

3D COMPUTER ANIMATION
COURSE DEVELOPMENT

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Abstract

Over the last ten years a new industry has grown and developed as the world's technology became faster, more powerful and affordable. This industry is 3D Computer Animation. Whether you watch movies or television, read magazines or newspapers, it is a rare day when you do not see 3D computer images of one type or another. While post secondary institutions have recognized the need to offer training in this industry, the public school system has almost all but ignored it. The cost of developing 3D Computer Animation programs in schools is now at an affordable level. As more schools in Alberta start offering 3D Computer Animation as part of the Career and Technology Studies program concerns become evident. One concern is that there are few teachers who are trained in this area and the other concern is that the curriculum and credits for a program of this type is almost nonexistent. This project addresses these concerns. This document outlines objectives for teachers who wish to teach 3D Computer Animation and would like to know what skills need to be taught. Four proposed introductory courses for the Career and Technology Studies program are presented. The author intends to approach Alberta Learning with completed courses for their consideration and acceptance as official Career and Technology Studies courses.

Table of Contents

Title Page.....	i
Signature Page.....	ii
Abstract.....	iii
Table of Contents	iv
List of Tables and Figures.....	viii
Introduction	1
Introduction to 3D Computer Animation	2
Rationale for 3D Computer Animation Course Development	5
Things to Consider When Planning a Computer Animation Course.....	6
Curriculum Categories and Sub-Categories	7
Definition of Categories and Sub-Categories	8
Processes and Procedures	8
The Artistic Process	8
Problem Solving/Writing Skills	8
Practice Skills with Technical Equipment	9
Applied Technologies	9
Tools and Technologies	9
The Process of Creation	10
Presentation	10
Presentation and Evaluation	11

The Industry	11
General Outcomes	12
Processes and Procedures	12
The Artistic Process.....	12
Problem Solving/Writing Skills	12
Practice Skills With Technical Equipment	13
Applied Technologies	14
Tools And Technologies	14
The Process Of Creation	15
Presentation	18
Presentation And Evaluation	18
The Industry	19
CTS Courses and the Scope and Sequence	20
Existing Courses	22
Proposed Courses	23
Scope and Sequence	24
Themes	24
Table 1 Scope and Sequence for 3D computer Animation	25
Suggested Instructional Strategies	26
The Sequence Of Steps To Produce A Full Animation.....	28
Traditional Film Camera Techniques	29

Field of View	29
Table 2 Standard Camera Shots Using Different Length Lenses	30
Transitions	30
Camera Angle	31
Camera Movement	32
Panning and Tilting	32
Dolly and Tracking Shots	33
Table 3 Examples of motion at different speeds	33
Crane or Boom Shot	33
Zoom Lenses and the Vertigo Effect	34
Depth of Field Effects	34
Principles of Traditional Animation Applied to 3D Computer Animation	35
Squash and Stretch	35
Timing and Motion	36
Anticipation	38
Staging	38
Follow Through and Overlapping Action	39
Straight Ahead Action and Pose-to-Pose Action	40
Slow In and Out	41
Exaggeration	41
Secondary Action	41

Appeal	42
Suggested Assessment Strategies	43
Recommended Software	45
Proposed CTS Courses For 3D Computer Animation.....	46
Course ANI 1020: Story Development/Storyboards 1	47
Portfolio Assessment ANI 1020	52
Presentation/Reports ANI 1020	53
Example of a Three Act Structure	54
Model of a Storyboard	55
Course ANI 1030: Modeling 1	63
Portfolio Assessment ANI 1030	69
Examples of Objects in 3D Space	70
Course ANI 1040: Animation Concepts	75
Portfolio Assessment ANI 1040	81
Presentation/Reports ANI 1040.....	82
Examples of the Principles of Animation	83
Course ANI 1060: Studio Lighting	93
Portfolio Assessment ANI 1060	99
Lighting Exemplars	100
References	109

List of Tables and Figures

List of Tables

Table

1.	Scope and Sequence for 3D computer Animation	22
2.	Standard Camera Shots Using Different Length Lenses	26
3.	Examples of motion at different speeds	30

Figures

Course ANI 1020: Story Development/Storyboards 1

1.	An Example of the Three-Act Structure	47
----	---	----

Model of a Storyboard

1.	Label Shots	48
2.	Write in Sound Effects	48
3.	Explain Action	48
4.	Use Arrows	49
5.	Use arrows with shot names	50
6.	Indicate Zoom Areas	51
7.	Examples of Action	52
8.	Examples of Camera Shots	53
9.	Vary Camera Angle	54
10.	Examples of Close Ups	55

Examples of Objects in 3D Space

1.	A box in World Space	63
2.	A Box with Segments and a Box without Segments	63
3.	The Faces that make a Sphere	63
4.	The Faces that make up a Box	63
5.	Vertexes of a Box	64
6.	Vertexes of a Sphere	64
7.	Selected Edges on a Box	64
8.	Selected Edges on a Sphere	64
9.	Extruding Faces to Create Fingers	65
10.	Extruding and Shaping the Thumb	65
11.	Editing the hand by moving vertexes	66
12.	Apply the Modifier Smooth to object	66
13.	The Finished Hand	67

Examples of the Principles of Animation

1.	Ball at rest	76
2.	Ball squashed ready to jump	76
3.	Ball stretched as it jumps	76
4.	Ball squashes as it reaches the top of the jump	76
5.	The ball is at rest	77
6.	Ball is stretched one direction	77
7.	The ball is released and shoots off	77

8.	An example of Staging	78
9.	An example of even movement	79
10.	An example of Slow In and Out	79
11.	An example of Secondary Action	80
12.	An example of Timing and Motion	81
13.	An example of Exaggeration	82
14.	An example of Appeal	83
15.	An example of Follow Through and Overlapping Action	84
16.	Key Frame one	85
17.	Key Frame two	85
18.	Key Frame three	85
19.	Key Frame four	85
20.	Key Frame five	85
21.	Key Frame six	85
 Lighting Exemplars		
1.	Example of a Spot Light	93
2.	An Example of Spot Light Cones	93
3.	An Example of Directional Light	94
4.	An Example of Directional Light Attributes	94
5.	An Example of a Point/Omni light	95
6.	An Example of Point/Omni Attributes	95
7.	An Example of Ambient Light	96

8.	An Example of a Front Light	96
9.	An Example of a Side Light	97
10.	An Example of a Back Light	97
11.	An Example of a Fill Light	98
12.	An Example of Kickers	98
13.	An Example of Bounce Light	99
14.	An Example of Motivated Light	99
15.	A Non Rendered Example of Motivated Lighting	100
16.	An Example of Key/Fill Lighting	100
17.	An Example of Three Point Lighting	101

3D Computer Animation

“There is no particular mystery in animation...its really very simple, and like anything that is simple, it is about the hardest thing in the world to do.”¹

Introduction

The use of 3D Computer Animation has been growing in the last 10 years, and continues to grow. While watching television there is hardly a commercial or television show that does not use computer animation in some form. This area is a growing industry that is constantly in need of qualified workers. This demand for workers has put pressure on the small number of colleges and technical schools that teach computer animation and only the most promising students can get in.

Schools have been teaching 3D Computer Animation for the past ten years, but there has not been any demand to write curriculum specifically for it. Teachers who have taught 3D Computer Animation for years, are doing as well as they can by creating their own curriculum. The concern now is that many schools are adding 3D Computer Animation courses, in order to be competitive with other schools, but they are doing so with teachers who do not know how to teach the course.

It is time that we standardise the course in order to produce students with a specific set of skills that would enable fair competition for entry into post secondary. The teaching of 3D Computer Animation will help to relieve the post secondary school system from teaching the fundamentals and allow them to teach more advanced concepts.

1. Bill Tytla at the Walt Disney Studio, June 28, 1937.

Introduction to 3D Computer Animation

In the past animation has been produced in two ways. The first is called traditional or classical animation. Artists create a series of drawn or painted frames, or cells, which are then combined into a film. The second way is to use actual models and stop motion photography is used to create motion. Stop motion photography is where the model is moved, the image recorded, and then moved again, the next image is recorded, and this process is continued.

Computer animation is a combination of these two methods. Like traditional animation the computer will create successive frames where the images change from one to the other. Also as in model animation the artist creates a wire mesh model on the computer. Moving the model and creating a key frame, moving it again and creating a key frame, create motion and this process is continued.

Of these two animation methods, it is important for those who wish to become good animators to learn as much as they can about traditional character animation. These skills are more important than knowing the latest computer software. By studying 2D animation 3D animators can develop a firm grounding in the foundations of animation, including anatomy, weight, timing, and motion.

The animation software is set-up similar to a production studio. The animator builds sets. This includes the creation of the environment by creating lights, objects and placing cameras. The animator then creates the characters and directs the character movement. For a simple animation this might be just moving the camera or some simple object such as a cube or a sphere in the scene. More sophisticated computer animation can move the

camera and/or the objects in more interesting ways, e.g. along computed curved paths, and can even use the laws of Physics to determine the behaviour of objects.

As in any movie creation, planning is the key to a successful production. What happens in many computer animation classes, is that the students get so excited about creating models and making them move, that they create a lot of small animated scenes that highlight the functions of the software, but do not tell a story. The students then get bored with this once they know they can make something blow up real good. The key to keeping the students interested and creating quality animations is to stress story development from the start of the program.

The animator develops an idea into a story and then into a visual reality by following a few but critical steps. The first is the story outline. Depending on its complexity a two-page outline of the story idea will help determine its feasibility. Once the artist has a basic outline the artist needs to storyboard the action. The storyboard is not a frame-by-frame drawing of the action but a diagram of the motion of all cameras, objects and lights. The next step is to create sketches of the characters. This acts as a guide to the artist when building models.

Once the models are created and the environment built the artist then creates the motion. It is at this point that the artist goes into a problem-solving mode. A major part of animation is motion control. Even the most crude of models can have life like character through motion. The opposite can be said for complex life like models, if the movement is crude and choppy then it looks like a lifeless model. The correct movement can make an audience forget that they are looking at computer-generated models and experience the

story and its characters. The goal of movie making, whether using animation or live actors, is to tell a story and tell it well.

Rationale for 3D Computer Animation

The process of creating computer animation requires both artistic and technical abilities. The creation of animation involves students in a design (problem solving) process, an artistic process, and a technical process.

As the CTS program now stands this course would enable students to receive credits in the following CTS courses. The CTS Strand “Communications Technology” has Animation 1, Animation 2, and Animation 3. “Design Studies” has Sketching, Drawing and Modeling – Fundamentals; The Design Process; Design Techniques – Fundamentals; 3D Design Applications; 3D Design Studio – Form, Composition, & Aesthetics; 3D Design Studio - Communication & Human Factors. These courses build on previous learning from the areas of Information Technology and the Fine Arts. This is a specialized course that allows the student to develop the personal attributes and skills to explore career paths. Industry standards are established and expected, while students direct their own learning experience through activities derived from their own creativity and personal interest.

Computer Animation provides learning opportunities for students to imagine, visualize, and tell a story. Students do this through the creation of moving images. At the same time it develops their technical knowledge and computer skills while using the tools of the craft. These opportunities contribute to the individual's aesthetic, social, emotional, and intellectual development. As the curriculum is offered in a hands-on environment, students will produce samples of their work, which will serve as portfolio examples while they explore career opportunities.

Things to Consider When Planning a Computer Animation Course

There are several issues to consider before starting a computer animation course.

