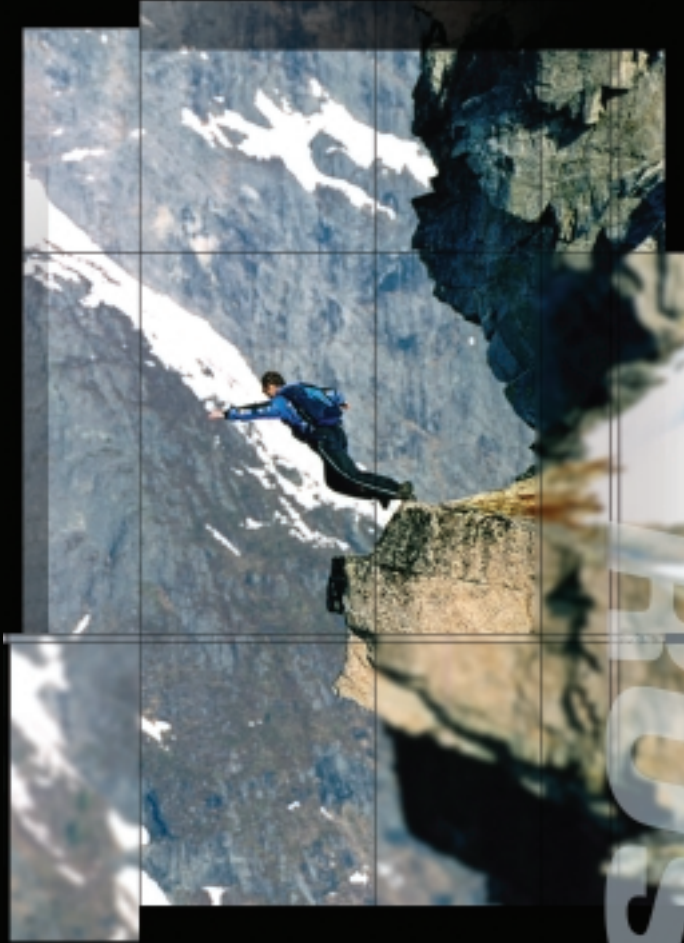


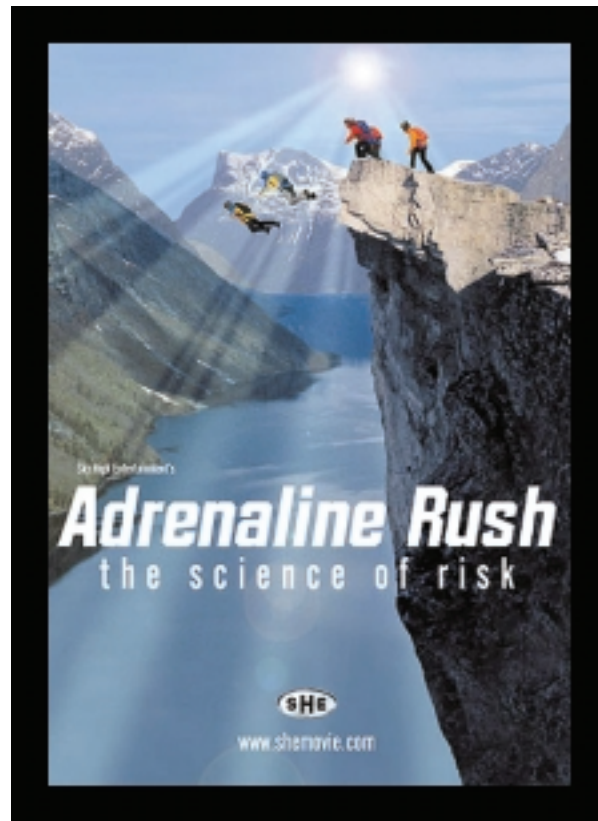
ADRENALINE RUSH

THE SCIENCE OF RISK



ADRENALINE RUSH

TEACHER'S GUIDE



ABOUT THIS GUIDE

This teacher's guide to **Adrenaline Rush** provides a series of modules and information sheets that allow students to further explore the world of risk through the world of skydiving and base jumping. It addresses issues like:

- > **how risk is part of our daily lives;**
- > **why certain people take more risks than others;**
- > **how people seek to manage and minimize risks, even in extreme activities**
- > **how science, innovation and risk are linked**
- > **the history of parachuting, from Leonardo da Vinci to today**

The first part of the guide, entitled Quick Jumps, provides seven two-page modules: the first page provides a short overview of the proposed theme and the second page provides suggested activities and questions.

The second part, entitled For a Bigger Rush, provides more in-depth explorations of some of the movie's themes with proposals for further reading.

