MIT GAMES-TO-TEACH PROJECT

Design Document for:

EXTREME SPORTS (TYCOON)

Written by Kevin Johnson, Zachary Nataf, Philip Tan, Kurt Squire and the Games-to-Teach Team

Version # 1.21

Monday, May 27, 2002

TABLE OF CONTENTS

DESIGN HISTORY

Version 1.10
February 21, 2002. Kurt Squire. Compiled Sangita, Philip, Kevin, and Zach's work into this document.

Version 1.11
Continued updating. Kurt Squire.

Version 1.20
Heather Miller gave it a proofread. Added Zach's materials

Version 1.20
Kurt added more stunts and tightened the document.

EXTREME SPORTS TYCOON

How does a bungee jumper miss the ground by inches? What keeps a twine from breaking? What allows extreme athletes to experience their outlandish exercise fantasies *without* being killed by them?

These and other haunting questions are yours for the solving in *Extreme Sports Tycoon* (EST). While the game is enough fun to be played for its own sake, the physics and math behind extreme sports is the true subject of EST. Players learn math and science by experimenting with extreme stunt performance and booth design in a virtual environment. In EST, math and science concepts aren't something you learn for a test and forget the next day; they are tools that build your rep and earn you cash. Players use F=MA and spring equations to design optimal bungee jumping experiences. They manipulate the mathematics behind centripocal force to perform tricks in a Half-Pipe. Through Bungee Jumping, BASE Jumping, BMX Jumping, Freefall Rope Jumping, Ski Jumping, Snowboarding, Street and Ice Luge, players learn the basics of AP-level physics concepts like force, gravity, tension, velocity, and acceleration. When they get things wrong, the results can be disastrous.

Of course, half the fun of pulling off a Triple Lindsey is showing off for the crowd and building an untouchable rep. That's where the Tycoon Part comes in. High stakes lie behind every jump. Pull off a dope 720 McTwist and earn rep points and prize money. Pull off only 700 and you still earn rep points, but you'll bust your teeth and lose cash fixing them. Build up money *and* rep points to enter the high-stakes snowboarding parks. Run out of either and you're stuck with the 8 year-olds at the local bunny hill.

Extreme Sports Tycoon aims at kids who are more interested in pulling off a flawless Crippler than in mastering the nuances of vector physics. Through playing Extreme

Sports Tycoon, players learn that physics helps us to understand the world around us, and is a useful set of analytic tools for solving problems.

Extreme Sports doesn't stop there. Included in the game are a powerful set of level - editing tools where players can build their own booths and construct their own playable levels that are posted and traded over the Internet. Even though Extreme Sports Tycoon can be played and enjoyed as a single-player game, this community-based metagame becomes a key context for play.

Perhaps best of all, Extreme Sports Tycoon builds on existing technologies, could run on Pentium IIs with 56K connection and could be used in formal and informal learning environments *right now*. Extreme Sports could be developed using common development platform combining Director 3-D, and web community tools. With proprietary engines such as Ya-Ya media's web game engine, players might even compete with each other via email. Extreme Sports Tycoon's hip aesthetic, appeal to non-gamers, technical accessibility, and natural fit between content and gameplay suggest a natural fit between fun and learning. Almost as fun as pulling off a 540 lien underneath a bright blue Colorado sky. *Almost.*

GAME OVERVIEW

Backstory

You're a fresh-faced newcomer to the extreme sports scene, completely focused on becoming the next Tony Hawk or Kelly Clark.

Years ago, Extreme Sports were ushered in by do-it-yourselfers. These rugged individualists took back the world's slopes, runs, bridges, and mountains from corporate America and gave them to the people. No jogging on a treadmill for them; these guys and gals were after human-versus-nature, do-or-die, take-no-prisoners sports.

These days, what was once the hobby of a few die-hards has now hit critical mass. Events like the X-Games and the Winter Olympics have brought big money and corporate interests into the playing field. As a result, the best runs have been bought up by wealthy real-estate trusts, more interested in developing high – priced condos than letting you experience a rush of adrenalin. Sky-rocketing insurance premiums are dictating where you can and can't go, what kind of equipment you can and can't use, and what kinds of half-pipes can be built or not. In effect, the extremes of extreme sports are getting reined in. Face it: as long as someone else owns the hill; you're gonna practice your sport on *their* terms.

In Extreme Sports Tycoon, success is not just *looking* like you own the hill…it's *owning* the hill. Just as in real life, becoming a tycoon is a skill game. Fasten your seat belt; it's going to be a bumpy ride.

GamePlay

There are two aspects to the gameplay.

- The first is the action sports element, where players experiment on courses, participating in Extreme Sports events. Here, players
    - Select a booth to compete in
    - Manipulate anywhere from 2-5 variables to determine the performance.
    - Try to hit an optimal performance to pull off a goofy stunt
    - Gain or lose reputation and / or money based on the outcome, adjusted for difficulty (computed by the level), social desirability calculated by supply and demand of booths.

  More on how these systems interact are included for each level.

- In the second component of the game players design Extreme Sports settings (booths) for other participants. In designing these booths, players must set the base variables and conditions for the event balancing, the risk and reward for players. Good players will earn money and reputation by constructing booths that offer a great amount of thrill, while advertising danger; if a player creates a booth where other players injure

themselves while performing within the “accepted safety limits”, the booth owner (not the player) will be penalized.

Extreme Tycoon Economic Gameplay

Extreme Tycoon is a statistics game, using the setting of one-shot extreme sports as the basis of the activity of the players. The sports are relatively simple in terms of decision-making, in the sense that real-time interactivity during the participation of the sport should not be necessary. Examples are BASE jumping, bungee jumping, rope jumping, extreme rappelling.

A player-character runs an extreme sports site somewhere in the world, which we shall refer here as a 'booth'. A player-character is also an extreme sports participant and needs to visit other player-characters' booths.

Each player-character in Extreme Tycoon has to balance four statistics in order to progress in the game, which translates into unlocking new locations for the player to move his or her booth to.

1. MONEY

Money is gained primarily through having people attend your booth, although it may also be gained through stellar achievement on a jump, or out of game wagering. Money is primarily spent on preparing for and executing jumps (equipment, insurance and recovery), although there is also a small money cost for maintenance, which can be used to balance the game economy.

Inputs:

- Attendance (linked to THRILL), Players visiting your booth, multiplied by Thrill.
- High Scores (linked to THRILL). Winning High Score on specific jumps / in tournaments.
- Offline betting. We anticipate that players may want to wager on jumps.

Outputs (e.g. costs):

- Equipment (increased THRILL increase / decrease RISK). Upgrading and testing equipment like rope, ankle grips, harnesses. Equipment can be used to manipulate thrill & risk.
- Insurance for particularly risky jumps (less expensive than the next option)
- Height of fall from failed jumps (medical care)
- Booth Maintenance (decreased RISK). Automatic replacements after a number of jumps. This variable can be tweaked to add or remove money from the system.
- Moving booths.

2. REP

Rep is produced primarily by completing stunts and hosting stunts on your booth. Because rep comes at the expense of money, it is relatively easy to get money or rep, but very difficult to get both.

Inputs:

- Completing stunts (decreased MONEY). Through participating in other booths, players gain rep, which is the product of Risk times variety. (Limited so that rep does not increase much if you participate in more than 10 jumps a day.)
- Hosting high thrill stunts in booth (decreased MONEY, REP) for variety, insurance.

Outputs:

- Advertising (increased MONEY). Players can spend rep points to gain visibility on Extreme Tycoon's web site. (As a booth becomes mainstream and "known," it becomes less "cool" thereby losing REP).
- Moving a booth to more exotic locations (increased THRILL). New booths involve starting over your reputation. Moving a booth, however, can lead to increased thrill.
- Buying insurance for booth owners (decreased RISK).
- Continual decrease if player does not participate in jumps (atrophy) .