There are Specific Outcomes outlined in the Career and Technology Studies – Communication Technology - Guide to Standards and Implementation, (Alberta Learning, 1997), that detail several considerations that the reader is encouraged to explore. Other considerations to safety, gender equity, and diverse student needs that are specific to computer animation are as follows:

- Establish an accepting and co-operative atmosphere in which students feel safe, and free to take risks.
- Establish expectations specific to the class, such as the need to share equipment and leave it in good running order for the next user.
- Establish a sense of ownership and trust between all members of the program.
- Determine options that will allow extended use of the facilities beyond the classroom time.
- Include strategies for students to update knowledge, and opportunities to experience emerging technological processes and equipment.
- Plan for ‘viewing time.’ Responding to works of others plays an important role.

Curriculum Categories and Sub-Categories

The General Outcomes for Computer Animation are grouped into the following three categories; the sub categories are added to clarify the General Outcomes:

1. Processes and Procedures
 - The Artistic Process
 - Problem Solving/Writing Skills
 - Practice Skills with Technical Equipment
2. Applied Technologies
 - Tools and Technologies
 - The Process of Creation
3. Presentation
 - Presentation and Evaluation
 - The Industry

Because of the dynamic nature of classroom learning, no single category should be used in isolation or as a basis for a lesson or unit of instruction. However, the key category to begin instruction should be The Artistic Process. The learning outcome in this category focuses on the development of the overall production, as Animation becomes a means to tell a story, not a technical exercise in using computers.

Definition of Categories and Sub-Categories

Processes and Procedures

This area relates to the thinking processes and the creation procedures that students need to understand as they begin to create computer animation.

The Artistic Process

Computer Animation is a form of art and design that requires a certain technical expertise. Therefore, when teaching Computer Animation the teacher needs to approach the subject more as an art course than a computer course. Students who excel at Computer Animation are creative and have a desire to make their imagination come to life. Students need to learn how to develop their story, characters, and scenes as well as their technical skills. A solid foundation of experience and knowledge will be gained from teaching the course with an emphasis on the artistic, and will help to ensure a quality product that goes beyond the technical focus traditionally seen in Computer Animation. By understanding design concepts students will be able to express their ideas clearly and concisely.

Problem Solving/Writing Skills

Prior to students placing their ideas on paper it would best to discuss organization and problem solving skills. The problem solving skills that the students learn now can be used throughout their project. Students need to express their ideas in an organized, easily understood manner. This process is difficult when dealing with creative thought and imagination. How does one get down on paper what is visualized in the mind and do it in such away as others can understand the vision. Students need to develop scripting, storyboarding and writing skills.

Practice Skills with Technical Equipment

Learning the tools of the trade is important. Whatever software is chosen the students must understand its basic use. To do this the teacher must create tutorials or use the tutorials that come with the software to cover the mechanics of the program. A wonderfully developed story is useless if the students do not understand the basic tools of the software they will use to create it.

Applied Technologies

Students need to learn how the computer hardware and software interact to make the creation process work. At times the limitations of the hardware and or software limit what the students are able to create or at least changes the way the students must approach the creation process. Once the students learn how to use the software they need to understand the tools provided as this also affects the manner in which they approach the creation process.

Tools and Technologies

After a student understands the basics of the software they must become proficient with the tools. The tools are the equipment and software used to produce computer animation. Because of the highly technical nature of the computers, networks and software in use by the computer animator, students need to explore and comprehend a large number of concepts. Developing a thorough understanding of the software and hardware will permit the 'tools' to become intuitive to the animator, and enhancing the creative processes. To ensure that the students become more than a passive consumer of technology, they are expected to learn and understand how the software and hardware interact with one another, and be able to troubleshoot basic errors and problems.

The Process of Creation

The technical and artistic processes are those, which transform ideas into reality using the tools of the craft. Beyond the basic use of the computer and software to make certain tasks and mundane operations easier and faster, the computer becomes the creative tool used by the animator to create visual magic. Modeling, materials, lighting, camera technique, animation, character animation and post-production techniques, require both artistic and technical skills. In the industry of computer animation, people generally take on only one of these skills as a career. Those that understand motion will generally gravitate towards animation; those that can make exciting objects will become modellers and so on. Lighting can be a career unto itself.

Students, whether in high school or a post-secondary institution, will have to learn all aspects of computer animation. It is important to have an understanding of all aspects of the creation process, whether they intend to specialize or not. The reason for this is that eventually the students may find themselves in a supervisory role and will have to organize all aspects of a project. If the students familiarize themselves with all aspects of production they will become better producers.

Presentation

Students must learn how to present their work to an audience. The method of presentation varies. When students are trying to either get a job in the industry or enter a post-secondary institution, they will have to present their work. This presentation will initially be through a Demo Reel but face-to-face presentations will follow and students need to feel comfortable calling attention to their accomplishments and explaining their work.

Presentation and Evaluation

Students must develop the ability to be public with their work and face criticism and adulation with the proper frame of mind. To this end students must prepare a presentation to discuss the project with the teacher and peers.

In their presentation students must:

- Identify animation techniques and styles available and identify and explain the animation techniques used.
- Identify possible enhancements to project.
- Identify and discuss any difficulties encountered with the project.
- Evaluate, edit and redo to improve the quality of the animation.
- Create and present a portfolio of work completed in their module (e.g., project plan, shot list or storyboard, finished project) or adds this work to an existing portfolio.

The Industry

The animator, the production team, and the workplace form the nucleus of the industry. The industry exists within the structure of the society. Students need to develop an understanding of these aspects of their career choice so that they will be competitive and remain a vital productive member of the industry and society. Resources need to be developed that will accurately depict the work environment of the animation industry.

General Outcomes

Processes and Procedures

The Artistic Process

Students will:

1. Identify the history of animation and how it contributed to the development of what we know as computer animation today.
2. Identify the principles and elements of design and how they are represented in computer animation.
3. Identify the impact of traditional and modern technologies on image development and design.
4. Effectively communicate their ideas in a visual manner using 2D drawing of both still life and life models.
5. Explore methods of character design.
6. Draw a series of characters that are examples of good and evil, and heroic and cowardly.

Problem Solving/Writing Skills

Students will:

1. Learn the basic format of script writing and storyboard development.
2. Learn to identify, describe, analyze, and interpret the visual elements and principals of art and design of a production based on the script and storyboard.
3. Demonstrate an ability to identify, describe, analyze, interpret, and make judgments about the visual elements and principles of art and design as used in a variety of productions.

4. Understand that story creation (Who, what, where, when and why) includes: character development, scene development, props and sets, and conveys a message.
5. Produce planning documents (script, storyboard) to recognized standards, including sufficient detail and information to enable others to produce a computer animation.

Practice Skills With Technical Equipment

Students will:

1. Describe and use correct and effective strategies to design a computer animation, including:
 - Story development
 - Production techniques
 - Aesthetics
2. Create computer animation productions that:
 - Defend values and traditions
 - Reflects an understanding of the impact of social/cultural/historical contexts
 - Reflects historical and contemporary themes
 - Reaches a specific audience or achieves a specific purpose
 - Conveys a message important to the author.

Tools And Technologies

Students will:

1. Explore basic concepts of animation
2. Employ concepts of animation to have the animation move effectively.
 - Squash and Stretch
 - Timing and Motion
 - Anticipation
 - Staging
 - Follow Through and Overlapping Action
 - Straight Ahead Action and Pose-to-Pose Action
 - Slow In and Out
 - Exaggeration
 - Secondary Action
 - Appeal
3. Identify, describe, evaluate and use a variety of processes, tools (hardware and software) and techniques available for image, audio and computer animation production.
4. Understand the different types of 3D Animation software available.
5. Know a number of computer Operating Systems, as different software uses different operating Systems.
6. Know the Application Software by name, type, and capability. Understand its user interface and tools. (Basic training - use tutorials)

7. Select the right software for each job.
8. Consistently use appropriate vocabulary when discussing the discipline studied, associated materials, technologies, and processes.
9. Explore, analyze and use application enhancement software (plug ins) to further the functionality of application software.
10. Learn the efficient use of production tools for example how to use the Computer for the organization of files, the different types of files (image and otherwise) and different types Input and output file types.
11. Understand the different Output Technologies i.e.) Video- pixels/ lines (resolution of TV vs. film), Limitations of different formats PAL and NTSC.
12. Know the different Output devices (Low budget vs. high end)
13. Understand the NTSC format and its problems with colour shift the effect on materials and lights.
14. Know frames per second - film vs. video
15. Know how to use the Internet /Interactive Multimedia
16. Use and maintain materials, equipment, and work space in a safe and environmentally sensitive manner.

The Process Of Creation

Students will:

1. Demonstrate safe work habits using tools and technical processes in accordance with the schools established rules and regulations. (Follow proper login procedures, save all work to authorized server; make regular backups of work, etc.)

2. Identify and use appropriate 2D imaging techniques to develop and enhance imagery.
3. Understand and use 3D modeling techniques such as:
 - Coordinate Systems in 3D Space
 - Object creation
 - Sub object details
 - Splines/NURBs
 - Polygons
 - Primitives
 - Lofts
 - Booleans
 - Particle Systems
 - Efficient Modeling (close tie to Materials)
4. Use appropriate lighting techniques to illuminate an animation.
 - Lighting Placement: key, fill, bounce lights and ambient
 - Understanding properties of surfaces (specular etc.)
 - Shadows how they are produced
 - Use for mood
5. Develop and use custom materials to map textures to the surface of objects and characters, or to create displacement maps to make unique objects.

6. Analyze motion to determine and create Animation through the understanding of:
 - Dynamics of objects (introduction)
 - Physical properties / motion
 - Timing
 - Keyframe - storyboard (frame count) - planning
 - Hierarchy
 - Controllers (path, dummy, motion capture)
7. Employ correct cinematic techniques such as:
 - Field of View
 - Transitions
 - Camera Angle
 - Camera moves
 - Panning, Dolly shot, Crane shot, Truck shot, Tilt shot
 - Lenses
 - Zoom Lenses and the Vertigo Effect
 - Depth of Field Effects
 - Line of action
8. Render the final animation for output and presentation.
9. Record and generate appropriate sounds to use in conjunction with the images produced in an animation. Learn what sound Foley is and what a Foley Artist does.

10. Demonstrate an ability to work in groups to analyses and solve production problems.
11. Synthesize and apply knowledge, concepts and experience from other disciplines and the community in the production process.
12. Show how mood and atmosphere is created by the use of different materials, lighting, motion, and audio.

Presentation

Presentation And Evaluation

Students will:

1. Use appropriate communication processes and media to develop and present a production to instructors and peers. Students should ensure that their presentation includes:
 - Prototypes and models
 - Computer animation
 - Multimedia
 - Video and audio production
2. Critique an animation relating its content to the context and purpose in which it was created.
3. As part of the evaluation process students should present their finished project to a small group of individuals to whom the animation was targeted. Record their reactions to the animation and then through a series of probing questions record their responses and suggestions for improvement.

4. Identify, describe, analyze, interpret, and make judgments about how ideas, thoughts, feelings, or messages are communicated in a variety of others' productions.

The Industry

Students will:

1. Identify the career opportunities for, and roles of persons employed in computer animation and determine the educational prerequisites.
2. Identify the Industry of computer animation with regards to:
 - Facilities
 - Workplace Environment and Health
 - Career options and requirements
 - Role in entertainment/business community
3. Understand Project Management in regards to:
 - Roles of team members
 - Time management
 - Production time, rendering time, output
4. Evaluate computer animation for its productivity, utility, and social impact.
5. Analyze ethical, moral, and legal considerations associated with using computer technology for image and sound development.
6. Create and present a portfolio of work. The portfolio should include project plan or script, shot list or storyboard, model sketches and drawings, finished project.