ABOUT THE MOVIE

Adrenaline Rush takes a look at the world of skydiving and base jumping. It explores how the risk-taking involved in such extreme activities can tell us about the world of science and innovation, and about the way we deal with risk in our daily lives. It focuses on two risk-takers, Adrian Nicholas and Katarina Ollikainen, as they prepare to undertake a unique scientific experiment: trying to fly the parachute imagined in 1485 by Leonardo da Vinci, the very first parachute design ever recorded in the world.

While providing breathtaking views of skydiving over the Florida Keys, the Mojave desert and in the magnificent Fjords of Norway, **Adrenaline Rush** explores the psychological and physiological forces behind risk-taking, and the physics involved in these activities. The movie shows us that while most of us will never go to such extremes, risk can lead to unexpected discoveries and help mankind fulfill its dreams.

Table of Contents

2 Introduction

Part 1: ***QUICK JUMPS***

4 Safety and Risk: Managing our Daily Lives

6 MAO and Me: Why Some People Take the Plunge

8 Before the Rush: Experience and Training

10 Leonardo da Vinci: Imagining Flight

12 Past and Present: The 15th Century Meets the 21st

14 The Science of Flight: A Quick Look at Aerodynamics

16 Opening New Possibilities: Science and Risk

Part 2: ***FOR A BIGGER RUSH***

17 Different Types of Risk

18 Leonardo da Vinci: A True Renaissance Man

19 From Imagination to Science: The History of Parachuting

20 Deformable Structures and Fluid Flows: What's That?

21 Capturing Risk: The Making of *Adrenaline Rush*

Part 1: *QUICK JUMPS*

SAFETY AND RISK:

Managing our Daily Lives



Risk is an unavoidable part of life. We work very hard to make our lives as safe as possible. Locks, safety belts, passwords, helmets, smoke detectors, fire alarms, traffic signals, lifejackets and security guards are part of our daily lives.

Still, accidents can happen, and ill-intentioned people can put us at risk. We can become sick or be a victim of circumstances beyond our control. What makes us go on with our daily lives is our confidence that everything will go right and that we can manage the risks we take.

When we ride a car, we trust that it is safe and that the driver knows all the rules and the necessary precautions. When we jump in a pool, we rely on the skills we learned through swimming lessons. If we walk across a street, we wait for a green light and we trust that cars will stop at the red light.

Extreme thrill seekers may take risks that most of us wouldn't. But even they do everything to make things safe, and they trust their experience and skills to avoid harm.

As they take chances that may endanger their lives, risk-takers and thrill-seekers rely on one basic thing: trust.

They have to trust their equipment and their skills. They must be confident that every factor is taken into account before they go ahead and face danger. Very often, they need to trust other people – the partners who make their experiences possible.

To Do:

Here's an exercise in trust that you can do with a partner:

Stand in front of your partner, with both of you facing the same direction. You should be at arm's length from your partner: when your partner holds his or her arms straight out, he or she should touch the back of your shoulders with his or her fingers.

Cross your arms and close your eyes. When your partner gives you a clear signal, let yourself fall backwards, resisting the urge to bend your legs or pull your arms back. It is your partner's job to catch you with both hands.

After you have done this, change places with your partner and repeat the experiment.

Here's a few questions to ask yourself after you've tried your trust:

Did you manage to take that risk? Why? Why not?

Did you feel afraid? Why? Why not?

Did you feel a "rush" before your partner caught you?

Did you feel good or bad after taking this risk? Why?

WARNING: PICK A PARTNER THAT IS ABOUT THE SAME SIZE AS YOU ARE, AND DO THIS EXPERIMENT IN AN OPEN SPACE, AWAY FROM TABLES, CHAIRS OR OTHER HARD OBJECTS.



MAO AND ME:

WHY SOME PEOPLE TAKE THE PLUNGE

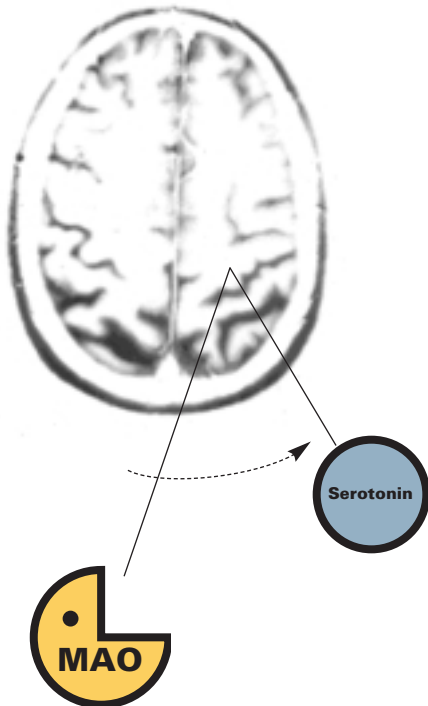
Why do most people run from danger, while some run to it? Some scientists now believe they may have found the answer to that question – an answer located in the complex chemistry of the human brain.