Booths produce statistics as well. Since each player-character runs up to 5 booths the following statistics are individual player-character statistics as well. Unlike the above two statistics, however, the following statistics do not have inflows and outflows but compute according to the qualities of the booth.

3. THRILL

Each performance on a booth produces a thrill variable. Generally speaking, THRILL produces rep while costing MONEY. Thrill is also created by skillful design / knowledge of physics. Thrill is calculated by:

- Top speed of jump
- Duration of jump
- Average minimum/maximum heights of jump
- Exoticness of location/inverse to the number of booths already in a location

4. RISK

Each jump has a risk variable associated with it. Risk serves primarily as a limit on MONEY. Risk is minimized by good design.

- Failures/successes with test jumps
- Injury rate from real jumps
- Number of jumps since last maintenance

Booths also have specific physical statistics based on the jump itself, such as the height of the jump, which players can get exact numbers for before deciding to participate in the jump. Although 'death' is not a possibility in this game, it is likely that many player-characters will plunge into extreme debt after a bad fall. It will be easier for a player to abandon and create a new character than to continue working with the same character.

These four factors can be balanced to achieve specific pedagogic ends; so, if a community of players is too engaged in jumping, and not enough jump planning or both designing, the variables can be tweaked to make failure more costly and the design of a good booth more rewarding. Similar, if players are not engaging with content in the design of their jumps, the RISK variable can be increased to stimulate thoughtful design.

Sports & Content

Extreme Sports provides contexts for students to learn about basic physics, including Kinematics, Newton's Second Law, Spring Formulas, and Uniform Circular Motion. The levels are not progressive; rather, they overlap and are redundant. This allows learners to work with content across contexts, which produces transfer.

Level	*Content*
Bungee Jumping	Multi-dimensional kinematics chaining into a spring problem; Newton's Second Law
BASE Jumping	Multi- dimensional kinematics chaining into another multi-dimensional kinematics problem; Newton's Second Law
BMX Jumping	Projectile motion
Freefall Rope Jumping	Multi-dimensional kinematics; Newton's Second Law; Friction
Ski Jumping	Multiple instances of projectile motion; Friction
Street (or Ice?) Luge	One dimensional kinematics and uniform circular motion
Snowboarding	Projectile motion; Friction

Simple Gameplay Description

The player decides to construct a bungee-jumping venue. He goes to the world map and scouts locations by dragging the mouse over available spots. When the mouse is stopped over a venue, a description of the default statistics is displayed. The player chooses a location to his liking and then purchases it. After reviewing the site statistics, the player begins to calculate what will happen during jumps. The key determination is how far the rope will stretch. First, the player derives an equation relating the distance the rope will stretch and acceleration via Newton's second law. Then, the player makes the same relation using the kinematics equations. With two equations and two unknowns, the player is able to solve for the distance the rope will stretch with relation to controlled variables. By plugging in values, the player is able to define parameters for his site for other people to follow. These values can be tested to see if the desired effect is achieved.

Simple Game Description 2

The player travels to a snowboard jumping venue. After viewing the jump statistics and the jump parameters set by the site owner, the player then makes calculations for his

jumper's particular statistics. Using projectile motion equations, the player is able to predict air-time and jump trajectory. The player then chooses the stunt he wants to perform on the jump. Once this is selected the player watches as his rider goes down the slope. At the appropriate time, the player presses the jump button to launch his rider off the ramp, hopefully at an angle close to the precalculated one. The player then watches as his rider attempts to perform the stunt. Unfortunately the player's timing on the jump was not sufficient and his rider is sent tumbling down the slope. The player is offered the opportunity to try the jump again or to move to a different location.

Stunts

Each sport will offer some basic stunts, and some unique stunts as well. What stunt is preformed is determined by the threshold that a player reaches, as determined by air time, top speed, and angle of trajectory. These are similar to SSX Tricky, but also very Tex Avery cartoon inspired. Player:

- Pulls out a book and reads it, with reading glasses
- Unties shoes, takes off board, holds it up and puts it back on.
- Changes his clothes (with a Sims like black box)
- Does a victory dance
- Does somersaults
- Flips
- Breakdances (spins, the wave)
- Pulls out a cell phone and makes a call
- Orders a pizza
- Pulls out a snack.
- Flexes in WWF style poses
- Pulls out and plays an instrument (electric guitar)
- Does the "YMCA"
- Cross dresses
- Pulls out a light sabre
- Swan Dive (and other various dives)
- The triple Lindsey

PHILOSOPHY / DESIGN GOALS

A game for the Extreme Sports crowd

Interest in Extreme Sports like Snowboarding, BASE jumping, and BMX racing has increased rapidly over the past decade. Games like Tony Hawk and SSX have capitalized on the growing popularity of these sports. Our goal is to create a game that will capture the fun of these sports and games to appeal to the aesthetic sensibilities of students who are into the Extreme Sports scene. Extreme Sports provides an inviting avenue into understanding how math and physics can be used in everyday life.

Low Technological Entry Point

Extreme Sports uses existing technologies, and could be developed today using Director, Flash, or other web-based 3D engines (e.g. Ya Ya Media) and web community software, written in PERL. Extreme Sports Tycoon is designed to be available to the broadest possible audience, and schools or users with modem-level connections and Pentium IIs could play the game. Players would not need 3D graphics cards, broadband connections. A major goal of Extreme Sports Tycoon is to provide a vision of how web-games might be used to support learning.

Appeal to non-core gamers

Extreme Sports Tycoon is designed to capture the casual or non-gamer. Extreme Sports is designed to appeal to the player who thinks that snowboards, BASE jumping, and Bungee cords are cooler than orcs, goblins, shooters, or puzzle games. The low technological entry point means that the casual or non- gamer can play Extreme Sports without having a "Next-generation" console or 3D graphics card. The simple point and click gameplay is designed to appeal to casual gamers who do not want a fast-paced game played under intense time pressures.

Appeal to Non academically inclined

Extreme Sports Tycoon makes physics and mathematics accessible to the non-mathematically inclined by using Extreme Sports as an entrée for understanding abstract Physics and Math concepts. Further, players are gently eased into interacting with mathematics formulas; they begin by manipulating simple variables, getting an intuitive feel for the relationships among variables. As players develop expertise in the game, they can use the formulas to guide the design of their booths and their choices in equipment. Thus, players are eased into using formulas to aid their design; they access formulas only once they've identified their functional value for creating effective performances.

Comic / Goofy Feel

Extreme Sports Tycoon has a comic and goofy feel. The game's fun factor engages players and relieves dramatic tension after disastrous falls. Players can choose among goofy and creative scenarios for their booths (e.g. rings of fire, lava, or jacuzzis), create colorful outfits to personalize their characters (e.g. bowling shoes, fedoras, or leather pants), create customized .mp3 files for when their characters perform stunts (e.g. shouts, songs, noises), choose among bizarre objects to add mass to their characters during stunts (e,g, cans of Spam, Farm animals, irons), and perform wild antics during their jumps (e.g.

changing their clothes in mid air). Much of the thrill of completing a successful (or unsuccessful) stunt is seeing the character perform a bizarre maneuver, or plummet to a hideous death. Thus, humor is used to both enliven the experience and lighten the mood after player failure (a design mechanism used with success in games like The Sims). There is a playful, humorous feel to each design element in the game.

Common Questions

What is the game?

Extreme Sports Tycoon is a web-based game that combines 1-shot extreme sports games and the design of extreme sports scenarios with an underlying web community meta-game. Players design extreme sports "booths" and compete in extreme sports events while earning money and reputation within a web community.

Why create this game?