CTS Courses and the Scope and Sequence

One objective in writing this project is to present this curriculum to Alberta Learning. It is necessary to present the curriculum information using the Alberta Learning CTS format. The CTS program was created by taking all the previous high school option courses such as all computer, home economics and industrial arts courses and divided them into skills. Each skill set was categorized and placed into Strands. In computers the Strands created were: Information Processing, Design Studies, and Communication Technology. Within each Strand a number of courses were developed to teach the skills and a Scope and Sequence was created to illustrate how the courses progressed and were interrelated. These courses are worth one credit and are designed to take approximately 25 hours to complete. In this document the skills for 3D Computer Animation were listed under General Outcomes and placed into a Strand called 3D Computer Animation. Courses have been developed for this Strand and a Scope and Sequence has been created to show how these courses progress and how they relate to each other. Each course created is worth one credit and designed to take 25 hours to complete.

The formatting of each course follows Alberta Learning format for CTS courses. Each course is evaluated on a completed portfolio of work. The work needed in the portfolio is listed with the suggested emphasis of time to spend on each piece of work and the assessment criteria. The course then lists all the specific outcomes that are to be covered by the students as they do the work.

Students, who wish to learn 3D Computer Animation and pursue it as a career, need to learn all of the General Outcomes. To learn these General Outcomes will take longer

than the present 75 hours allotted to animation. To this end I propose that Alberta Learning creates a new Strand. This Strand is to be called 3D Computer Animation.

In order to create new courses and place them in a new Strand, one must look through the courses that already exist in the CTS program and compared the General Outcomes listed on page 10 to the outcomes listed for those courses. Those courses whose outcomes match the General Outcomes are listed in the section below called Existing Courses. Once the existing courses were identified the remaining outcomes were grouped into courses of their own. These have been listed in the section called Proposed Courses.

At the present “Animation” is part of the Communication Technology Strand. Within this Strand there are three courses for animation: Animation 1, Animation 2, Animation 3. These courses total 75 hours of instruction. The Animation courses are not included in the existing courses list, as they do not meet many of the General Outcomes. These courses are very generic courses that can be used for any form of animation. The outcomes in these courses are so general that the students could meet them by creating a flipbook type of animation. There is nothing specific to 3D Computer Animation in these courses. (Alberta Learning, CTS, Communications Technology, 1997)

Existing Courses

Course Title	Course Number
• Presentation and Communication 1	COM 1010
• Presentation and Communication 2	COM 2010
• Presentation and Communication 3	COM 3010
• The Design Process	DES 1020
• 2D Design Fundamentals	DES 1030
• 2D Design Applications	DES 2010
• Sketching, Drawing, & Modeling	DES 1010
• Audio/Video Production 1	COM 1060
• Audio/Video 1	COM 2090
• Audio/Video 2	COM 2100
• Audio 3	COM 3100
• Video 3	COM 3110

Proposed Courses

Course Title	Course Number
• Animation Basics	ANI 1010
• Script Writing / Story Board 1	ANI 1020
• Script Writing / Story Board 2	ANI 2020
• Leica Reel/Pencil Test	ANI 3020
• Modeling 1	ANI 1030
• Modeling 2	ANI 2030
• Modeling 3	ANI 3030
• Animation Concepts	ANI 1040
• Animation 1	ANI 2040
• Animation 2	ANI 3040
• The Study of Motion	ANI 1050
• Cinématique Techniques	ANI 2050
• Studio Lighting	ANI 2020
• Environmental Design 1	ANI 2060
• Environmental Design 2	ANI 3050

Scope and Sequence

Alberta Learning creates a Scope and Sequence for each strand of the CTS program. In the Scope and Sequence they list all the courses available to the students. These Courses are grouped into Themes and Levels. The Themes reflect the type of courses and the Levels group the difficulty of the courses. The levels are: Introduction, Intermediate, and Advanced. In the Strand that has been developed for 3D Computer Animation the Themes reflect the division of work in the animation industry.

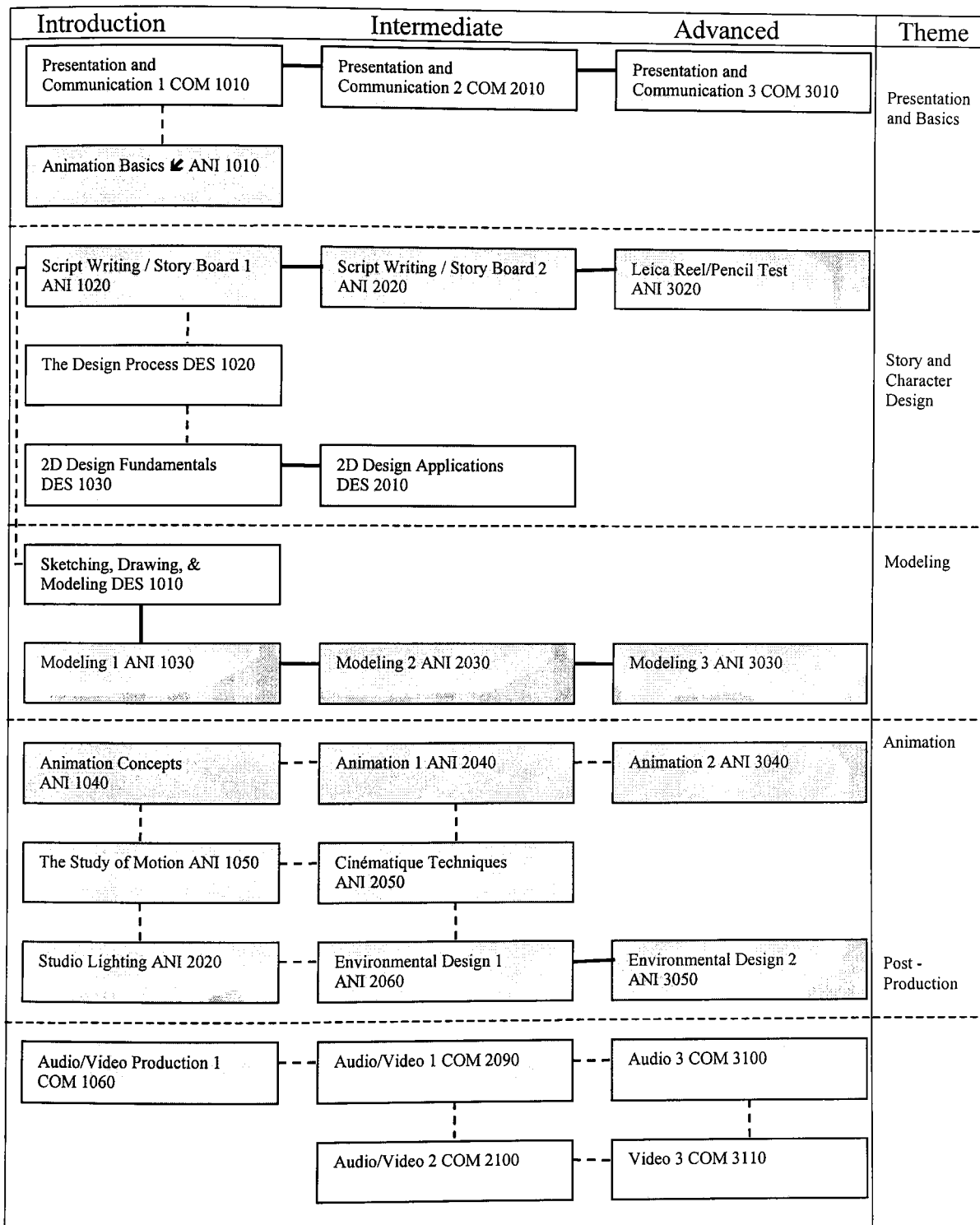
Themes

- Presentation and Basics
- Story and Character Design
- Modeling
- Animation
- Post-Production

The Scope and Sequence illustrates how the existing courses and the proposed courses fit into the themes and link to each other. There are two methods in which the courses are linked to each other. One method is called Prerequisites; solid lines connecting the course boxes indicate these. Prerequisites require the students to complete each course in the order indicated, as each course will build on knowledge presented in the previous course. The second method called Recommended Sequence; dotted lines connecting the course boxes indicate these. The courses are set out in a logical sequence that complement each other yet are not prerequisites for each other. (See Figure 1 Scope and Sequence for 3D Computer Animation)

Scope and Sequence

3D Computer Animation



— Prerequisite. - - - - Recommended sequence. ↙ Course provides a strong foundation for further learning in this strand. Existing CTS Courses Proposed CTS Courses.

Table 1 Scope and Sequence for 3D Computer Animation

Suggested Instructional Strategies

The following series of information is designed to give the teacher who is new to 3D Computer Animation, or one who needs more information as their students skills increase. 3D Computer Animation emphasizes the skills needed in a continually changing workplace. The teacher needs to employ strategies that use technology to develop artistic and technical skills. A 3D Computer Animation course must be offered as a 'hands on' course. Students must explore the specific outcomes of each course and use the technology to apply to their artistic and creative ideas. The teacher needs to foster creativity, problem solving and critical-thinking skills. As animators students will be faced with challenges demanding creativity and problem solving skills.

The production environment is not as forgiving as the classroom environment, students need to practice and apply their survival skills. Students need to learn to critique themselves and how to accept the critique of other students and the teacher. One reason for this is because the workplace requires that people work effectively, individually and with others, to solve problems and to complete tasks. Students need to experience the dynamics of group work to enhance their understanding of the problem-solving process. Group work focuses on such skills as collaboration, communication, leadership, co-operation, and the specialized technical skills to facilitate group work. Having students work in a variety of groups is recommended. Students tend to work with friends, yet they need to learn to work with others in order to learn the different group skills.

The teacher needs to remain up to date on the changes in the industry and the new developments in the way 3D computer graphics are created. This can be accomplished in a number of ways. One method is to subscribe to magazines, another is to attend conferences and the third is to use the Internet. There are a large number of web sites that the teacher and students of 3D animation courses can use as resources; here is a list of a few that could get you started.

<http://www.digitalanimators.com/>

http://www.animationartist.com/2001/02_feb/tutorials/character_modeling.htm

<http://www.siggraph.org/>

http://www.cyberfilmschool.com/mschool/4_syntax/theory_syntax.h

<http://www.3dcafe.com>

http://www.learning.gov.ab.ca/k_12/curriculum/bySubject/cts/comTech/

<http://www.screentalk.org/index.htm>

<http://www.3dark.com>

<http://www.storyborg.com/storyboards.html>

<http://www.cyberfilmschool.com/mschool/startpg.htm>

Knowing how to model and create animations is knowledge that the teacher will have to eventually acquire. There is a core foundation of knowledge that the teacher needs to be familiar with to successfully develop 3D Computer Animation courses. Without this foundation it is difficult for the teacher to guide students through the creation process. This core foundation of knowledge includes a sequence of steps to produce a full animation, traditional film camera techniques, and principles of traditional animation applied to 3D Computer Animation. The following information is core to being able to

create 3D computer animations in the a manner similar to how they are created in the industry and create 3D computer animations that are pleasing to the eye and contain elements that are standard to the movie industry.