Inside the brain are billions of special molecules called neurotransmitters. It is by controlling the flow of these molecules that we formulate thoughts, make decisions and experience various sensations and feelings. One particular neurotransmitter called “serotonin” is linked with feelings of well-being and anxiety.

Serotonin levels are regulated by another molecule called Monoamine Oxidase (MAO) and extreme risk takers tend to have about a third less MAO than the average person. It is interesting to note that while low MAO levels are found in athletes, performers, entrepreneurs and artists, they are also common among those prone to anti-social behavior like crime and drug or alcohol addiction – less recommendable kinds of risk-taking.

Still, MAO is just one of many factors that shape a human being. Personality, family and social context can also intervene, as well as other factors like the male hormone testosterone or a gene called D4DR which can cause variations in the levels of another neurotransmitter called dopamine.

In other words, brain chemicals alone cannot explain why most people choose the safe route and why some will prefer taking chances and risks. Personality, upbringing and education, or even the encouragement of peers can lead us either way.



To Do:

Are you a risk-taker? Do you like to step off the beaten track? How much do you value personal safety? Here are a few questions to help you define your attitude towards risk. After you have answered the questions, you can discuss them with the rest of the class.

You can also use this questionnaire as an informal poll of the class, compiling all the answers to get a group portrait.

1. Do you participate in competitive sports? _____
What is your favorite sport? _____
Why? _____

2. Are you afraid of heights?

- a) Yes
- b) No

3. When you get a new device (computer, game, tool, etc.), do you read the instruction manual?

- a) Always, before I start using it
- b) Most of the time, as I try new features
- c) Only for troubleshooting
- d) Never, I rely on instinct and skill

4. Rate the following activities from 0 to 5, with 0 meaning you try to avoid it and 5 meaning you love to do it.

How much do you like to:

1) try new foods?	1 2 3 4 5
2) travel to new places?	1 2 3 4 5
3) meet new people?	1 2 3 4 5
4) try new sports or hobbies?	1 2 3 4 5
5) set new goals or challenges for yourself?	1 2 3 4 5
6) engage in strenuous physical activities?	1 2 3 4 5
7) ride roller coasters?	1 2 3 4 5

Before the Rush:

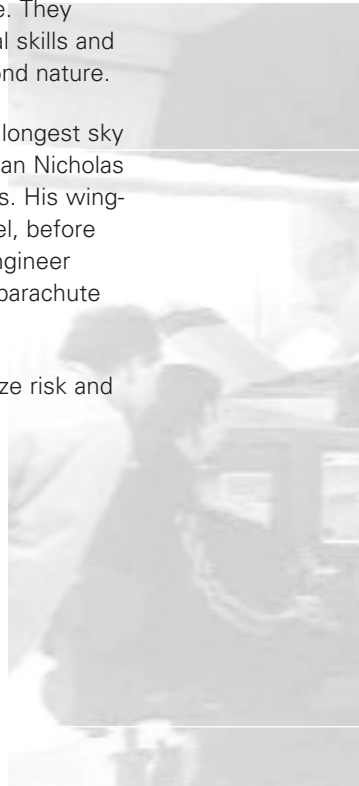
Experience and Training

Very few people will ever go skydiving. Even fewer will ever try base jumping.

Before they decide to jump off a 4,100-foot cliff (1,300 meters), like those seen in the movie, these thrill seekers spend a long time building up the knowledge that can make the experience as safe as possible. They learn a number of safety measures, technical skills and procedures, until every move becomes second nature.

Before establishing the world record for the longest sky dive or trying out Leonardo's parachute, Adrian Nicholas had done approximately 6,500 previous dives. His wingsuit was tested in the safety of a wind tunnel, before actual jumps were taken. An experienced engineer helped evaluate the potential of Leonardo's parachute before it was built.

A lot of practice and a lot of tests, to minimize risk and make things as safe as possible.



To Do:

Adrian Nicholas, the world record-holder for the longest unassisted human flight has jumped up to 2,500 times in one year.

How many jumps a day does Adrian make?

Before trying out for his world record, Adrian had done around 6,500 jumps.

If you jumped only once a day, how many years would it take you to be ready for the world record?

When he established his world record, Adrian's unassisted flight lasted 4 minutes and 55 seconds, thanks to a revolutionary wing-suit. His speed during that record flight reached 120 miles per hour (200 kilometers per hour).

How far did he travel? (round the time to five minutes)

Look at a map of your city or area. Can you find out how far that is?