Web–games are an underexplored platform for educational gaming. They are widely accessible, cheap to produce, and popular with mass audiences. Extreme Sports games can be easily simulated through a web gaming engine. Students who are uninterested in math or science will be drawn into the game and in the process of playing, will learn basic Physics.

Where does the game take place?

Extreme Sports Tycoon takes place in a series of "booths" across the world in the not-too-distant future. Players build booths at sites selected for their ability to illustrate physics concepts and appeal, such as the Eifell Tower, The Golden Gate Bridge, or Victoria Falls. These sites are tied together by a web community.

Describe the Controls

In the design phase, players control objects by dragging and dropping them into a design screen. They can tweak the exact distances of objects through fields. While performing jumps, players control the timing of events, and the direction and trajectory of initial velocity.

Trajectories are determined by a needle oscillating back and forth. The player hits the space bar when the needle exceeds the desired point of trajectory. The initial velocity is determined by how long the player holds down the space bar. Once the jump has begun, some sports (BASE jumping and snowboarding) will require a second action to time an event (such as releasing the parachute or pushing off of the jump) also by pressing the space bar. Players can use the timer or visual depiction to guide their jump.

What is the main focus?

The main focus of Extreme Sports Tycoon is playing around with different combinations of variables to produce the most thrilling jump and the most profitable booth. Players begin by "playing" around with these variables. In the process, they develop intuitive understandings of the math and physics involved. Once they've developed an intuitive understanding of the variables, they can use the exact equations to maximize their performance.

What's different?
Other extreme sports games exist, but none of them use humor, community-based metagaming, and viral marketing to create a more engaging experience. Other games such as bungee jumping flash games or The Incredible Machine have similar mechanics, but none of them approach any physics realism. Further, EST provides an inroads for players to start manipulating mathematical formula, which no commercially available games do

Who is the target audience?
People interested in math and physics-based games, ages 12 and up. We are not assuming any familiarity with extreme sports, physics or gaming conventions. We expect that this game will appeal to people interested in trying out extreme sports, or with a curiosity of how they work.

What will people learn through playing this game?
Kinematics, Newton's 2nd law, circular motion, and gravitation and oscillations, all of which are typically taught in AP-level Physics.

How will people learn through playing this game?
People learn through a trajectory of behaviors.
- They play with variables to gain an intuitive sense of how they interact in producing motion.
- They learn about relationships through designing booths
- They use Physics concepts to analyze booths for potential play
- They use formulas to tweak, and optimize booths

What are the core game mechanics?
Money, Rep, Thrill, Risk, and knowledge of Physics. Players must use money & physics knowledge to design booths. Booths produce thrill and risk. Players spend money to perform stunts, which gains them rep. The game is balanced so that attaining either money or rep demands some knowledge of physics. To attain either is easier than attaining both simultaneously. To gain both money and rep demands the creative use of Physics knowledge in effective booth design.

Give 3-5 verbs that describe the gameplay.
Planning, experimenting, playing, researching, laughing.

What platform are you aiming for?
PC – Web connected.

Describe the look and feel.
Extreme Sports Tycoon has a bright and colorful feel, common to the X-Games, or other Extreme Sports properties. There are a lot of bright oranges, yellows, and neon greens, similar to the pallette of Jet Set Radio Future.

Why is the game fun?

The game is fun because players can create alternate identities that are bold, daring, and famous. Successfully performing stunts is fun, as players gain a sense of accomplishment by earning money and rep. Humor of the game, particularly the randomly generated stunts provides a "fun factor." Finally, players' creativity in booth design provides much of the fun.

USER SCENARIOS

Minutes	Events	User Responses
0-3	Player learns about game, typically through email.	Player views jump, is curious about the application, and wonders if she can compete with friend.
3-5	Player visits website.	Player logs on to website and creates character. Player builds identification with character by choosing outfits and equipment.
5-8	Player tries a jump	Player experiments with a jump. She successfully completes a small snowboarding jump off of a bunny hill. Not very fun. Her rep actually goes down because she was on the jump. She decides to try building a booth to get more money.
8-10	Player creates booth. Player selects location, sets parameters of the booth, and creates obstacles / thrill bonuses.	Player feels a little unsure of what is happening, starts to wonder how detailed this simulation will be. For the first time, he wonders "How do they make sure that people don't die when they build these things?"
10-15	Player tests site to set recommended variables. Player throws bricks off of bridge to analyze how objects of different masses behave on the site.	Player experiences some relief in seeing that the game lets the player experiment by trial and error.
15-20	Player opens booth	Player feels some sense of accomplishment having completed a booth. Player gains satisfaction of watching others interact with the booth and begins earning some money.
20-45	Player tweaks booth	Player might choose to tweak booth, including the "recommended equipment."
20-22	Player selects booths for jumps.	Player get s a feeling for the expanse of the online community, as she looks at other booths and finds a booth to perform jump on.
22-30	Player performs jumps on other booths. Player selects proper equipment, calculates risk, takes out insurance, completes jumps, and earns reputation points.	Player feels sense of adventure has she tries out new extreme sports. Player is curious, and at times possibly frustrated at her inability to perform jumps correctly. Player also experiences surprise (and hopefully delight) at the humor of the game, seeing the adventurous booth set-

		ups goofy tricks, and funny failure states.
45	Player has completed a booth so that he/ she may earn money overnight.	Player ends with a sense of accomplishment and an eagerness to return sometime soon to see how well his / her creation does.
45	Player completes first jumps	Player earns first rep points; joins leaders

WALKTHROUGH 1: New User

Jim, 24 years old, receives an email from a friend, Kim, requesting that he check out a web game. Clicking on a supplied web site address, Jim opens up his web browser and begins watching a dynamic animation with accompanying music, introducing "Extreme Tycoon" with an animation of a BASE jumper landing into a pile of money. Intrigued, Jim clicks on the 'How to Play' button.

The instructions explain that this is an ongoing online game that saves a player's progress after each session of play. A player needs to design and run an extreme sports booth somewhere in the world in order to earn enough money to participate in other players' booths. The game prompts Jim to type in a username and a password, which he does. Detecting that Jim is a new player, the game asks Jim to confirm that he is creating a new player account on the online game.

After confirmation, the game lets Jim select how his character looks, which affects the weight of his character. The game also allows Jim to upload a WAV file as a 'trademark scream' but Jim elects to use one of the default sound effects for his character. Jim notes that he can return in the future to change the clothing and the scream of his character. Changing weight, apparently, costs in-game money for gym or food expenses. Jim notes he has some money to begin the game with.

The game asks Jim what sort of booth he intends to set up. Jim looks at the options and selects Bungee Jumping. The game then brings up a world map with three blinking dots, which reveal more information as the mouse moves over them. Jim notices that Bridalveil Falls in Yosemite National Park is an option but over 200 other players currently have booths in that area. He elects to set up his Bungee Jump location at Boondocks Bridge in the Midwest of the USA, which only 2 other players have selected so far.

The Bungee Jump design screen appears with a picture of the bridge and the river underneath it. Jim has a variety of options available to him, including the type of rope and the length of rope. He has a limited amount of money and the cost per unit length of rope is available on the screen.

“All of these options!” Jim thinks to himself. Jim notices that there is an *Extreme Sports Tycoon Manager’s Guide,* marked with a large question mark. Must be the help manual, Jim thinks. Jim scans the guide. “Welcome to the Extreme Sports Tycoon Manager’s Guide! This guide tells you all you need to know about owning and running an Extreme

Sports booth. Find out how to set up a booth that will earn you the most money, or learn a little more about the history of extreme sports."

Beneath this introductory description is listed the 7 Extreme Sports. Jim scans the list, finds Bungee Jumping, and clicks on the link. Jim sees (taken from The Physics of Bungee Jumping, The Physics Teacher.
http://www.bungee.com/press&more/press/pt.html:

> Bungee jumping make look crazy (and maybe it is). But, with a little knowledge of physics, you can greatly minimize the risks of jumping off of bridges and platforms with nothing more than a piece of string to save you.