The Sequence Of Steps To Produce A Full Animation

- Develop a script or story for the animation
- Lay out a storyboard, that is a sequence of informal drawings that shows the form, structure, and story of the animation.
- Record a soundtrack
- Produce a detailed set of drawings of the action called a layout.
- Correlate the layout with a mock-up of the soundtrack.
- Make a trial "film" called a "pencil test" by either scanning the layout and editing it with digital editing software or by using traditional animation techniques and create cells of each frame.
- Use this to correct any timing errors.
- Use computer software to create characters
- Use computer software to create props
- Use computer software to create environments
- Use computer software to create scenes from the script
- Add sound track to low resolution rendering of scene
- Correct any timing errors
- Render at a high resolution
- Edit scenes together and add sound track

Traditional Film Camera Techniques

It is important to understand the connections between film, video production and 3D computer animation. This section is about the use of traditional film camera techniques and how to employ them in 3D computer animation.

In film and video production the cinematographer sets the camera shots and decides what camera movement is necessary for a scene. An excellent way to learn how to be a cinematographer is to take filmmaking courses, since the methods of film cinematography are valid for computer animation. (Maestri, 1996)

One potential problem in computer animation is that animators try too much razzle-dazzle with the camera - if the viewer notices the camera action too much then they won't really notice the animation. Since most viewers have already seen countless hours of film or video, if the students use the camera in traditional methods then it adds rather than detracts from the experience.

The following are the camera elements in any scene:

Field of View

The Field of View (FOV) is the angle described by a cone with the vertex at the camera's position. It is determined by the camera's focal length, with the shorter the focal length the wider the FOV. For example, for a 35mm lens the FOV is 63 degrees (wide-angle), for a 50 mm lens it is 46 degrees (normal), and for a 135 mm lens it is 18 degrees (telephoto). A wide-angle lens exaggerates depth while a telephoto lens minimizes depth differences. (Maestri, 1996)

Shot	Visual Composition	Use
Extreme long shot	Characters are small in frame; all or major parts of buildings appear.	Establishes physical context of action; shows landscape and architectural exteriors.
Long shot	Shows all or nearly all of the standing person; large parts of a building.	Shows a large-scale action; shows whole groups of people; displays large architectural details.
Medium shot	Character shown from waist up, medium-sized architectural.	For showing details of small groups such as two or three people.
Close-up	Head and neck of character; objects about the size of the desktop computer fill frame.	Focus on one character; facial expression very important.
Extreme close-up	The frame filled with just part of a character or very small objects.	Focus on facial features in a character or small objects.

Table 2 Standard Camera Shots Using Different Length Lenses

Transitions

A film or video scene consists of a sequence of shots. Each shot is made from a different perspective and then they are joined together. The joining together of the individual shots to make a particular scene is accomplished through transitions.

The transition may be from one camera angle to another camera angle or from one camera to another camera. When the students do transitions, as a 3D computer animator they are fulfilling the role of the editor, whose task is to put together a set of individual shots into a scene. One technique that film editor's use is to focus on a particular element that is consistent between shots. This can be a physical object or it can be a compositional element such as a motion, colour, or direction.

The simplest transition between shots is a straight cut, which is an abrupt transition between two shots. Another type of transition is called a fade, in which the overall value

of the scene increases or decreases into a frame of just one colour. For example, a fade to black may indicate the end of the sequence. When one scene fades out as another scene fades in this is a dissolve. These dissolves are used frequently to indicate a passage of time. For example, a camera shot may be moving down a hall and then dissolves as it moves to a camera shot in a different part of the building.

Another type of transition is when one scene wipes across the frame and replaces the previous seen. Wipes can move in any direction and open one side to the other or they can start in the centre and move out or the edge of the frame and move in. Wipes are very noticeable and best not used often.

Camera Angle

The camera angle helps to determine the point of view of the camera. This is very important since viewers have seen a lot of TV or film and this has conditioned them to interpret the cameras "eye level" as containing meaning. Viewers expect the camera to show a level horizon. If the camera is not then it appears sinister to them. The cameras height above ground level and its angle in relationship to the ground should reflect real-life. A bird's eye or worms eye view is unnatural and draws attention to it. This may be all right if there's a reason. However, it may detract from the content of the animation. Something that is a problem in 3D computer animation, is that the ease of moving or putting a virtual camera anywhere may lead to excessive use of inappropriate camera angles. (Maestri, 1996)

A good idea is to observe existing film and video and to determine how far above ground level the camera is for a particular scene and use that information. For example, in a wide-angle shot the camera is usually in position of a viewer sitting down. In close-

ups males are usually shown from just below eye level and females from just above eye-level. Placing a camera at the eye level of a standing person actually appears too high most of the time.

Camera Movement

There are several fundamental camera moves that were developed right after the invention of motion picture cameras and are still used today. By using a virtual camera the animator can make almost any move, however, it is still a good idea to use these real world moves. These moves include the following:

Panning and Tilting

For both panning and tilting the camera is stationary and rotates in a horizontal (panning) or vertical (tilting) plane. Panning is used to follow a moving object or character, or to show more than can fit into a single frame, such as panning across a landscape. It is also used as a transition between one camera position and another. Inexperienced operators may pan too fast and caused an effect known as strobing. This is also a problem in Computer Animation and is called tearing. This can cause motion sickness or cause the illusion of motion to be broken. For example, for an animation at 30 frames per second, the number of frames needed for a 45-degree pan would be about 22 frames for a quick turn or 66 frames for a casual turn. (Billups, 2000)

One-way to avoid strobing is to use scene motion blur when rendering; blur is done by sharing information between frames. Note that this is a scene motion blur where a scene shares information from the prior and next scenes. This is not the same as object motion blur. The same motion considerations about panning are valid for tilting.

Dolly and Tracking shots

A dolly is a small-wheeled vehicle, piloted by a dolly grip, which is used to move a camera around in a scene. A dolly shot is a move in and out of a scene, i.e., the movement is parallel to the camera lens axis. A tracking shot is a movement perpendicular to the camera lens axis. The key to these shots is to have realistic motion. The motion can be judged by looking at how fast humans move and then how many frames it would take to realize this motion. Examples of motion at different speeds are given in the following table

Miles Per Hour	Feet Per Second	Number of Frames to Move 10 feet at 30 fps
Casual stroll 2	2.9	102
Average walk 3	4.4	68
Brisk walk 4	5.9	51
Average jog 6	8.8	34
Average run 8	11.7	26
All out sprint 12	17.6	17
Car 30	44	7

Table 3 Examples of motion at different speeds

It is very important to have realistically smooth starts and stops. (Billups, 2000)

Crane or Boom Shot

This is when the camera moves up or down, as if it were on a physical crane. The same considerations for panning and tilting apply for crane shots.

Zoom Lenses and the Vertigo Effect

A Zoom lens has a variable focal length and so camera "moves" can be made without actually moving the camera. Professional cinematographers use the zoom very sparingly and generally prefer to move the camera. Amateurs love the zoom and can create some very nauseating motion by combining zooms and rapid pans. A zoom changes the angle of display so spatial relationships also change.

In the movie "Vertigo", Alfred Hitchcock took advantage of this feature to create what is now known as the vertigo shot. This involves synchronizing the movement of the subject with the zoom so that the subject is always the same size, but the background changes. (Billups, 2000)

Depth of Field Effects

Real cameras have a depth of field, i.e., only part of the image is in focus at anyone time. The depth of field is a function of the lens length with short lenses (wide-angle) having a large depth of field and telephoto lenses have a small depth of field. Many Computer Animation cameras have an infinite depth of field, i.e., everything is in focus, and this looks unnatural. More advanced Computer Animation Software systems have cameras that emulate real lenses this way.

One way to change the centre of attention in a scene is to have one object, e.g., in the foreground, in focus, with the background out of focus. Then an object in the background is brought into focus, with the foreground object now out of focus. For example, two people might be having a conversation in a crowded room and only they are in focus. Then the focus changes to reveal a person several feet away looking intensely at the two people.

Principles of Traditional Animation Applied to 3D Computer Animation

“Many of the principles of traditional animation were developed in the 1930's at the Walt Disney studios. These principles were developed to make animation, especially character animation, more realistic and entertaining. These principles can and should be applied to 3D computer animation.” (Lasseter, 1987)

Squash and Stretch

When real objects move only totally rigid ones, e.g., a chair, remain rigid in motion. Living creatures always deform in shape in some manner. For example, if a person bends their arm, the bicep muscles contract and bulge out. They then lengthen and disappear when the arm straightens out. The squashed position shows the form flattened out and the stretched position shows the form extended. An important rule is that the volume of the object should remain constant at rest, squashed, or stretched. If this rule is not obeyed, then the object appears to shrink when squashed and to grow when stretched. (Examples of the Principles of Animation, Figures 1-4) Squash and stretch can be accomplished by differential scaling in 3D Keyframe systems. Be sure to conserve volume, i.e., a stretch in one direction, (X) must be accompanied by a squash in the other directions (Z, Y). Also, the direction of the stretch should be along the direction of motion so a rotational transformation may be required. (Lasseter, 1987)

A classic example is a bouncing ball, which squashes when it hits the ground and stretches just before and after. The stretching, while not realistic, makes the ball appear to be moving faster right before and after it hits the ground. When an object squashes or stretches, it appears to be made of a pliable material, if it doesn't then it appears rigid.

Objects that are partially pliable and partially rigid should have only the pliable parts deform. These deformations are very important in facial animation, since they show the flexibility of the skin and muscle and also the relationship between the different facial parts. In very early animation, a character chewing something only moved its mouth and it appeared unrealistic. A later innovation was to have the entire face moving with the mouth motion, thus looking more realistic. This can be exaggerated for effect. A broad smile or frown similarly involves more than the mouth. (Lasseter, 1987)

Timing and Motion

The speed of an action, for example timing, gives meaning to movement. It gives both physical and emotional meaning. The animator must spend the appropriate amount of time on the anticipation of an action, on the action, and on the reaction to the action. If too much time is spent, then the viewer may lose attention, if too little, then the viewer may not notice or understand the action. (Examples of the Principles of Animation, Figure 12)

Timing can also affect the perception of mass of an object. A heavier object takes a greater force and a longer time to accelerate and decelerate. For example, if a character picks up a heavy object, e.g., a bowling ball, they should do it much slower than picking up a light object such as a basketball. Similarly, timing affects the perception of object size. A larger object moves more slowly than a smaller object and has greater inertia. These effects are done not by changing the poses, but by varying the spaces or time (number of frames) between poses. (Lasseter, 1987)

Motion also can give the illusion of weight. For example, consider a ball hitting a box. If the ball rebounds from the box, and the box is unmoved, we have the illusion that the box is much heavier than the ball. If the ball knocks the box aside, then the effect is that the box is much lighter than the ball.

Lasseter (1987) indicated that Timing could also indicate an emotional state. Consider a scenario with a head looking first over the right shoulder and then over the left shoulder. By varying the number of in-between frames the following meanings can be implied:

- No in-betweens - the character has been hit by a strong force and its head almost snapped off
- One in-betweens - the character has been hit by something substantial, e.g., frying pan
- Two in-betweens - the character has a nervous twitch
- Three in-betweens - the character is dodging a flying object
- Four in-betweens - the character is giving a crisp order
- Six in-betweens - the character sees something inviting
- Nine in-betweens - the character is thinking about something
- Ten in-betweens - the character is stretching a sore muscle

Anticipation

An action occurs in three parts:

1. The preparation for the action - this is anticipation
2. The action
3. The termination of the action

Anticipation can be the anatomical preparation for the action, e.g., retracting a foot before kicking a ball. It can also be a device to attract the viewer's attention to the proper screen area and to prepare them for the action, e.g., raising the arms and staring at something before picking it up, or staring off-screen at something and then reacting to it before the action moves on-screen.