Leonardo **DA VINCI**

Innovation and ***Flight***



Born in a small Italian town in 1452, Leonardo da Vinci was a brilliant painter, an engineer and an architect. His Mona Lisa may be the best known painting in the world. He also was an accomplished musician, a botanist, an expert in human anatomy, and even an event organizer for princes and kings.

His irresistible drive to invent, to find new ideas and new techniques, led him to create designs for industrial machinery, submarines and diving gear, clocks and cranes, water pumps and drills, and especially, all types of flying machines.



As an innovator, Leonardo constantly took chances, and often faced failure. His mural masterpiece, The Last Supper, has almost been lost because he tried out a new kind of painting that quickly started flaking. Many of his designs never went beyond the drawing stage, and some could indeed result in dangerous or unworkable machines.

Yet his efforts were so inspiring that they even led a modern group of risk-takers to test one of his most original inventions: the parachute. Not too many people still drive innovation, some five hundred years after their death!



To Do:

Tell us about an innovator you like. It could be an artist, a musician, a scientist, an entrepreneur: any person that has made a difference in their field.

As you present your innovator, answer the following questions:

What did he or she contribute to human experience?

Why is that important?

How did people react to those new ideas?

Past and Present:

The 15th Century **Meets** the 21st



Although parachuting has evolved into a high-tech sport, with constant improvement in materials and manufacturing, testing out the first parachute imagined by mankind remained an interesting challenge for Adrian Nicholas and Katarina Ollikainen.

With a design completely different from today's parachutes, Leonardo's parachute left many people skeptical. "Nobody said it would work and they gave various reasons why it wouldn't work", says Adrian Nicholas. "And the consensus opinion was that I was going to be in for a very wild ride."

Still, Adrian and Katarina went ahead, recruiting Oxford University history professor Martin Kemp, who helped them decipher Leonardo's instructions for size and materials.

Because they took this risk, we know more about flying parachutes than we did before. And we know that Leonardo was right 500 years ago, even though the laws governing aerodynamics and flight had not yet been precisely defined.

Better still, Adrian and Katarina's experiment helped open new avenues in modern science. A team of scientists from Salford University, in England, used Leonardo's chute to record precise data about the way materials move under various pressures. This information can now help scientists make better artificial heart valves, better cars, and improve air traffic control. Trying to fulfil Leonardo's dream was, in this case, a risk that paid off.



Now, you can also build Leonardo's parachute. For this experiment, you will need:

1. **Four sheets of paper** (preferably construction paper)
2. **Some string** (four lengths of 12 inches or 30 centimeters, and a little extra)
3. **A precise ruler**
4. **A pair of scissors or a box cutter**
5. **Some light adhesive tape**
6. **Four straws or light sticks** (optional)

To Do:

To prepare an eight-inch high (20 centimeters) parachute,

1

cut four isosceles triangles 8 inches wide (20 cm) and $8\frac{7}{8}$ inches (22.4 cm) high (see figure 1).

2

Tightly tape the sides of the four faces of the parachute together to produce the pyramid shape.

3

Tape a piece of string to each corner, and tape or tie the end of the four strings together.

4

Use some string or tape to attach a light object to the parachute strings. A wine cork has just about the right weight for this size parachute, although you can also test the effects of lighter and heavier objects. To make the chute more solid, straws or light sticks can be used to create a square frame at the base of the parachute.

Figure 1

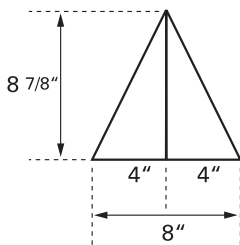


Figure 2

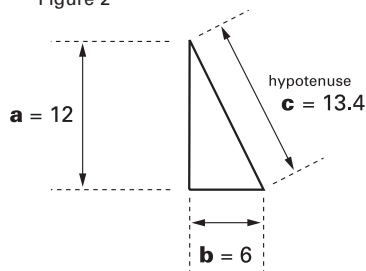
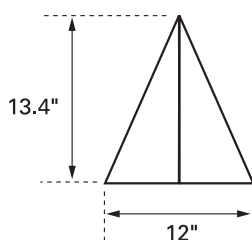


Figure 3



More advanced options:

You can try making models of Leonardo's parachute in different sizes, and using different materials like cloth or plastic, by using some basic mathematics to figure out the proportions. To figure out dimensions, use the Pythagorean theorem ($a^2 + b^2 = c^2$). Here's how.

Leonardo da Vinci specified that his parachute should be "a length of gummed linen cloth, with a length of 12 yards ("braccia") on each side and 12 yards high". Since it is as high as it is wide, we can use the Pythagorean theorem to create a model of any size.