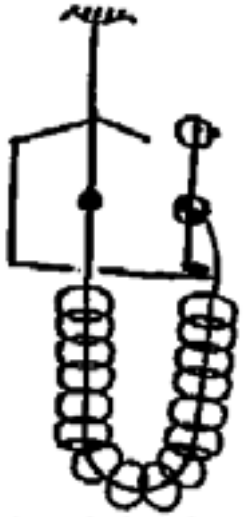

Fig .5. Schematic depiction of a jumper in the initial position.

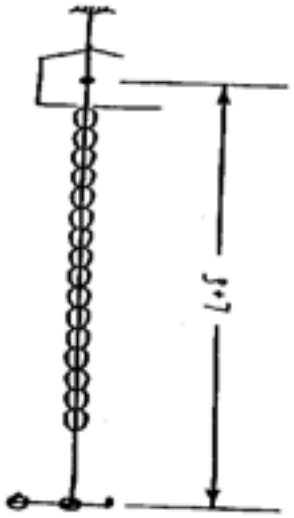

Fig.7. Schematic depiction of a jumper having fallen the jump height, L + δ .

> From a physics standpoint, bungee jumping about the conversion of potential energy at the start of a jump to elastic potential energy at the bottom. The basic equations involved have been used for years to describe events in which loads are suddenly applied to springs. The bungee cord is simply a very weak spring yielding large spring deflections and rather small force magnitudes. But for the benefit of those who didn't know this, we'll lay it all out here.
>
> If learning through play is more your style, we encourage you to set up a booth and experiment by throwing some weights off of your platform and seeing what happens.

Notes on the History of Bungee Jumping, Equipment, Safety, and the Physics of Bungee Jumping follow) . This information can be found at
http://www.bungee.com/press&more/press/pt.html:

Jim scans the text. "looks interesting, but I'd rather play around with the weights, first." Jim closes out the Manual so that he may perform tests by putting measured weights on the rope and throwing them off the side of the bridge. He notes that each test costs a small amount of money.

Jim starts testing weights. The default setting works but when Jim tests the jump with a 60kg test weight, it only falls three-quarters of the way before snapping back up again. “That doesn’t look very fun,” Jim thinks. He decides to extend the length of the rope, which brings the weight closer to the river but costs him more money. While he performs these tests, the game records the fastest speeds experienced by the test weights, the maximum forces on the weight and the relevant heights. All these factors are computed to show the jump's current Thrill rating, which corresponds to how the excitement level for Jim's jump for the virtual jumpers.

Jim experiments with a less-expensive, stiffer rope. However, the forces experienced by the weight are much greater. “I wonder if they’d hurt a human jumper,” Jim thinks. Jim looks at the force meter, which is blinking in red. “Heh, yeah, that can’t be a good thing”. Jim chooses a more elastic rope, which works well with a short length of rope. It does not achieve great speeds, as the rope begins slowing the weight down before it has had much time to accelerate but it saves Jim a lot of money. “Well, good enough. It works, at least.” With his left over money, Jim buys a jacuzzi, and places it at the bottom of the bridge, floating on araft. Heh…that’s pretty funny, he thinks.

Jim is ready to make his jump available to other players. The game allows him to name his jump and add a small message. Jim simply names it "Jim's Jump" and writes “Leap into Jim’s Jacuzzi with Jim’s Bungee Jump!” to make his jump sound attractive.

Jim then visits the other jumps at Boondocks Bridge and looks at them, noting that one of them has used the message option to state the safety margins of the jump. Seeing that the weight of his character almost fits in those safety margins, he selects that jump and the game shows his character standing on the side of the bridge. Before he jumps, however, he notes that the rope is considerably longer than his jump and uses the same type of rope that Jim uses. Realizing he might be hurt from this jump, he elects to participate in a different Boondocks Bridge jump, which his character survives and enjoys with a satisfying yell.

Jim decides to take a break at this point and return to the game later. Jim notices the option “Email to friend” at the bottom of the screen. Jim clicks “save jump” and sends it to his friend Karen via email.

WALKTHROUGH 2: Returning Player

Logging in to Extreme Tycoon after lunch, Jim notes that several people have visited his jump and he now has more money. However, he wants to figure out how he could save money in the future, realizing that a lot of money was spent on testing his jump. This decreased the Risk rating of his jump (automatically computed by the game) but it should not have been necessary for him to spend so much.

Clicking on the 'Your Booth' button brings Jim's Jump to the window and Jim realizes that each of the statistics computed during the jumps has a little question-mark icon next to it. He clicks on the icon, re-opening the Manual in a small window. The Manual opens

to the Bungee Jumping page and explains how the game calculates the statistics. The same window also explains the physical principles behind each statistic and a few equations that can be used to approximate the statistics without performing an actual test.

Jim notes that the sample equations automatically compute results as he attempts to vary the properties of his Bungee rope and test weight without having to actually perform tests. Clicking on the other question-marks open other small windows that calculate other statistical approximations as he makes his variations, allowing Jim to make good guesses regarding the optimization of his booth. He notes that balancing the maximum speed of his jump against a safe maximum length of the elastic cord is rather difficult but by playing with the values, he gets an intuitive sense of how safe or dangerous his jump is for different weights. Jim changes his jump's message to state the safety margins of his jump, based on his intuition. However, he does not commit to any other changes to his jump for now.

Examining his personal profile and switching clothes of his character, he notes that he has a Rep statistic, which the game explains will increase by successfully participating in extreme sports booths but will decrease with inactivity over a day. Furthermore, Jim can opt to move his booth to a new, exotic location with a reduction in his Rep. At this moment, however, Jim notes that his Rep is far too low to be useful and begins seeking other kinds of extreme sports offered by the game.

Clicking on 'Visit Booth', the game asks Jim what sort of booth he is interested in finding. Jim notes that there is an option for 'BASE jumping', which intrigues him. The game explains that this is an activity where one jumps off a high location and parachutes to safety. The dangers primarily arise from poor timing; too soon and the wind blows you off-course, too late and you suffer injuries, which would cost Jim medical fees. The world map shows currently staffed BASE jumping locations around the world. Jim selects Paris, which leads him to the Eiffel Tower. “That’s pretty cool,” Jim thinks.

300 booths operate in this location, so Jim has some freedom to pick and choose. Each Eiffel Tower booth has information on its owner next to it, as well as each booth's attached message. Jim selects a booth belonging to a player with a very high Rep and a comprehensive message listing safety ranges. Not having performed this sort of jump before, Jim elects to click on the Red Cross icon beside the 'Jump' button, which spends most of his available money buying medical insurance.

Jim clicks the 'Jump' button, which triggers the animation of Jim's character jumping off the Eiffel Tower. A prominent digital clock counts the number of seconds elapsed from the beginning of the Jump. Jim remembers that the booth's message recommended that he pull the ripcord between 4 and 5 seconds by pressing the Space Bar. However, Jim's reflexes are not terribly good, and having pulled the ripcord one second late, Jim's parachute opens but his character has a nasty fall on the ground.

Normally, this would have cost Jim all the money than he had. However, since he had medical insurance, he does not need to pay for additional medical bills. Out of this

experience, Jim learns about BASE jumping, gets some ideas for setting up his own BASE jumping booth in Extreme Tycoon, and watches an amusing replay of his own pathetic plummet into the Parisian sidewalk.