A properly timed anticipation can enable the viewer to better understand a rapid action, e.g., preparing to run and then dashing off-screen. Anticipation can also create the perception of weight or mass, e.g., a heavy person might put their arms on a chair before they rise, whereas a smaller person might just stand up. (Examples of the Principles of Animation, Figures 5-7)

Staging

Staging is the presentation of an idea so that it is clear. This idea can be an action, a personality, an expression, or a mood. The key idea is that the idea is made clear to the viewer. An important objective of staging is to lead the viewer's eye to where the action will occur so that they do not miss anything. This means that only one idea at a time occurs, or else the viewers may be looking at the wrong thing. So, the main object should be contrasted in some way with the rest of the scene. A good example is motion, since the

eye is drawn to motion in an otherwise still scene. In a scene with everything moving, the eye is drawn to a still object. (Examples of the Principles of Animation, Figure 8)

The animator must use different techniques to ensure that the viewer is looking at the correct object at the correct time. For example, in a room in a house the Father appears first, and so is the centre of attention. Then the son bounds in, moving rapidly, so the centre of attention shifts to him. At a certain point the son stops and looks up at the father, refocusing the attention on the father.

In the early days at Disney all characters were black and white, with no grey. All action was shown in silhouette (to the side), because if a character moved its black arm in front of its black body it would disappear, so the action had to be against the white background. The Disney animators realized that even without this technological limitation action was more clearly visible in silhouette. Even with modern colour 3D graphics, silhouette actions are more clearly delineated and thus to be preferred, over frontal action. An example would be a character waking up and scratching its side, it is easier to understand what it is doing than if it scratched its stomach. (Lasseter, 1987)

Follow Through and Overlapping Action

Follow through is the termination part of an action. An example is in throwing a ball - the hand continues to move after the ball is released. In the movement of a complex object, different parts of the object move at different times and different rates. For example, in walking, the hip leads, followed by the leg and then the foot. As the lead part stops, the lagging parts continue in motion. Heavier parts lag farther and stop slower. An example is in the antennae of an insect - they will lag behind and then move quickly to indicate the lighter mass. Overlapping means to start a second action before the first

action has completely finished. This keeps the interest of the viewer, since there is no dead time between actions. (Examples of the Principles of Animation, Figure 15)

Here is a quote about overlapping from Walt Disney:

"It is not necessary for an animator to take a character to one point, complete that action completely, and then turn to the following action as if he had never given it a thought until after completing the first action. When a character knows what he is going to do he doesn't have to stop before each individual action and think to do it. He has it planned in advance in his mind."

(Lasseter, 1987)

Straight Ahead Action and Pose-to-Pose Action

Straight Ahead Action in hand drawn animation is when the animator starts at the first drawing in a scene and then draws all of the subsequent frames until he reaches the end of the scene. This creates very spontaneous and zany looking animation and is used for wild, scrambling action. Pose-to-Pose Action is when the animator carefully plans out the animation, draws a sequence of poses, i.e., the initial, some in-between, and the final poses and then draws all the in-between frames (or another artist or the computer draws the in-between frames). This is used when the scene requires more thought and the poses and timing are important. (Examples of the Principles of Animation, Figures 16-21)

This is similar to keyframing with computer graphics but it must be modified slightly since the in-betweens may be too unpredictable. For example, objects or parts of objects may intersect one another. Computer keyframing can take advantage of the hierarchical model structure of a complex object. Different parts of the hierarchy can be transformed at different keyframes. For example, in a jump, translation keyframes can be set for the

entire model in the X and Z directions. Then other rotation or translation keyframes can be set for portions of the model, e.g., the legs and arms. (Lasseter, 1987)

Slow In and Out

Refers to the spacing of the in-between frames at maximum positions. It is the second and third order continuity of motion of the object. Rather than having a uniform velocity for an object, it is more appealing, and sometimes more realistic, to have the velocity vary at the extremes. For example, a bouncing ball moves faster as it approaches or leaves the ground and slower as it approaches or leaves its maximum position. The name comes from having the object or character "slow out" of one pose and "slow in" to the next pose. (Examples of the Principles of Animation, Figures 9,10)

Exaggeration

Exaggeration does not mean just distorting the actions or objects arbitrarily, but the animator must carefully choose which properties to exaggerate. If only one thing is exaggerated then it may stand out too much. If everything is exaggerated, then the entire scene may appear too unrealistic. (Examples of the Principles of Animation, Fig 13)

Secondary Action

This is an action that directly results from another action. It can be used to increase the complexity and interest in a scene. It should always be subordinate to and not compete with the primary action in the scene. An example might be the facial expression on a character. The body would be expressing the primary action while the expression adds to it. (Examples of the Principles of Animation, Figure 11)

Appeal

Appeal means something that the audience will want to see. This is equivalent to charisma in a live actor. A scene or character should not be too simple (boring!) or too complex (can't understand it). One principle to achieve this is to avoid mirror symmetry. Asymmetry tends to be more interesting and appealing. Personality in character animation is the goal of all of the above.

(Examples of the Principles of Animation, Figure 14)

Suggested Assessment Strategies

A strong aspect of this course of study is the preparation of the student for the production environment. To be successful, the student must develop the ability to articulate an explanation of why their work is acceptable or not. Teachers are recommended to formalize the self-assessment process to empower the students to become competent at formal and informal assessment. The student should be given the Rubric Evaluation sheets at the beginning of the course. This will allow the student to see what it is he/she will be evaluated on and they can plan accordingly. Also students will then be able to complete the Rubric as a self-evaluation to be compared with the teacher's evaluation. One method of evaluation is to use the Demo Reel. A Demo Reel is a compilation of the student's best work. A Demo Reel includes scripts, digital images, drawn images, models, scenes and animations, all the best work the student has done. A student will need one to get a job in the industry or get into a good technical school. It is the equivalent of an artist's portfolio or a resume. It is a good idea for students to get used to creating a Demo Reel.

Because a demo reel is a sales tool, the student must get use to the idea of selling themselves and proving, to an extent, what sort of positive addition they will be to a company. If the students can prove they have a lot of talent and a creative way of thinking about things, their demo reel will get noticed. If it is exceptionally good, it is their doorway into the industry.

For more information as to what makes a good Demo Reel look like look on the Internet there are a number of good sites that will help. This site provides a good example: <http://www.3dark.com/archives/demoreels/index.html> (Dean, Zero Z. Batzell, 2000)

Recommended Software

- 3D Studio MAX (Windows 9x, Windows NT/2000)
- NewTek Light Wave 3D (Mac, Windows NT/2000, Windows 9x)
- Bryce 3D (Mac, Windows NT/2000, Windows 9x)
- Rhinoceros 3D (Windows NT/2000, Windows 9x)
- PhotoShop (Mac, Windows NT/2000, Windows 9x)
- Corel Photo Paint (Mac, Windows NT/2000, Windows 9x)
- Corel Painter (Mac, Windows NT/2000, Windows 9x)
- Alias/Wavefront MAYA (Mac, Windows NT/2000, Linux)
- Electric Image (Mac, Windows NT/2000, Windows 9x)
- Mirai (Windows NT/2000, Windows 9x)
- Softimage 3D (Windows NT/2000, Windows 9x)
- Strata 3D (Mac, Windows NT/2000, Windows 9x)
- Caligari truespace (Windows NT/2000, Windows 9x)
- Poser (Mac, Windows NT/2000, Windows 9x)
- RealSoft 3D (Windows NT/2000, Windows 9x)

Proposed Courses For 3D Computer Animation

Included in this project are four courses that have been developed based on the Scope and Sequence for 3D Computer Animation (Figure 1). Each course is 25 hours in length and is formatted to match Alberta Learning's CTS course format. Included with the courses are examples of work that the teacher can use to teach the course. Where possible I have included examples from professionals in the industry, with their permission, or ones that I have created specifically for the course.

The courses developed are from the introductory group of courses. These are the best to start with as teachers would be able to start right away and as the remainder of the courses are completed they can be added. Another reason for creating the introductory courses is that I plan to approach Alberta Learning to include these courses in the Alberta CTS Curriculum. I do not know if they would allow fourteen new courses to be created. I will have to revise the Scope and Sequence to reflect what Alberta Learning would be willing to add.

The information included in this document is a compilation of materials that myself or other teachers have collected over the years. While I am no expert in the field of 3D computer Animation, I have had the support and help of many experts either through personal meetings or over World Wide Web. I hope that teachers will be able to use this material and that Alberta will produce some world-class digital artists.

COURSE ANI 1020: STORY DEVELOPMENT/STORYBOARDS 1

Level:	Introductory
Theme:	Developing story lines, creating characters, making Storyboards
Prerequisite:	None
Description:	Students learn a process of generating ideas, which can then be turned into story and character ideas. These stories and characters are combined into a storyboard, which describes the action and dialog.
Parameters:	Access to basic sketching, drawing and modeling tools and equipment and writing tools such as a computer and or pen and paper.
Supporting Courses:	DES 1010 Sketching Drawing, & Modeling, DES 1020 The Design Process, DES 1030 2D Design Fundamentals

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <p>Create a portfolio that demonstrates an understanding of the following:</p> <ul style="list-style-type: none"> • Create a story outline (Who, what, where, when and why) that includes: character development, scene development, props and sets, and conveys a message. • Produce planning documents (script, storyboard) to recognized standards, including sufficient detail and information to enable others to produce a computer animation. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • A portfolio consisting of: <ul style="list-style-type: none"> – A story brainstorming chart that uses the headings: Character, Setting, Motivation, and Obstacles. – A story concept sentence for four different 60-second 3D Computer Animations. – A Three Act Structure of two of the story concept sentences. – A one-page summary of one of the story concept sentences. – A list of scenes - each scene about two sentences in length. – An outline of where the character sleeps, works plays and eats. – A folder of exciting camera shots from the students favourite movies. – A storyboard based on the list of scenes. <p><i>Assessment Tool</i> <i>Portfolio Assessment, ANI 1020</i></p> <p><i>Standard</i> <i>Performance rating of 1 for each criteria</i></p>	<p>5</p> <p>10</p> <p>5</p> <p>5</p> <p>10</p> <p>5</p> <p>5</p> <p>45</p>

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> • Story Pitch – After creating the story concept, the characters and the storyboard, students need to pitch the idea to a class (not necessarily their own class). Then use their feedback to make necessary adjustments. • Demonstrate basic competencies. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • The student’s presentation of work completed in this course. <p style="text-align: center;"><i>Assessment Tool</i> <i>Presentations/reports, ANI 1020</i></p> <p style="text-align: center;"><i>Standard</i> <i>Performance rating of 1 for each criteria</i></p> <ul style="list-style-type: none"> • Observations of individual effort and interpersonal interaction during the learning process. <p style="text-align: center;"><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above.</i></p>	<p style="text-align: center;">10</p> <p style="text-align: center;">Integrated throughout</p>

Concept	Specific Outcomes	Notes
Brain - storming Ideas	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> • Begin the story concept process <ul style="list-style-type: none"> – The most important thing is to evoke a strong emotional response from the audience – Researching Ideas – Brainstorming techniques • Define the story concept sentence <ul style="list-style-type: none"> – The basic structure: “My story is about <i>a character</i> who wants <i>something</i>.” – Do not use well-known characters; pretend that the students are trying to explain the concept to a person who has been isolated for the last 50 years. – Create a brainstorming chart. Use the headings: Character, Setting, Motivation, and Obstacles. 	<p>This is an important step in setting up for the story concept sentence.</p> <p>Be sure the students do not make reference to any type of stereotypical character.</p> <p>Instead of saying, “A Luke Skywalker type of character” say, “A young farm boy in a futuristic desert planet.”</p>