For example, for a 12 inches wide parachute (see figure 2) we know that $a=12$, $b=6$ (half the total width). This means that the hypotenuse equals the square root of 180 ($144+36$), or approximately 13.4 inches ($13\frac{7}{16}$ "). The hypotenuse is the height of each face of the parachute, meaning that each face should be 12 inches wide and 13.4 inches high (see figure 3) to produce a 12-inch high pyramid. The strings should be approximately one and a half times the height of the pyramid.

Please note that bigger models will definitely need a frame to keep the opening in its square shape as the parachute flies. You can also experiment with the weight of the attached object. If it is too light, the parachute will be unstable. If it is too heavy, the parachute will fall too fast.

THE **SCIENCE** OF **FLIGHT**:

*A Quick Look at **Aerodynamics***

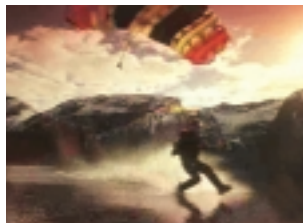


Every object that flies – or falls – is subject to the same type of forces: lift, drag and gravity. Lift is what keeps an object airborne or slows its fall. Drag is the amount of resistance the object creates against the air flowing around it. Gravity is the forces that pulls us towards the center of the Earth, making sure that what goes up eventually comes down.

Here's how these forces allow a parachute to work. Air rushing underneath the parachute creates low air pressure above it, creating a lift that pushes upwards and breaks the jumpers' free fall. The overall drag of the jumper, determined by his or her weight and the size of the parachute, dictates how much a parachute will slow down the fall of the diver.

To make the ride stable, the pressure inside the parachute must also remain as constant as possible. This is why a vent needs to be placed in the fabric, allowing an escape for the air to come out. The parachute used by André-Jacques Garnerin for the very first successful human parachute jump in 1797 had no vents, and it swung wildly from side to side as the air was forced to escape to the sides.

In the 1960s, designers started to work on new parachutes built more like airplane wings, trading some air resistance and lift for horizontal speed and maneuverability. Adrian Nicholas' wingsuit, which was designed with the help of Katarina Ollikainen and the late aerial stuntman Patrick de Gayardon, applies the same principles. It slows down the jumper's fall by providing extra lift and horizontal speed.



To Do:

An Experiment: *The Egg Drop*

An excellent way to test aerodynamic principles is to build a (small) working parachute. Using it to drop an egg safely to the ground is an excellent way to see how well it works. Although you could use a relatively large version of Leonardo's parachute, many other models can be used for the experiment.

For a circular parachute, cut a large circle out of a plastic bag, or fabrics like cotton or nylon, with a small hole in the middle acting as a chimney. For a more challenging project, you can try to build a wing-shaped parachute, using light cardboard for the frame and paper or fabric for the wing's surface. You can also create a net or a padded basket to carry the egg, change the number of strings, or try different lengths and types of string to tie the egg to the parachute, etc.

The experiment can also be turned into a competition, with prizes for the lightest working parachute, the fastest safe drop, the longest drop, etc.

Here are two web sites that provide useful instructions and tips:

<http://school.discovery.com/lessonplans/programs/forcesandmotion/>

A page by the Discovery Channel shows how to test various sizes of parachutes, always with the goal of dropping the egg to the ground without it breaking.

<http://college.hmco.com/education/pbl/project/project3.html>

Another page on possible ways to drop the egg safely, by publisher Houghton Mifflin.

NASA to the Rescue

NASA's John H. Glenn Research Center in Cleveland, Ohio, has published an online Beginner's Guide to Aeronautics, featuring dozens of activities for elementary, middle and secondary school students which were designed by teachers from all over America.

Beginner's Guide to Aeronautics home page

<http://www.grc.nasa.gov/WWW/K-12/airplane/>

Activities home page

<http://www.grc.nasa.gov/WWW/K12/TRC/Aeronautics/AeronauticActivitiesHome2.htm>

Discussing Aerodynamics and Parachutes:

Here are a few questions that can also help you discuss the principles of aerodynamics and the uses of parachutes:

1. Would a parachute work in space? Why?

2. Beyond human jumps, what are parachutes also used for?

3. Why can't a parachute work without someone or something suspended to it?

4. What other force makes flying a plane different, in terms of aerodynamics, from flying a parachute, a kite or a glider?

5. Even though cars don't fly, aerodynamics play an important part in their design. Why?

(Answers on page 17)

OPENING

New Possibilities:

SCIENCE AND RISK

When Benjamin Franklin flew a kite in a thunderstorm, he was at great risk of being electrocuted. Still, taking that risk allowed him to invent the lightning rod, which in turned has saved many buildings from being destroyed by fire.