WALKTHROUGH 3: Established Player

Kim has been playing Extreme Tycoon for a while now, and logs in to see how her snowboard jump is doing. Her profits are falling somewhat, which is problematic, as the booth design screen reveals that the strength of the struts supporting her jump is failing due to the high numbers of visitors to her booth. Furthermore, she has used the booth design window to set up a maintenance schedule, which automatically spends money from her account in order to maintain the freshness of the snow on the jump in order to reduce the friction. If she fails to earn enough money to fund her maintenance schedule, snowboarders will not be able to get enough speed to clear some of the coniferous trees between her jump and the landing site and attendance to her booth will drop.

She considers spending some money on replacing the struts and renewing the maintenance schedule but she decides to investigate alternative solutions. Since her booth has not collapsed yet, and the maintenance schedule has been regularly funded, there cannot be anything inherently wrong with her booth. Looking at the World Map, she confirms her suspicions: other people have moved their booths into the same location as hers and have optimized their jumps to provide better Thrill ratings.

Kim weighs her options: while she has a considerable amount of money in her account, staying in this location will probably cause her income to drop to negative levels extremely soon. She also has an extremely high rep rating, due to her having lots of fun participating in other people's booths. Kim decides to bite the bullet and scrap her booth, reclaiming a fraction of its value in salvage costs. The game asks her what sort of booth she is now interested in setting up, and she decides to stick with the snow theme and check out Ice Luge.

The World Map appears with a large number of potential locations. She could move into several of the more crowded locations at no penalty, or into some of the more exotic, less competitive sites in the world by spending some of her Rep. She picks a location at Vostok, Antartica, thinking that producing snow would be relatively cheaper at the South Pole compared to an equally exotic location in Jamaica.

The booth design screen is again customized for the type of booth. Kim puts in twists and turns into the ice, occasionally adding artificial inclines and embankments to maintain the speed of the test luge while she keeps an eye on the estimated Thrill level of her booth. She brings up the formulae that allow her to estimate the kinetic energy of the luge at various hills, troughs and turns of her luge route, reducing the number of costly test runs needed.

Once she is happy with her design, Kim clicks on the 'Publicity' icon, which allows her to send automatic messages to a proportion of the other players of Extreme Tycoon by spending in-game money. Figuring that it is a new booth, she spends heavily on publicity, ensuring that her two-line blurb will appear whenever a player logs in within the next 48 hours. Once this is done, she receives an email from Jim asking her to check out his Bungee Jump at Boondocks Bridge, which she does.

GAMEPLAY VARIABLES

Extreme Tycoon Economic Gameplay

Extreme Tycoon is a statistics game. The setting of one-shot extreme sports is the basis of the activity of the players. The sports are relatively simple in terms of decision-making, in the sense that real-time interactivity during the participation of the sport should not be necessary. Examples are BASE jumping, bungee jumping, rope jumping and extreme rappelling.

A player-character runs an extreme sports site somewhere in the world, which we shall refer here as a 'booth'. A player-character is also an extreme sports fan and needs to visit other player-characters' booths.

Game Types and Variables

Bungee

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Crosswinds
- Scenario weirdness

Cost of setup/maintenance:

- Height of platform
- Length of rope
- Type of rope
- Harnesses

Schtick:

- Flaming hoops
- Paintbrush hat
- Jacuzzi
- Misc. Objects

Jumper Variables

- Mass
- Height
- Type of Rope
- Length of Rope
- Angle of Trajectory

BASE

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Crosswinds
- Scenario weirdness
- Fogginess

Cost of setup/maintenance:

- Height of platform
- Size of parachute
- Landing area

Schtick:

- Mines
- Landing area weirdness

Jumper Variables

- Mass
- Height
- Size of Parachute
- Timing of Parachute
- Angle of Trajectory
- Velocity of take-off

Rope

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Scenario weirdness

Cost of setup/maintenance:

- Type of rope (spring constants)
- Height of platform (difference in heights)
- Length of rope
- Harnesses

Schtick:

- Flaming hoops

Player Variables

- Mass
- Strength
- Push-off velocity

Extreme Rappelling

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Crosswinds
- Scenario weirdness

Cost of setup/maintenance:

- Height of platform
- Length of rope
- Type of rope
- Harnesses/grips

Schtick:

- Flaming hoops

Player Variables

- Mass
- Strength
- Push-off velocity

BMX

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Scenario weirdness

Cost of setup/maintenance:

- Height of ramps
- Angles of ramps
- Quality of bike (speed, landing)

Schtick:

- Obstacles
- Animations (random)

Player Variables

- Speed
- Timing of Push off

Snowboard

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Scenario weirdness

Cost of setup/maintenance:

- Height of ramps
- Angles of ramps (amplitude tricks)
- Quality of board (speed, landing)
- Quality of snow (runway, snow on ramp, landing)

Schtick:

- Obstacles

Player Variables

- Speed
- Timing of Push off

Ski

Site:

- Cost of venue
- Base thrill of venue
- Base risk of venue
- Scenario weirdness

Cost of setup/maintenance:

- Height of ramps
- Angles of ramps
- Number of jumps
- Quality of ski (speed, landing)
- Quality of snow (runway, snow on ramp, landing)

Schtick:

- Obstacles

Player Variables

- Speed
- Timing of Push off

Ice Luge

Site:
Cost of venue
Base thrill of venue
Base risk of venue
Scenario weirdness

Cost of setup/maintenance:
Banking of turns
Number of turns
Quality of Luge brakes (speed, thrill)
Quality of ice

Schtick:
Jumps

Player Variables

- Initial velocity (push off)
- Timing of Push off
- Breaking
- Angle of Turns

GAME CHARACTERS

Overview

The game player consists of an avatar, a combination of statistics, particularly money and reputation, a history of accomplishments, as represented through artifacts, awards, and descriptions of accomplishments, and creations manifested in booths.

Avatar

Players create avatars by selecting from pre-existing choices of character parts, or uploading their own. Customizable parts include (nearly all of them have piercings):

- Headgear
- Hair
- Eyebrows / forehead
- Eyes
- Nose / Cheeks
- Mouth / Teeth / Lips
- Chin / Neck
- Torso
- Arms
- Upper Legs
- Lower Legs
- Shoes
- Equipment

Attributes

Players then enter in the height and mass, and the avatar is adjusted accordingly.

Statistics

The primary two statistics are Money and Rep.

Player Statistics:

The game tracks for each player:

- Number of jumps taken
- Number of successful jumps (including %)
- Number of accidents (including %)
- Total hospital bills
- Number & percent of jumps taken without insurance
- Number of jumps taken of each type
- Rep per jump

Booth Statistics:

The game tracks the following statistics for booths.

- Money earned
- Total jumps / plays

- Money per play
- Thrill Factor
- Thrill per jump
- Number of accidents
- Number of accidents / jump
- Number and percent of accidents due to user error

History of Accomplishments

Top accomplishments for each type (top velocity, longest airtime, fastest time, closest to ground -- bungee, longest time in air -- parachuting) are also tracked. Awards are given for

- any jump that is in the top 1%, 5%, and 10% of all performed,
- the top statistic for any booth.
- top statistic in entire land
- Top rep & rep per jump
- Top money

A number of “silly awards are also given for

- worst accident
- top number of doctor bills
- Longest streak without a wreck

In addition, awards are given to booth owners for

- Top thrill rating,
- Safest booth
- Most dangerous booth (% wrecks, most number of wrecks)
- Most visitors,
- Most days without a wreck.
- Most day with at least 1 accident

These lists can be added to or subtracted from. The goal of tracking these statistics is to provide players feedback on their actions and to promote metagaming.

USER INTERFACE, AESTHETICS AND SKINS

The overview shows sports stalls for bungee jumping, canyoning, BASE jumping, etc., in a range of locations. The sites are surrealistically embedded in a mountainous, virtual Japanese (Hiroshige or Hokusai woodblock print) type landscape.