Concept	Specific Outcomes	Notes
Creating Story Ideas and Scripting	<ul style="list-style-type: none"> • Use the Three-Act Structure to develop the concept sentence. • Create a Three-Act Structure of the concept sentence. <ul style="list-style-type: none"> – Divide the story into three parts or acts. – Act One – Set-up story and define the status quo and introduce the event that changes the status quo called the Catalyst. – Act Two – The first turning point occurs which provides a fresh turn of action for the story. There is an escalation of obstacles. Building of intensity in the story. – Act Three – Climax of the story happens at the point of greatest intensity. This is followed by the final confrontation between two main characters and the resolution that ties up all the loose ends. • Develop the Three Act Structure into a one-page summary of the story. <ul style="list-style-type: none"> – Step one write a short story. Usually Act One and Act Three are the same length and Act Two is twice as long. – Step two write a short script, one page equals one minute in time. – Step three write a list of scenes, each scene should be about two sentences in length. This should help to create a storyboard. 	<p>Web site to check out: http://www.cyberfilm school.com</p> <p>Definition of an act: Act - A finite block of story action, its conclusion leading either a new direction for the story's conflict, or to a resolution.</p> <p>See Figure 1 Diagram of the Three-Act Structure. This will help to visualize the flow of the story.</p>
Story - board Creation	<ul style="list-style-type: none"> • Things to consider prior to creating a story board: <ul style="list-style-type: none"> – Make sure that everyone can see the storyboards, even from three metres away. – Set design <ul style="list-style-type: none"> ○ Know where the character sleeps, works plays and eats. ○ Study the masters – Study existing movies for ideas on sets and the amount of detail each set designer puts into the movie. ○ Study good architectural design magazines. ○ Remember the students have an imagination. Encourage them to use it, do not use stereotypical sets, and remember 3D Computer Animation allows them to create anything. – Production Design – <ul style="list-style-type: none"> ○ Collect a portfolio of exciting camera shots from favourite movies. ○ Timing – Move one thing at a time. Only move something a good reason to. ○ Shot – Move one thing at a time. Only move something a good reason to. ○ Shot – Move one thing at a time. Only move something a good reason to. ○ Shot – Move one thing at a time. Only move something a good reason to. – Shot – Move one thing at a time. Only move something a good reason to. – Shot – Move one thing at a time. Only move something a good reason to. – Shot – Move one thing at a time. Only move something a good reason to. – Shot – Move one thing at a time. Only move something a good reason to. <p>shot length of about four seconds. Only extend the shot to 10 seconds or more if they are establishing shots or creating dramatic effects.</p> <p>Act out the shots with a stopwatch.</p>	<p>Shot: A shot is a continuous view filmed by one camera without interruption. Each shot is a take. When additional shots of the same action are filmed from the same set-up, the resulting shots are "retakes". This is an important point. If the camera set-up itself is changed in any way - the camera moved, lens changed or different action is filmed -- it is a new shot, not a retake. A shot or a portion of a shot is also known as a "cut".</p>

Concept	Specific Outcomes	Notes
Story - board Creation	<ul style="list-style-type: none"> • Cinematography - Every illustrator creating storyboards for 3D animation must have a solid background in cinematography and editing. • Create a storyboard based on the list of scenes. When creating a storyboard here are a few things to remember: <ul style="list-style-type: none"> - Draw boxes that are the same aspect ratio as the output size. I.E. Video 4:3, HDTV and Film 16:9. - Use arrows to indicate camera movement or motion in the frame. - Use arrows along with shot names to convey specific camera movement that may not be understood by arrows alone. - Use a frame within a frame or arrows to indicate zoom areas. - Use differently shaped, extra long, or extra wide boxes to show pans. - Draw multiple pictures for moving objects or characters within a frame if it seems important to the story. - Write dialog beneath storyboard panels so the reader can see how the audio track will help tell the story, but be brief. - Number each shot next to each frame to indicate order. Number the shots horizontally, not vertically. - Place major transitions between panels. - Vary the camera angles to get more interesting shots. - Using the Rule of thirds will help for composition. Break the screen into thirds both horizontally and vertically. Place the elements along the lines and centre of interest at one of the four points where the lines cross. - Follow Disney's 12 Principles of Animation. <ul style="list-style-type: none"> ○ Squash and Stretch ○ Anticipation ○ Staging ○ Ease In, Ease Out ○ Arcs ○ Secondary Action ○ Timing ○ Exaggeration ○ Solid Drawing ○ Appeal ○ Follow through and Overlapping Action ○ Pose to Pose and Straight Ahead 	<p>There are 47 different camera shots used in 3D Computer Animation. These include: 33 camera shots, 5 camera movements, and 8 basic transitions. Be familiar with them.</p> <p>Storyboard Model By Duke Crawford <i>See Exemplar 1</i> Storyboards courtesy of Duke Crawford.</p> <p>Mr. Crawford uses sticky notes to create his storyboards and is happy to discuss his methods with anyone interested. http://www.storyborg.com duke@storyb.org</p> <p>To find descriptions of the 12 Principles of Animation, search the internet using the search topic "Principles of Animation", there are a number of sites that describe the principals in detail.</p>

Concept	Specific Outcomes	Notes
Story Presentation	<ul style="list-style-type: none"> • Pitch the storyboard to the class for feed back keeping in mind the following: <ul style="list-style-type: none"> – Pretend the class is a five-year old child with a short attention span. – Stick to pitching the story; leave the technical aspect for after the pitch during questions. – Remind the class to ask questions during the pitch, but to keep the questions to the story, there will be time after for technical questions. – Start with the story concept question to give the class an over all idea without giving anything away. – Briefly introduce the main characters before starting the story pitch. – Try to act out the characters voices in order to keep the class involved. – Point to each frame as the story is told so the class can follow visually. – Try to tell the story in the same amount of time it would take to see it. – Make sure storyboards are easy for everyone to see even from three metres away. – Pay attention to when the class hearing the story laugh, look concerned, or show emotion. – Ask the class question as well. How did they like it, what were there favourite parts etc? 	<p>Pitch: A term used in the motion picture industry to describe a sales presentation in order to sell an idea for a movie to producers.</p>

PORTFOLIO ASSESSMENT

ANI 1020 52

Student Name _____

Teacher _____

Project _____

Date _____

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	1
Teamwork	4 3 2 1 0 N/A	1
Content	4 3 2 1 0	1
Equipment and Materials	4 3 2 1 0	1

THE STANDARD IS 1 IN EACH APPLICABLE CRITERIA UNLESS OTHERWISE STATED

Rating Scale

The Student:

- 4 Exceed defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively and with confidence.
- 3 Meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.
- 2 Meets defined outcomes. Plans and solves with limited assistance. Tools, materials and/or processes are selected and used appropriately.
- 1 Meets defined outcomes. Follows a guided plan of action. Limited ranges of tools, materials and/or processes are used appropriately.
- 0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

Criteria

The Student:

Management

- Prepares self for task
- Organizes and works in an orderly manner
- Carries out instructions accurately
- Uses time effectively

Teamwork

- Cooperates with group Members
- Shares work appropriately among group members
- Exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Content

- A story brainstorming chart that uses the headings: Character, Setting, Motivation, and Obstacles.
- A story concept sentence for four different 60-second 3D Computer Animations.
- A Three Act Structure of two of your story concept sentences.
- A one-page summary of one of your story concept sentences.
- A list of scenes - each scene about two sentences in length.
- An outline of where your character sleeps, works plays and eats.

Content (continued)

- A folder of exciting camera shots from some of your favourite movies.
- Create a storyboard based on your list of scenes. Insure you use boxes and that it can be seen easily.

Equipment and Materials

- Selects and uses appropriate equipment and materials
- Follows safe procedures and techniques
- Returns class equipment and materials to storage areas

PRESENTATION/REPORTS

Student Name _____

Teacher _____

Project _____

Date _____

Criteria	Observation/ Rating	Standard
Preparation and Planning	2 1 0	1
Content	2 1 0	1
Presentation	2 1 0	1

THE STANDARD IS 1 IN EACH APPLICABLE CRITERIA UNLESS OTHERWISE STATED

Rating Scale

The Student:

- 4 Exceed defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively and with confidence.
- 3 Meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.
- 2 Meets defined outcomes. Plans and solves with limited assistance. Tools, materials and/or processes are selected and used appropriately.
- 1 Meets defined outcomes. Follows a guided plan of action. Limited ranges of tools, materials and/or processes are used appropriately.
- 0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

Criteria

The Student:

Preparation and Planning

- Sets goals and follows instructions accurately
- Responds to directed questions and follows necessary steps to find answers
- Interprets and organizes information into a logical sequence
- Records information accurately, using correct technical terms
- Uses time effectively

Content

- Presents assignment to teacher and peers
- Sticks to pitching the story; leave the technical aspect for after the pitch
- Started with story concept sentence to give the class an over all idea
- introduces the main characters before starting the story pitch.
- ensure storyboards are easy for everyone to see even from three metres away
- Ask the class question
- Evaluates projects/exercises for possible enhancements
- Identifies/explains any difficulties encountered
- Obtains and responds to feedback and based on:
 - Consider revisions
 - Plan for revisions
 - Revise to improve quality

Content (continued)

- Creates a portfolio or adds assignment to existing portfolio

Presentation

- Demonstrates effective use of at least one medium of communication:

e.g. **Written:** spelling, punctuation, grammar, basic format
Oral: voice projection, body language

Audio Visual:

- technique s, tools
- Uses correct grammatical convention and technical terms
- Provides an introduction that describes the purpose of the project
- Communicates information in a logical sequence