On the other hand, the many people who worked on inventing personal computers didn't face much physical danger – except maybe a jolt of static electricity. Yet they had to stay committed in the face of frustration and frequent failure before producing a working prototype and leading a revolution that is reshaping our lives today.

For scientists and innovators, working on new inventions and discoveries doesn't necessarily involve physical risk. The risks may have been professional (turning down opportunities to pursue their dream) or financial (investing great sums in ventures that might have proven useless or unworkable).

In other words, there is a deep connection between innovation and risk. But that doesn't mean you have to risk your life. Your imagination, your skills and your knowledge are generally the most useful things you'll need, along with the commitment to try and try again until you are successful.



To Do:

Match each inventor with his or her invention or discovery :

- | | |
|--------------------------------------|----------------------------|
| 1. Louis Pasteur | A. X-Rays |
| 2. Thomas Edison | B. Radium |
| 3. Mary Anderson | C. Plane |
| 4. Leonardo da Vinci | D. Printing Press |
| 5. Alfred Nobel | E. Telephone |
| 6. Wilhelm Conrad Röntgen | F. Parachute |
| 7. Marie Curie | G. Windshield wiper |
| 8. Johannes Gutenberg | H. Pasteurization |
| 9. Alexander Graham Bell | I. Dynamite |
| 10. Orville and Wilbur Wright | J. Light Bulb |

(Answers on page 15)

If you need to, use the hints given below about each inventor:

- | | |
|---|---|
| 1. Got Milk? Thanks to this inventor, you have it for a longer time : the process he invented kills most bacteria and makes food safer. | 6. Thanks to his invention, this man could see right through you. |
| 2. When he invented this bright little thing, did one of them pop up over his head? | 7. She knew she had been successful when she saw her discovery glow in the dark from radiation. |
| 3. Thanks to her, you can see much better when driving a car. | 8. His invention allowed more people to read books than ever before in history. |
| 4. His design wasn't tested for five hundred years but, despite what some critics said, it flew perfectly. | 9. Thanks to him, voices and information can reach across the world. |
| 5. His truly explosive invention made him rich, allowing him to create a series of prestigious prizes. | 10. When their invention worked, it gave people quite a lift. |

- Answers from page 15:**
1. Without enough air or gas present, there is not enough resistance to provide drag or lift.
 2. Parachutes can be used to slow down landing planes, rocket components or space shuttles, and even some race cars.
 3. Without a force pulling it in one direction, the parachute will simply let the air slip to the sides, turning or slipping back and forth like a falling leaf.
 4. Planes use the thrust from their engines to provide speed and lift.
 5. Aerodynamics are used to reduce the drag caused by air resistance, providing better road handling and even reducing gas consumption.



Part 2: FOR A BIGGER RUSH

Different **Types** of **RISK**

As an unavoidable part of life, risk comes in many shapes and forms. There are, of course, the physical risks that we experience in our everyday activities or the medical risks that come from exposure to virus and bacteria or other health-threatening products. There are also financial risks that come along with almost any of life's major endeavors, and environmental risks caused by weather phenomena and natural catastrophes like forest fires or earthquakes. There are risks to our personal property, and even emotional risks in our personal relationships. And for some people, there are judicial risks linked to breaking the rules and laws that govern society.

No wonder we collectively spend so much time trying to keep ourselves safe – or in other words, evaluating and managing risk. These tasks are complex and are often influenced by subjective perceptions, rather than hard facts.

For instance, although we are constantly impressed by the destructive power of earthquakes and hurricanes, the most deadly form of weather phenomena is actually the heat wave. On average, according to scientists at the University of Delaware, heat waves cause an average of 1,500 deaths in American cities per year, while tornadoes, earthquakes and floods together total less than 200 deaths a year.

The impressive and the dramatic often seem more dangerous to us than the commonplace, yet actual risk often goes the other way around. Shark attacks may seem a high risk to us, but they actually cause around ten deaths per year worldwide. By comparison, allergic reactions to bee- and wasp-stings cause somewhere between 50 to 100 deaths per year in the US alone –

after all, many more people are exposed to bee stings than shark attacks. Plane crashes are omnipresent in our imagination, yet the chances of dying in a car wreck are much higher: 1 in 6,000 for cars, less than 1 in 1 million for planes.

Evaluating risks of any kind also requires weighing individual as well as collective or environmental circumstances. Risks of dying from cancer or from heart disease are relatively high, on average, but they vary greatly according to your age, where you live, and other health factors like smoking, exercise, etc.

In other words, in evaluating and managing the risks in our lives, and before making lifestyle choices that may influence a number of risk factors (negatively or positively), we may need to take a deeper look at serious numbers and facts to make the right decision.