In turn mode at each stall, the interface has numerous options, which can be applied to create a unique 'branded' look, built by the stallholder. These interface options include, many fantastic options, including 60s (mod and hippie), 70s (disco and burn-out), 80s, and several bright and colorful looks that are typical to the extreme sports genre. Some are more fantastic, some retro; some are high-tech or futuristic-organic hybrids. These multiple versions dot the landscape, each with its own characteristic that represents a specific stall for a specific sport at a specific geographical location.

Using the pop-up character description screen within the interface, the players' simulated characters/athletes can be customized to have certain visual characteristics such as gender, body style, muscle development, hair style as well as sports performance characteristics such as speed, dexterity and courage. However, at the start of each attempt, at the site of each sports stall, athletes characteristics can be further tweaked to fit circumstances from sport to sport (a barbell power-up can give more muscle mass, a stretch power-up more flexibility).

In the same way that characters can be tweaked, the setting of each jump, etc. can be adjusted according to the characteristics of the character (weight and height) or the weather or wind conditions, the qualities of the equipment (more or less springy bungee cord), the nature of the (score-enhancing) stunts or moves that the character wishes to execute. As well as the technical tweaking players can change characters clothes, select gear (boards, boots, goggles, etc) which can be coordinated, spoofing Extreme sport fashion and lifestyle, and importantly with each attempt players can select the accompanying music to set the mood for their turn.

As well as the location overview and the stall view there is also the drop view of the athletes in the midst of falling. Although this is a 2-D environment, the perspective change will add to the intuitive feel of this simple flash animated simulation.

TECHNICAL INFORMATION

Overview

Extreme Sports Tycoon is designed to run on contemporary Web-based 3D gaming engines, such as Java 3D, Shockwave, or Ya – Ya Media. The level-constructor is the only technically novel aspect of the game. There are several physics engines such as Havok that can be used with most web plugin software applications.

Small Game Levels

On each game level, the player controls 3-4 limited variables. Only one or two of them change action within each level. More often, the levels involve setting the initial conditions for the variables.

Multiple Camera Angles

On each level, the player can view the actions from multiple cameras. Minimally, there is an overall perspective camera, and the point of view of the player. However, booth designers can also set cameras in the world.

Interactive Textbook Resources

Extreme Sports Tycoon includes all of the text and pictorial information that one might commonly find in Physics textbooks. However, because Extreme Sports Tycoon also ships with robust simulation software (in the form of the game), students can not only read about Physics information, but they can also experiment with variables, and learn through Play.

MUSICAL SCORES AND SOUND EFFECTS

Overview

Because Extreme Sports Tycoon may be used in a variety of settings (including classrooms), we have tried to minimize the amount of sound in the game. However, sound effects are a key component of the game (particularly the fun factor). Comical sounds play at the beginning and ending of jumps. Players can upload sounds into the system that are to be played while doing their jumps. Booth owners can upload sounds to play at the completion of jumps as well.

Music Design

Each player can set their own music to play during their booth. The game will include options for listening to a list of songs across musical genres, including techno, house, country, blues, modern rock, and classical. Drawing from the success of games like GTA3, we want to give players opportunities to create interesting juxtapositions of action and soundtrack through their musical choices. In addition players can upload their own songs to play at their booths during the game. If licensing / distribution becomes a problem, we will instead contract bands / musicians from mp3.com to participate in the game for free publicity. We think that getting unsigned or underground acts will be consistent with the independent nature of the game.

WORLD EDITING

Overview

Players construct their jumps through a WYSIWYG editor system. Each sport is reduced to a set of variables that the player can manipulate. In the case of bungee jumping, this includes setting, platform height, rope length, rope elasticity, initial velocity, initial angle of trajectory, and jumper mass. Further, designers can place objects, such as flaming hoops in the environment.

Constrained Choices

Complexity is reduced by allowing users finite choices. Players can choose from any one of 100 settings for their site (Each setting is a simple 2.5 D environment, constructed in a 3D program like Studio Max and exported into the game engine).

- *Platform height.* Designers can set the height of the platform in each environment. Players set this height by drag and drop, and then can tweak the exact height by entering the exact distance in a field.
- *Rope Length*. Designers can choose a set of 12 rope lengths that will be available for each site.
- *Rope Elasticity*. Designers can choose between 10 different rope elasticities.
- *Jumper Mass*. Designers can make extra objects available for players to increase their mass.
- Schtick Objects. Designers can select from a list of objects to increase the thrill of jumps, which would include flaming hoops, buckets of water, jacuzzis, and paint brushes / targets.

Allowing for choices in objects minimizes the amount of computation and enables the application to store objects client side.

WYSIWYG Editing and Simulation

Although players interact with the authoring tools in a WYSIWYG editor, the exact position of each elements are recorded along x, y, & z axes. Players can tweak the exact positioning in dialog boxes. As the simulations run, players can observe simulation output in real time, including the velocity, acceleration, and positioning of the avatar.

MATH/SCIENCE / CONTENT

Overview

Extreme Sports Tycoon is designed to be used in support of learning first year AP – level Physics. While playing Extreme Sports Tycoon, players deal with content covered in the following areas of introductory physics.

A. Kinematics (including vectors, vector algebra, components of vectors, coordinate systems, displacement, velocity, and acceleration)
    1. Motion in one dimension
    2. Motion in two dimensions including projectile motion

B. Newton's laws of motion (including friction and centripetal force)
    1. Dynamics of a single particle (second law)

C. Circular motion and rotation
    1. Uniform circular motion

D. Oscillations and gravitation
    Mass on a spring

These are core areas of most any AP-level Physics course.

Formulas for Extreme Tycoon

Variables

- Xo/X – initial/final position
- Vo/V – initial/final velocity
- A – Acceleration
- G – Acceleration of gravity
- Mx – Mass of object x
- K – Spring constant
- Fx – Force of x
- L – Length
- R – Radius
- T – Period of circular motion

Kinematics Equations

- $X=Xo + VoT + .5AT^2$ – finds position; useful for calculating parameters of a freefall

- $V = Vo + AT$ – used to calculate instantaneous velocity
- $X = Xo + ((Vo + V)/ 2)T$ – a way to solve for position, velocity, or time when acceleration is unknown
- $V^2 = Vo^2 + 2A(X – Xo)$ – solve for position, velocity, or acceleration without knowing time

Newton's Second Law

- $F = MA$ – use given forces to calculate acceleration, or calculate forces from acceleration

Spring Formula

- $F_{spring} = -KX_{spring}$ – Calculate the force of spring with relation to how far it stretches from equilibrium

Uniform Circular Motion

- $A = V^2/R$ – The acceleration of an object in circular motion
- $A = 4\pi^2 R/T^2$ – Calculate circular motion acceleration when velocity is unknown

Sample Program – Bungee Jumping

Two part problem – freefall portion and rope portion

1) Freefall portion – the only important element here is the velocity of the body when the bungee begins to pull. Realizing that this is the only important part is the difficulty of this segment (which is more difficult than it sounds).

$V^2 = Vo^2 + 2A(X - Xo)$ – we can't figure out T nor do we need it

$V^2 = 0 + 2GL$ – Starting velocity is 0 because the jumper starts at a standstill. Freefall means that A = G and the freefall lasts as long as the length of the rope L

$V^2 = 2GL$ – We'll leave it like this for now

2) Bungee portion – The ultimate thing to calculate here is how far the rope will stretch. One thing to keep in mind is that the acceleration at this point is upwards and <u>not</u> G.

$F_{total} = MA$ – There are forces at work so start with Newton's Second Law. The mass of the falling body will just be M since there are no other masses.