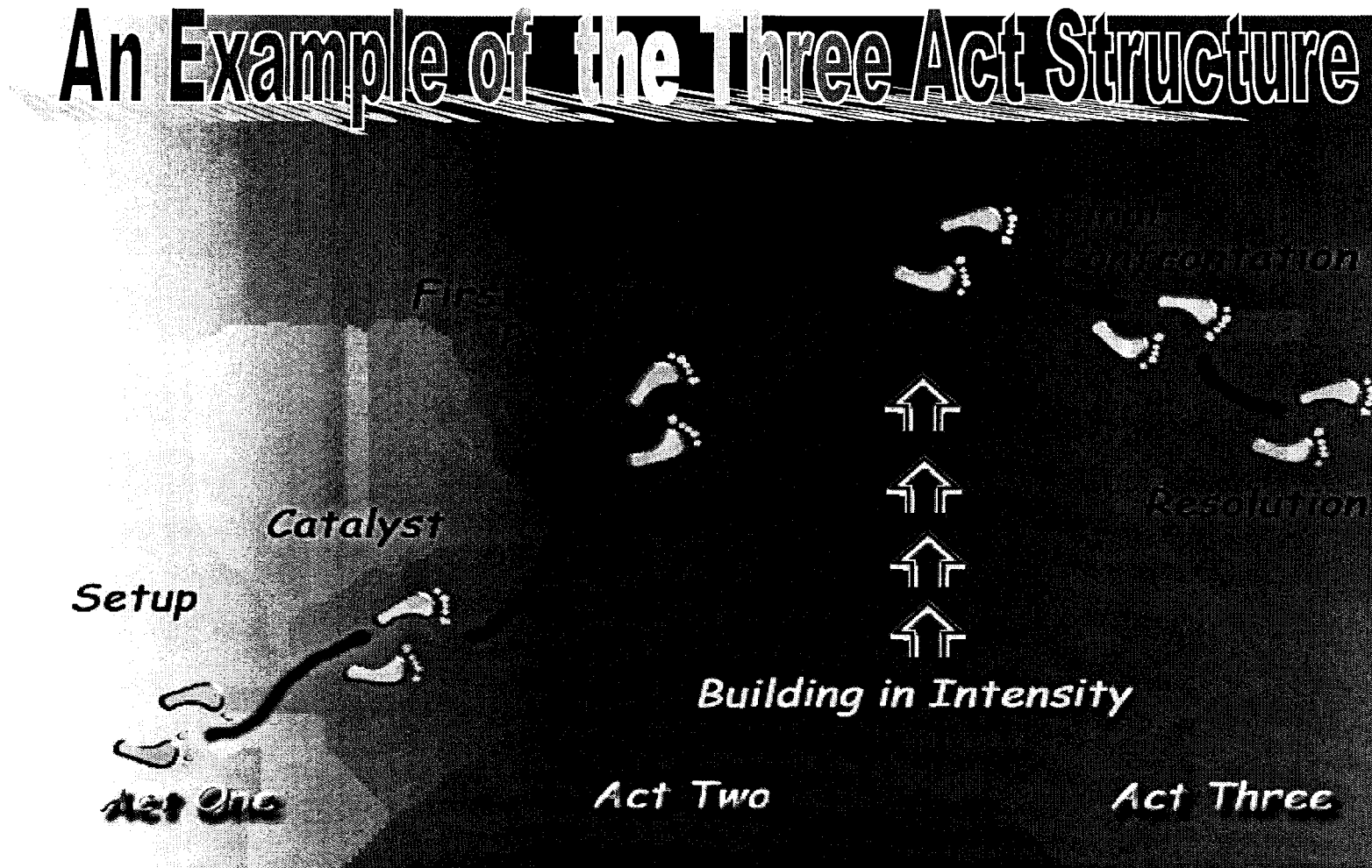
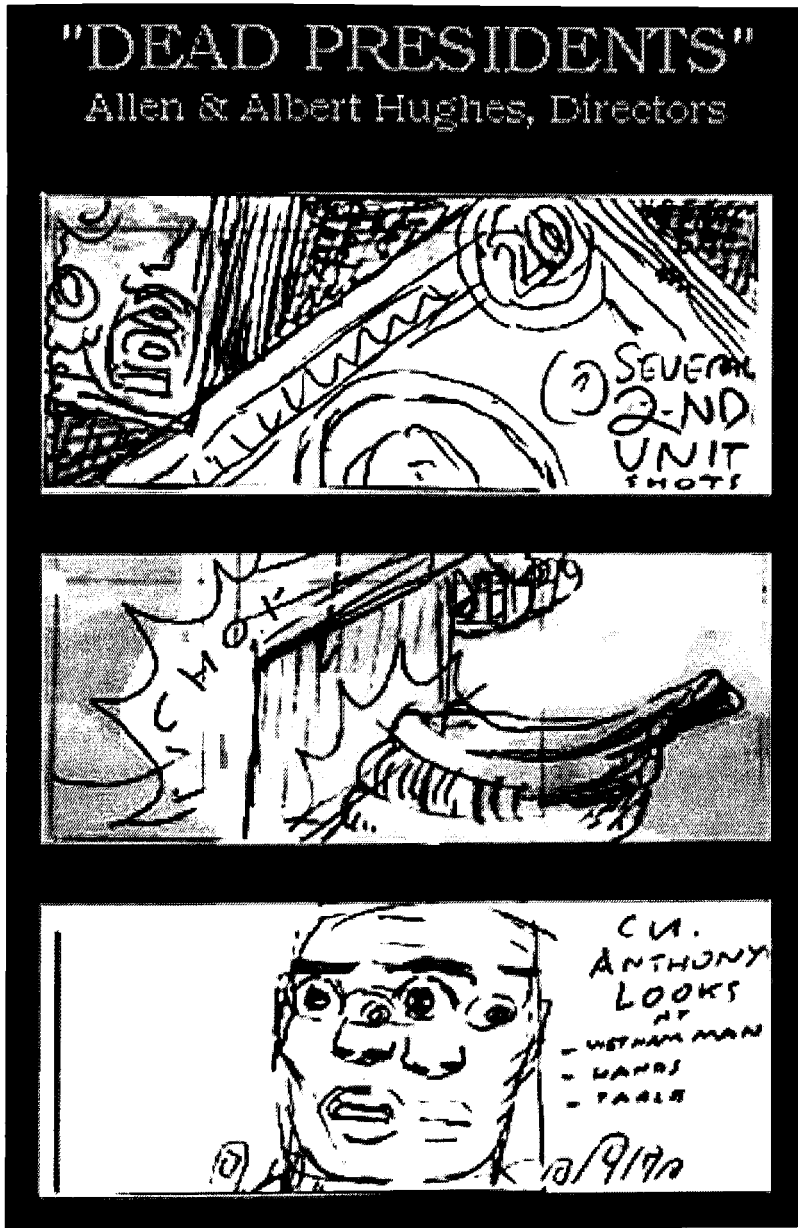


Figure 1 An Example of the Three-Act Structure

Model of a Storyboard



Label shots that are not easy to understand.

Figure 1 Label Shots

Write in sound effects or dialog to clarify action.

Figure 2 Write in Sound Effects

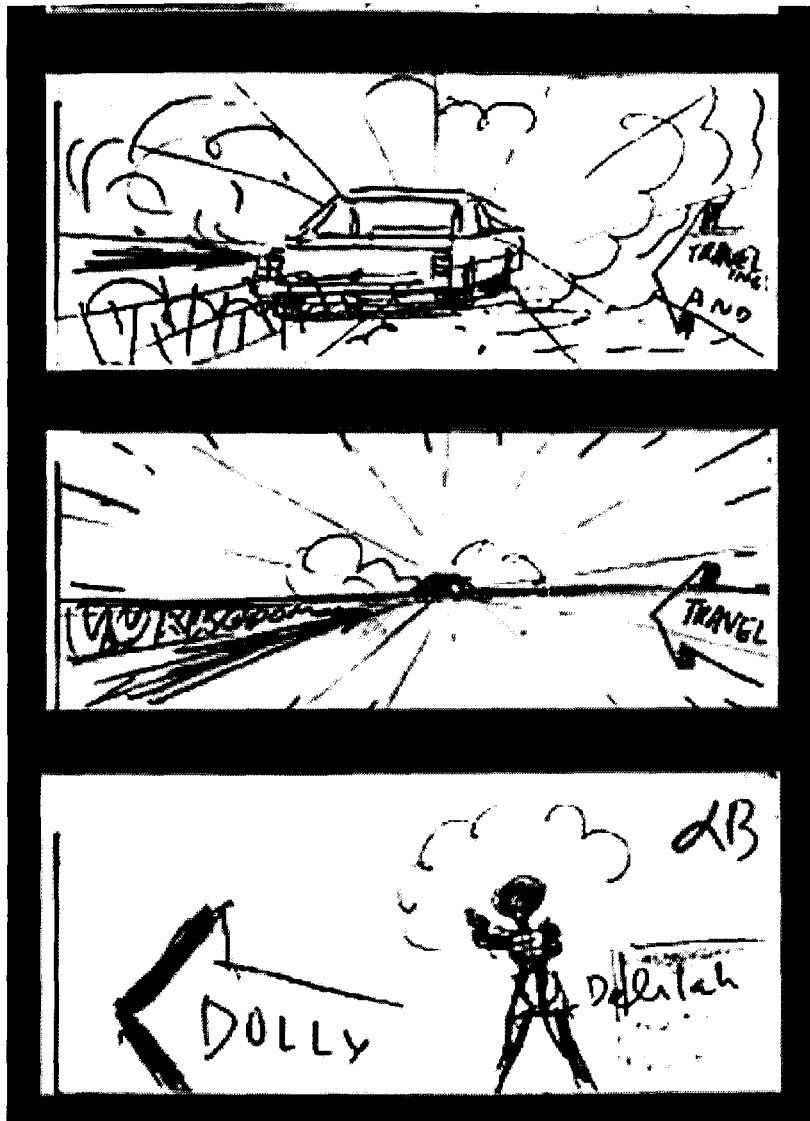
Explain action if the drawing is not clear.

Figure 3 Explain Action



Use arrows to indicate camera movement or motion in the

Figure 4 Use Arrows



Use arrows along with shot names to convey specific camera movement that may not be understood by arrows alone.

Figure 5 Use arrows with shot names



Use a frame within a frame or arrows to indicate zoom areas.