Links:

<http://www.nfpa.org/Education/index.asp>

The National Fire Prevention Association's website has a large section on safety, going well beyond fire prevention and including games and useful safety tips.

<http://www.cdc.gov/safeusa/school/safescho.htm>

The United States' Center for Disease Control and Prevention's SafeUSA program includes a Safe at School Section that provides a wide array of resources to reduce violence and injury in and around schools:

LEONARDO DA VINCI:

A TRUE *Renaissance* Man

Born on April 15, 1452 in Tuscany, Leonardo was the illegitimate son of notary Ser Piero, and a woman named Catarina. He moved to his father's home in Vinci at the age of five before moving to Florence in 1460. After an apprenticeship at the workshops of famous craftsman and artist Verrochio, he moved to Milan in 1482, first holding a position as a musician at the court of the duke of Milan, Ludovico il Moro.

It is there that he began producing an impressive body of work, mostly as a painter, architect and military engineer. Although he left relatively few finished paintings, works like his Last Supper and the Mona Lisa are among the most famous in the world. His painted work also shows remarkable innovations in perspective and proportion, techniques which provide two-dimensional works with a realistic three-dimensional feel.

As a true Renaissance person – a person showing mastery in a wide range of fields – he also contributed dozens of models and designs for machines and devices that were often well ahead of their times: a tank, a self-propelled car, a helicopter, a plane, a parachute, an odometer, and a number of cranes, architectural tools and hydraulic machines. His anatomical and botanical observations were also extremely precise and detailed, driven by the idea that all things were governed by a set of universal laws and principles.

To pursue his art and his research, Leonardo da Vinci had to count on the generosity of noble patrons, a position which provided uneven security. When his first patron, Ludovico il Moro, was defeated by French armies in 1499, Leonardo had to wander from city to city, looking for new patrons and new commissions. After going back and forth between Florence, Mantua, Milan and Rome, he was named “first painter engineer and architect” to the King of France, François I, from 1516 until his death in 1519.

How did Leonardo manage to remain so creative and innovative throughout his life? Well, among other things, he was always exerting his imagination and his thoughts and constantly studying everything from geometry to geology, music, anatomy, botany, engineering and painting. In 1490, at the age of 38, he was still training in the Italian city of Pavia, learning more about architecture from another Renaissance artist and engineer, Francesco di Giorgio.

Whether by reading, building theories, or observing nature –especially the flight of birds, which fills up an entire notebook – he sought to constantly expand his knowledge and his ability to find new solutions to the problems of his day. As shown by the 5,000 manuscript pages left by Leonardo, creativity and innovation are driven not only by a certain amount of risk-taking, but also by constant training, learning and trying.

Further reading:

<http://www.museoscienza.org/english/leonardo>

The Leonardo da Vinci Gallery is one of the main attractions of the National Museum of Science and Technology in Milan, Italy. The same can be said for the Leonardo section of their web site, which features original drawings and photographs of scale models of Leonardo's machines, information about and pages from his many manuscripts, and an extensive series of links.

<http://www.mos.org/sln/Leonardo/LeoHomePage.html>

Boston's Museum of Science has created a whole section of its web site to Leonardo, including a number of classroom activities.

<http://galileo.imss.firenze.it/news/mostra/6/>

The Istituto e Museo di Storia della Scienza (Institute and Museum of Science History) in Florence, Italy, has a some interesting information about Leonardo's role as an Innovative Engineer of the Renaissance.

From Imagination to **Science:**

The History of **Parachuting**



1485

Leonardo da Vinci draws his design for a parachute, the very first on record.

1783

Pioneer balloonists Jacques and Joseph Montgolfier use parachutes to lower animals from balloons and rooftops.

1797

André-Jacques Garnerin makes the first successful human jump ever recorded, by releasing himself from a hot air balloon with the parachute attached to the balloon's basket. Because there are no vents in his parachute, it swings wildly in all directions but still lands safely.

1799

Jeanne-Geneviève Garnerin, André-Jacques' wife, becomes the first woman parachutist.

1800s

Parachuting becomes a daredevil act presented in fairs and carnivals. Jumps are made from high structures or balloons, with the parachute opening through an automatic release system.

1837

Robert Cocking becomes the first person to die in the era of modern parachuting.

1890

A woman, Katchen Paulus, performs the first intentional breakaway: the release of a first parachute opens a second one, as part of a daredevil act.

1911 or 1912

First parachute jump from an airplane, claimed by both Grant Morton and Captain Albert Berry.

1914

Another woman, Georgia "Tiny" Broadwick becomes the first person to perform a free fall.

1930s

Armies across the world begin experimenting the idea of using paratroopers in their strategies; during the Second World War, thousands of young men get their first taste of skydiving this way.