$MG - F_{rope} = MA$ – We assume that down is positive so the force of gravity (MG) is positive and the force of the bungee is negative. But the bungee is a spring so we get:

$MG + KX_r = MA$ – The spring formula calls for $-KX$ (X_r is the length the bungee will stretch) so we get the plus sign. Now we have 2 unknowns: X_r and A. There is a way to relate them however…

$V^2 = Vo^2 + 2A(X - Xo)$ – We can relate X_r and A with this

$0 = Vo^2 + 2AX_r$ – We try to calculate what happens when the bungee is fully extended. At this point the velocity is zero, but the acceleration is upwards. Vo is the velocity once the rope begins to tighten. We figured this out from the freefall section.

$0 = 2GL + 2AX_r$ – Substituting for Vo^2

$A = -GL/X_r$ – Solve for A. Now we plug into our Newton's Law equation

$MG + KX_r = -MGL/X_r$ – Now X_r is the only unknown

$MGX_r + KX_r^2 = -MGL$ – Multiply through by X_r

$KX_r^2 + MGX_r + MGL = 0$ – In the end you are left with a simple quadratic. Plug in values for M and find an acceptable range for X_r

PEDAGOGICAL APPROACHES

Overview

Extreme Sports Tycoon is designed to give players both an intuitive understanding of physics phenomena, and an entrée for using physics formulas to solve real world problems. Thus players begin by designing booths where they manipulate key variables, using trial and error to arrive at productive combinations of variables. The tycoon game mechanics are designed to promote prolonged engagement in the game. After several hours of gameplay, players will have developed intuitive understandings of the formulas and can begin tweaking particular variables to achieve maximum results.

We hope that playing Extreme Sports Tycoon will promote deep conceptual understanding of Motion Physics. Players interact with physics concepts both conceptually and mathematically and across a variety of contexts. Extreme Sports Tycoon allows players to focuses on 2-3 key concepts, and examine and re-examine them in different contexts. John Bransford and colleagues show that such intense study of concepts in multiple situations -- particularly when used to solve problems is a strategy known to facilitate deep learning and transfer of knowledge.

Thus, Extreme Sports Tycoon is designed to gradually lead players into the world of Physics. Players learn that Physics not only has practical uses in the world, but is well within their intellectual grasp. Gradually, they begin to fine tune variables and start interacting with formulas in a more comprehensive and precise manner.

A subtext to Extreme Sports Tycoon is that Physics is not only accessible, but can be fun. We've consciously tapped into the "coolness" of extreme sports, showing how a knowledge of Physics is a core element of these sports. Extreme Sports will help students begin to link Physics with motion, action, and understanding the world around them.

Learning By Design

Pedagogically, the game leverages learning by design approaches. Players learn through thinking with Physics concepts in the design of their booths. Learning by Design approaches (e.g. Perkins, 1986) facilitate deep learning by allowing students to think critically and creatively with information.

Purpose

A critical element of learning by design is that learners construct knowledge in purposeful activities. Creating knowledge in functional contexts helps students develop robust (as opposed to inert) knowledge that can be used to solve problems. In Extreme Sports Tycoon, students are required to develop their own purposes (do I want a fast booth, a dangerous booth, one that’s accessible to a broad audience?) and then use Physics to design the booth according to those specifications.

Connecting to Models

Robust Physics models underlie Extreme Sports Tycoon. Players learn by tinkering with their models. Participating in Trial and Error performances, players can develop intuitive

understandings of how models of motion interact, and then test these models in their design.

Connecting to Structures

A potential problem with complex learning by design / modeling activities is that learners may not have opportunities for perceiving the deeper, structural relationships between elements. To counteract this pitfall, Extreme Sports Tycoon includes textbook – like resources in the form of the help files where players can learn about the specific formula and see demonstrations of concepts. We expect that students would use this text as a resource to flesh out their understandings of Physical phenomena, consulting it much like a researcher refers to reference texts.

Opportunities for Reflection

Money and rep function in the game to encourage students to reflect on their designs between iterations. Because failure means losing money and / or reputation points, players are given incentive to reflect on their activities and predict the consequences of their choices. Further, the communication structures allow players to collaborate on designs and critique one another's designs. Players might debate the safety of a booth, or assist one another in the design of their booths.

Flexibly Adaptive to Teaching Situations

Extreme Sports Tycoon is designed to be a stand-alone game that players and students could play for entertainment or to learn more about Physics. However, we have also designed Extreme Sports Tycoon so that teachers could use it in a variety of scenarios.

Extreme Sports Tycoon as a Stand Alone Unit

The most obvious, and perhaps most desirable method for using Extreme Sports Tycoon would be as a relatively self-contained unit, spanning 3-6 weeks. One can imagine a unit starting with some videos and pictures of Bungee Jumps, and then asking students "How does this jumper know that she won't crack her head open?" From there, students might be given a simple bungee problem, and a few formulas, and asked to estimate answers. This activity would prompt students to ask questions about how and why Bungee jumping works.

The instructor might introduce the game, explaining that players will play Extreme Sports Tycoon in order to learn more about the laws of motion and how they play out in events on earth. Players might be given 1-2 weeks to play the game, with the instructor answering questions, and delivering just-in-time lectures as necessary. The instructor may construct booths to isolate variables or highlight particular relationships. The savvy instructor might also observe students' activities, and assign design challenges as homework (e.g. design a bungee jump where the jumper reaches a velocity of 100 mph but is left hanging 36 feet from the ground at the end). Or, the instructor might use Extreme Sports Tycoon as a test for students at the end of a unit.

Thus, embedded within this "Unit Plan" Scenario might be three other uses of Extreme Sports Tycoon:

- Demonstrations

- Practice Problems
- Assessments

Different instructors might arrange these activities according to their needs. Some may assign the game as homework. Others may prefer to use class time to have students work on problems and then observe student work and give just-in-time lectures as necessary. Still others may want to supplement the game playing with demonstrations and activities that involve physical objects. Next, we highlight Extreme Sports Tycoon as a demonstration, practice, and assessment tool.

Extreme Sports Tycoon as Demonstration

The instructor is introducing the spring formula. So, she constructs three different booths with three different rope lengths. Next, she has the class predict which rope will leave the jumper at selected heights. Using a projector, the instructor runs the simulation nine different times. In each demonstration, she asks students to predict how the system will behave. Then, she explains to them why it unfolded the way it did.

Extreme Sports Tycoon as Practice Problems

These same three problems might be given to students to work on in a laboratory situation. Working in teams of three, students have 5 minutes to develop a solution to the problem. Students might split their efforts between estimating values by running trial jumps, and then plugging numbers into formula. Or, teachers might construct challenges for students, such as design a booth with the highest thrill value. Finally, instructors might challenge students to design a series of booths to communicate a Physics principle concept, such as F=MA. So, students might design a series of jumps with varying initial velocities or masses in order to show how different variables create different force on the rope. The same web community that is used for players to create booths might be used for teachers to exchange formulas.

Extreme Sports Tycoon as Assessment.

Teachers might use Extreme Sports Tycoon as tests. Whereas in traditional environments, teachers might construct paper-based problems where students solve for unknowns, in Extreme Sports Tycoon, teachers might construct problems where players must select the proper length of rope, or design a booth where players reach a top velocity of 100 mph and are left hanging 25 feet from the ground. Such design tasks would demand that students have a comprehensive understanding of the key formula, including when and how to employ them in the pursuit of complex design tasks.

Assessment Methodologies

Extreme Sports Tycoon is designed to support several types of assessments. First, players get continuous feedback on their work by watching how well their choices work in the game. As players perform jumps, and conduct trial tests on their booths, they can test their assumptions about how booths work. Further, they can receive peer feedback as classmates critique how well their designs function within the community. The chat tools and message board tools of the community allow players to critique and debate different booths.

RESOURCES

Menz, Paul G. The physics of bungee jumping. Physics teacher, v. 31, Nov. 1993: 483-487.

AP Physics — Newtonian Mechanics Table
http://www.collegeboard.com/ap/students/physics/cours007.html
A list of the content of the AP Physics B and C tests

Justin the Bungee Jumper. Clemson University Physics Department.
http://hubcap.clemson.edu/phys-car/fun/bungee/

Hands on Physics—The Great Bungee Jump Project
http://hop.concord.org/amu/amu.index.html

Bungee Equipment—http://www.fettke.com/bungee/equip.htm
Canyoning Equipment—http://www.petzl.com/FRENG/tech/canyon.html

Geographic Imaging Tools
http://ww.esri.com/software/arcview/extensions/imageext.html

SPORTS HISTORY APPENDIX

II. HISTORY OF BUNGEE JUMPING

Bungee has quite an old origin. The idea of this way of jumping comes from the ancient ritual "Gkol" performed in the Pentecost Island in the Pacific Archipelago of Vanuatu. The legend says that in the village Bunlap a man called Tamalie had a quarrel with his wife and she ran away and climbed a Banyan tree where she wrapped her ankles with liana vines. When Tamalie came up to her, the woman jumped from the tree and so did her husband not knowing what had his wife done. So he died but the woman survived. The men of Bunlap were very impressed by this performance and they began to practice such jumps in case they got in similar situation. This practice transformed into a ritual for rich yam harvest and also for proving manhood.

Modern bungee jumping as we know it today actually started on the 1st of April (Fools' Day) 1979 when a group of people from the Oxford University Dangerous Sport Club, impressed by a film about "vine jumpers", jumped from 245-Clifton Suspension Bridge in Bristol, England. Using nylon braided, rubber shock cord instead of vines, and dressed in their customary top hat and tails, they performed a four man simultaneous jump .The enthusiasts were promptly arrested for this. But the news hit the world press the next day. The new adrenaline mania had begun. The D.S.C. performed many other jumps, including one off the Golden Gate Bridge. In early 1988, A.J. Hackett and Chris Allum, opened the first commercial jump site in Ohakune, New Zealand. Hackett also made a great commercial show in 1987 when he jumped from the Eiffel Tower in Paris.

As part of the publicity, Hackett performed an astounding bungee jump from the Eiffel Tower! Since then, there have been a lot of towers, cranes, bridges and even hot-air balloons serving as platforms for jumping and bungee is the simplest and most easily understood of the aerial extreme sports.

III. **History of Parachuting**

Information about parachute-like contraptions dates back to the 12th Century. By that time in Chinese court ceremonials certain devices resembling parachutes were used to perform jumping stunts from special towers. The umbrella - one of the inventions of Chinese people, has a significant similarity to the parachute mechanism.

Three centuries later the idea of the parachute was invented by Leonardo Da Vinci. He made a sketch of pyramid-shaped structure in his notebook. His original idea was to help people escape from high-burning buildings safely. Although as far as it is known Da Vinci did not put into practice his project. Modern engineers believe it would have worked. That is why Leonardo Da Vinci is considered to be the "Father of the parachute".

About a century later the Hungarian mathematician Fausto de Veranzio who was working in Italy published a book called "Machinae Nova" about his designs of new devices. In that book he shows a picture of "Homo Volans" ("Flying Man") - a man who had jumped from a high tower with an almost modern-looking parachute - some kind of oblong sail attached with four lines to a harness on the jumper. Although Vernanzio claimed to have several jumps with it there is not evidence proving this statement.

In 1779 the French physicist Sebastian Le Normand, together with Joseph Montgolfier studied about parachutes by throwing animals. Le Normand is considered to be the first systematic parachute constructor.
Then in 1785 Jean Pierre Blanchard, famous balloonist and the first man who flew over the English channel, began to work on parachutes. After making successful tests with animals and even his own dog, he jumped himself several times reaching altitude of approximately 2400 meters. Blanchard also made the first silk canopy parachute.

But the first parachute jump known for sure took place on 22 October 1797 in Paris. A man called Andre-Jacques Garnerin was doing his living by charging people watching his balloon flight until one day his balloon exploded at an altitude of 700 meters in front of the terrified spectators. Then Garnerin put into practice his homemade parachute which was 10 meters in diameter and had 36 suspension lines. He landed safely about 1 km far from his starting point.
Garnerin's wife Genevieve Labrosse and niece Elisa were the first women to perform the parachute jump.

The first recorded emergency jump was made by the Polish aeronaut Jordaki Kuparento who jumped from his burning balloon on 14 July 1808 over Warsaw.

In 1837 the first fatal accident occurred in Skydiving History when Robert Cocking jumped from 1700 meters and his cone-shaped parachute disintegrated.

In 1802 the French astronomer Lelandes realized that the reason for the oscillations during his fall was in the air that was under the parachute surface. He suggested putting a hole in the middle of the canopy and this really solved the problem.

In 1885 Thomas Balwing invented the harness. In 1890 the Germans Paul Letteman and Kaethe Paulus used parachutes folded in bags. Grant Morton jumped from his plane in 1911 over Venice Beach, California. Captain Albert Berry who had previously jumped from balloons, made his parachute fall on March 1st, 1912 near St. Louis. With the first freefall in 1914 began the sport of parachuting. In the World War I the military forces realized the importance of the parachute in saving pilot in emergency. The first emergency escape was performed by an Australian pilot on the Russian front in 1916. Then parachuting was considerably improved by the army for a special crew of paratroopers.

Parachuting became popular as some French jumpers began doing it for fun.

The first sport parachuting championship was held in Yugoslavia in 1951. On August 16, 1960 in the New Mexico desert Colonel Joseph Kittinger made a worldwide record by jumping from an altitude of 102,800ft.His fall lasted about 4.8 minutes and he reached almost supersonic speed! His achievement remains the highest parachute jump in history.

VIII. Luge History (in note form)

800 A.D. Earliest evidence of sledding. It is thought that the Vikings were among the earliest users of sleds. Findings suggest that sleds having two runners were in use in the area of the Slagen countryside on Olsofjord as early as 800 A.D.

1883 First International Luge Race.. 21 competitors from the nations of Australia, England, Germany, Neatherlands, Sweden, and Switzerland (though some accounts include the United States) participated in a race organized by hotels in the Swiss spa of Davos. This race covered the four kilometers from St. Wolfgang to Klosters and was won by Georg Robertson, a student from Australia, and Peter Minsch, a mailman from Klosters, who both finished within the time of 9 minutes and 15 seconds.

1913 International Sled Sport Federation Founded. International Sled Sport Federation is founded in Dresden, Germany by the nations of Germany, Austria and Switzerland.

1914 First European Luge Championships. Singles won by Rudolf Kauschka of Bohemia (now Liberec, Czech Republic). Doubles won by Karl Lobel and Erwin Posselt of Gablonz (now Jablonec, Czech Republic).

1923 International Bobsleigh and Tobogganing Federation (FIBT) Founded

1935 Luge and Bobsleigh Federations Merge. The International Sledding Federation (now known as the International Luge Federation) is merged into the International Bobsleigh and Tobogganing Federation (FIBT) as the "Section de Luge".

1954 Luge Selected as Olympic Sport. At the congress of the International Olympic Committee in Athens, Greece, a resolution is passed stating that Kunstbahn (Artificial-Track) Luge will replace the sport of Skeleton.

1955 1st Luge World Championships. OSLO, Norway. On the naturally iced track at the Holmenkollen, the first World Champions are crowned: mens singles - Anton Salvesen of Norway; womens singles - Karla Kienzl of Austria; doubles - Hans Krausner & Josef Thaler of Austria. Eight nations participated

1957 The International Luge Federation is Founded. Davos, Switzerland. The FIL is founded with delegates from 14 nations. Bert Isatitsch from Rottenmann, Austria is elected President.