1960

US Air Force Captain Joseph Kittinger breaks the record for the highest free fall, jumping 102,800 feet (over 31 000 meters) or over 18 miles (almost 30 kilometers) from a balloon.

1960s and 70s

Airfoil and airwing parachutes are developed, allowing much greater maneuverability and speed, and encouraging the development of parachuting as a sport.

1999

Thanks to a wingsuit designed with Patrick de Gayardon and Katarina Ollikainen, Adrian Nicholas sets the world record for the longest unassisted human flight, at 4 minutes and 55 seconds.

2000-2001

Adrian Nicholas and Katarina Ollikainen build and successfully test Leonardo da Vinci's parachute in South Africa and California.

For more on parachute history:

<http://www.users.muohio.edu/mcgratra/history.html>

<http://www.parachutehistory.com/eng/drs.html>

Deformable Structures and Fluid Flows:

WHAT'S THAT?

When Adrian Nicholas and Katarina Ollikainen reconstructed Leonardo's parachute, they were contacted by scientists from Salford University, in England. They wanted to put cameras on the lower structure of the parachute and visible black dots on one side of the parachute's canopy. This would allow them to record the ways in which air caused the structure to move.

By studying the way the parachute behaved as the air flowed into it, the scientists were able to learn new things about the way deformable structures (anything whose shape will yield to pressure) behave in fluid flows (the movement of gases or liquids). Specifically, as air flowed in and out of the parachute, it created pressure on the fabric and turbulence around it. By applying the data from this particular fluid flow study, the team from Salford hopes to create improved computer programs that will help develop or improve a wide range of technologies.

For example, veins, arteries and the valves and chambers of the heart are deformable structures that change shape in response to the flow of blood that comes through them. The observations and calculations derived from the Leonardo experiment will help scientists determine how they can improve the materials used in medical tools such as artificial heart valves. Thanks to those observations, they will have a better idea of the interaction between the blood and the vessels in which it travels through the body, and thus the type of response that is needed from valves and other such parts.

Specialists in this science of fluid dynamics can also use this data for a wide range of applications, from better cancer cell detection to safer cars. Even things like air traffic control can be improved by this science, as the effects of turbulence and air movement around the rather large structures of airplanes is better understood. Associating Leonardo's intuition to Adrian Nicholas' thrill seeking has produced unexpected results that may influence science for years to come.



CAPTURING RISK

The Making of *Adrenaline Rush*



You can't make a movie about risk without taking a few of your own.

Filming skydivers playing catch with a lead-filled tennis ball at each other, as they are falling towards the ground at 120 miles per hour (200 kilometers per hour) is by definition risky business. It requires careful planning, a lot of precise maneuvers from the jumpers and some nifty technical feats to bring the cameras right where the action is.

Swedish collaborators Göran Widenby and Peter Degerfeldt are partners at Blue Sky AB, a production company specializing in films about aerial sports. They played an important part in getting the stunning images of skydiving featured in *Adrenaline Rush*. Catching the skydivers in free fall required falling right along with them, with Göran or Peter wearing a camera strapped to their helmet.

The base jumping sequences – especially the jump filmed from a subjective perspective, making audiences truly feel as though they are jumping off a Norwegian cliff – required even more daring camera people. A 25-pound (12-kilogram) VistaVision 35 mm camera was strapped to the jumper's body, adding weight and extra aerodynamic challenge to an activity where half a second's hesitation can put your life in jeopardy.

Writer-director Marc Fafard, producer Carl Samson and the rest of the *Adrenaline Rush* cast and crew also benefited from a bit of sheer luck. On the day scheduled for testing Leonardo da Vinci's parachute in the Sonoma Desert in California, weather conditions were picture perfect, with clear skies and almost no wind. The next day, the wind rose and the weather remained bad for over two weeks. Obviously, the cast and crew had seized the only available window of opportunity, avoiding Mother Nature's rather fickle mood changes. In the world of risk, you can't control everything.

More importantly, the production completed without any accidents or injuries, after months of filming daring skydiving and base jumping feats. The result is a movie where safety and careful planning prevailed over risk, with remarkable and spectacular results.

Adrenaline Rush is a production of Sky High Entertainment, a film production company based in Quebec City in Canada. You can learn more about the company and about the production of *Adrenaline Rush* by visiting the Sky High website at:

<http://www.shemovie.com>



ADRENALINE RUSH

A Sky High Entertainment Production

Produced by: Carl Samson

Written and Directed by : Marc Fafard

Photography: Peter Degerfeldt & Göran Widenby

Editing: René Caron

Distribution: Giant Screen Films

TEACHER'S GUIDE

Text: Rémy Charest

Design: Christian Simon