Figure 6 Indicate Zoom Areas

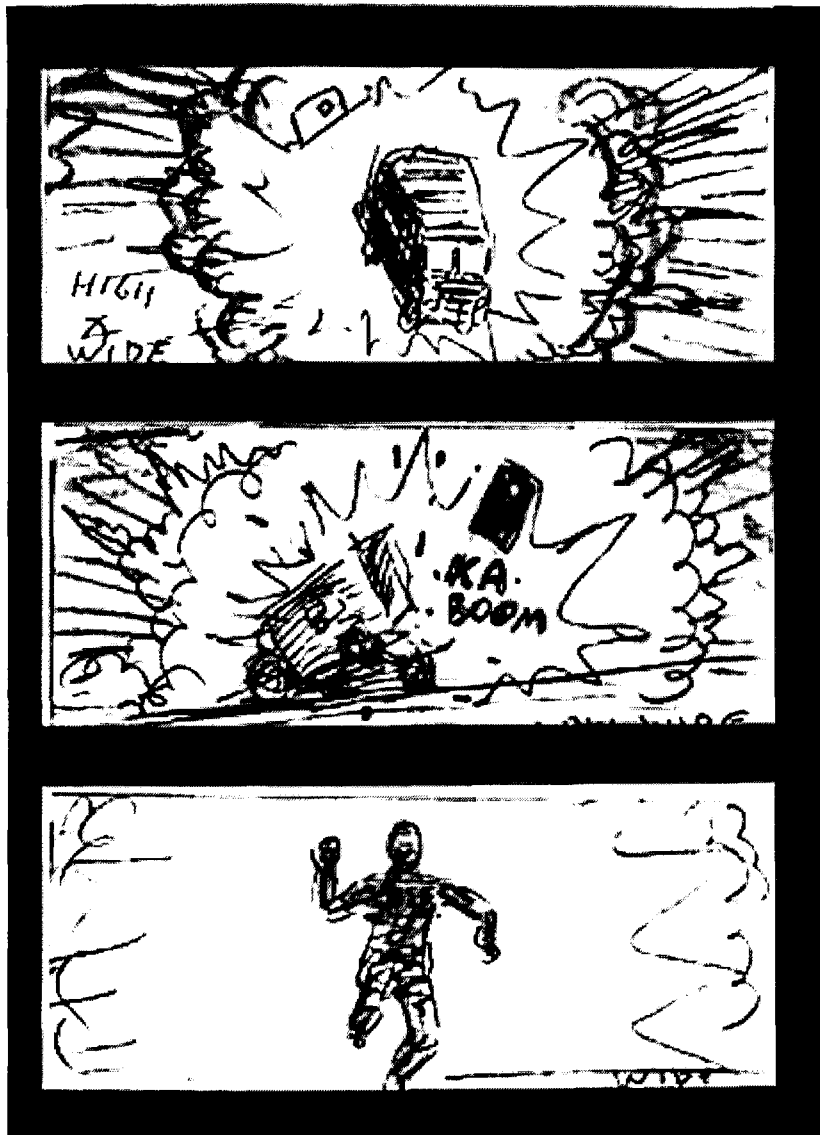


Figure 7 Examples of Action

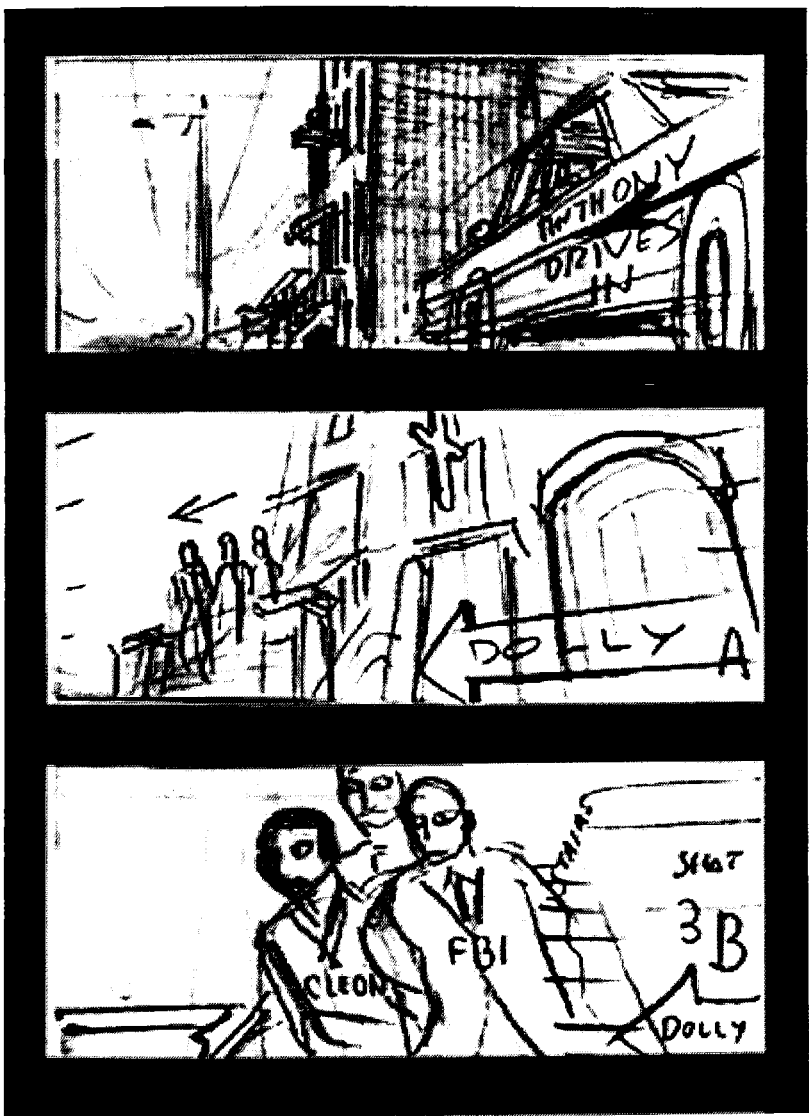


Figure 8 Examples of Camera Shots



Vary your camera angles to get more interesting shots

Figure 9 Vary Camera Angle



Figure 10 Examples of Close Ups

Dead Presidents Storyboard provided courtesy of Duke Crawford

COURSE ANI 1030: MODELING 1

Level: Introductory

Theme: Learn the basics of 3D modeling.

Prerequisite: None

Description: Students understand the 3D world, how 3D objects are created and learn the process of creating and manipulating objects

Parameters: Access to computer with 3D Animation Software that allows the creation and manipulation of objects.

Supporting Courses: None

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <p>Understand the 3D environment and how 3D objects are created.</p>	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • Students must demonstrate an understanding of the following concepts through their use while modeling: <ul style="list-style-type: none"> – Coordinate Systems in 3D Space – Perspective Space – Orthographic Projections – Geometry Types – Shape Types – Faces – Vertexes – Edges – Length, Width, Height, Radius – Segments – Pivot Points – Modifiers and Transformers 	<p>30</p>
<p>Learn the process of creating and manipulating 3D objects.</p>	<ul style="list-style-type: none"> • Students must create a portfolio that exhibits their best models created. This portfolio must include at least one of the following: <ul style="list-style-type: none"> – A hand – A vehicle – A kitchen appliance – A piece of living room furniture – A child's toy – A circular staircase 	<p>60</p>

Concept	Specific Outcomes	Notes
Perspective Space	<ul style="list-style-type: none"> • When an object is moved, rotated, or scaled, the XYZ axes are used for reference. An object is moved along, rotated around, or scaled along the chosen axis line. Values for these transformations are stored for each of the three axes. • When you visualise objects in the real world, you do not usually think about axis lines and 3D coordinates. Instead, you see the world in perspective where lines vanish to the horizon and objects get smaller as they get further. • A perspective view allows you to visualize 3D space in a way similar to how you view the world through either your eyes or the lens of a camera. 	
Orthographic Projections	<ul style="list-style-type: none"> • While a perspective view can help you compose a shot, it is not always the ideal method for modeling and animating objects. Therefore, an orthographic view lets you analyse your scene using parallel projections of only two axes at a time. Using these views, you can more accurately determine how an object is positioned. • Most 3D animators find themselves using perspective views to compose a shot but the perspective view can be misleading depending on your view. The orthographic views offer a place to view the scene more accurately. Both views are crucial to working properly in 3D. 	
Geometry Types	<ul style="list-style-type: none"> • Standard Primitives are relatively simple 3D objects. They include the Box, Sphere, Cylinder, Prism, Cone, and Tube, but are the building blocks for all objects. • Compound Objects include Morphs and Booleans. Booleans combine the geometry of two objects using union, intersection, and difference operations. Morphs are animated objects that that change one geometric shape into other shapes over time. • Loft Object are 2D shapes such a circle, polygon, lines, etc. that are extended along a path to create a 3D object. • Particle Systems are animated objects that simulate spray, snow, sparks and similar collections of small objects. • Patch Grids are simple 2D surfaces ready for modeling or repairing existing meshes. • NURBS Surfaces are analytically generated surfaces especially suited for modeling. NURBS are found in higher end software such as 3D Max, MAYA and SoftImage. They are controlled through a lattice and CV points that can be manipulated to create a more organic looking shape. 	

Concept	Specific Outcomes	Notes
Modifiers and Transformers	<ul style="list-style-type: none"> • Pivot Points – Every object has a pivot point. The pivot point is important for a number of reasons. First, it is the point upon which the object will rotate. If the pivot point was in the centre of the object it will rotate around its centre like a globe. If the pivot point is at the end of the object it will pivot around the end like a hinge. In most 3D animation software you can adjust the pivot point to wherever you need for the effect you wish. The second use of the pivot point is important for modeling. When you apply a modifier, such as a bend or taper, the pivot point controls how that modifier will affect the object. When you apply the bend modifier, if the pivot point is in the centre of the object then both ends of the object will curve around the pivot point. When the pivot point is placed at the end of the object that end will be anchored and the rest of the object will curve around it. • Modifiers are applied in Object Space and Transformers in World Space, but they differ in more ways than which space that are applied in. They also differ in how they affect an object and the order in which they are applied to an object. • Modifiers are operations that act on the internal structure of an object in object space. For example, when you apply a modifier such as twist to a mesh object, the position of each vertex of the object is individually changed in object space to produce that twist affect. • Modifiers operate at the sub-object level and are dependent on the internal structure of the object when the modifier is applied. • Modifiers have the following properties. They are: <ul style="list-style-type: none"> – Applied to all of an object, or part of an object. – Dependent on the order of application. Applying a Bend followed by a Twist produces a result different from applying a Twist followed by a Bend. • Transforms are the most basic of 3D manipulations. Depending of the software you use they may or may not be called transformers. They are more universally called: Move, Rotate, and Scale. Unlike modifiers, Transformers are independent of an objects internal structure; they act directly on the objects local coordinate system. • The local coordinate system of an object can be expressed as a matrix of values that specify the following information in world space: <ul style="list-style-type: none"> – Position of the object’s center n world space. – Rotation of the object in world space. – Scale of the object along its local axes. 	For an example of how to use modifiers and transformers to create objects see An Example of Manipulating Faces and Vertexes to Create a Hand on page 50.

Concept	Specific Outcomes	Notes
	<ul style="list-style-type: none">• The matrix is called the transformation matrix and its information relates directly to the transforms of Move, Rotate, and Scale. These transforms represent addition and multiplication of the values in the transformation matrix. • Transforms have the following properties. They are:<ul style="list-style-type: none">– Applied to the entire object.– Stored as single values independent of the order of application. No matter how many times you transform an object, the results are stored as one set of values in the matrix.– Applied after all object modifiers have been evaluated.	

PORTFOLIO ASSESSMENT

Student Name _____

Teacher _____

Project _____

Date _____

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	1
Teamwork	4 3 2 1 0 N/A	1
Content	4 3 2 1 0	1
Equipment and Materials	4 3 2 1 0	1

THE STANDARD IS 1 IN EACH APPLICABLE CRITERIA UNLESS OTHERWISE STATED

Rating Scale

The Student:

- 4 Exceed defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively and with confidence.
- 3 Meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.
- 2 Meets defined outcomes. Plans and solves with limited assistance. Tools, materials and/or processes are selected and used appropriately.
- 1 Meets defined outcomes. Follows a guided plan of action. Limited ranges of tools, materials and/or processes are used appropriately.
- 0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

<p>Criteria <i>The Student:</i></p> <p>Management</p> <ul style="list-style-type: none"> <input type="checkbox"/> Prepares self for task <input type="checkbox"/> Organizes and works in an orderly manner <input type="checkbox"/> Carries out instructions accurately <input type="checkbox"/> Uses time effectively <p>Teamwork</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cooperates with group Members <input type="checkbox"/> Shares work appropriately among group members <input type="checkbox"/> Exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing <p>Content</p> <p>Students must demonstrate an understanding of the following concepts through their use while modeling:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Coordinate Systems in 3D Space <input type="checkbox"/> Perspective Space <input type="checkbox"/> Orthographic Projections <input type="checkbox"/> Geometry Types <input type="checkbox"/> Shape Types <input type="checkbox"/> Faces <input type="checkbox"/> Vertices <input type="checkbox"/> Edges <input type="checkbox"/> Length, Width, Height, Radius <input type="checkbox"/> Segments <input type="checkbox"/> Pivot Points <input type="checkbox"/> Modifiers and Transformers 	<p>Content (continued)</p> <p>Students must create a portfolio that exhibits their best models created. This portfolio must include at least one of the following:</p> <ul style="list-style-type: none"> <input type="checkbox"/> A hand <input type="checkbox"/> A vehicle <input type="checkbox"/> A kitchen appliance <input type="checkbox"/> A piece of living room furniture <input type="checkbox"/> A child's toy <input type="checkbox"/> A circular staircase <p>Equipment and Materials</p> <ul style="list-style-type: none"> <input type="checkbox"/> Selects and uses appropriate equipment and materials <input type="checkbox"/> Follows safe procedures and techniques <input type="checkbox"/> Returns class equipment and materials to storage areas
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Examples of Objects in 3D Space

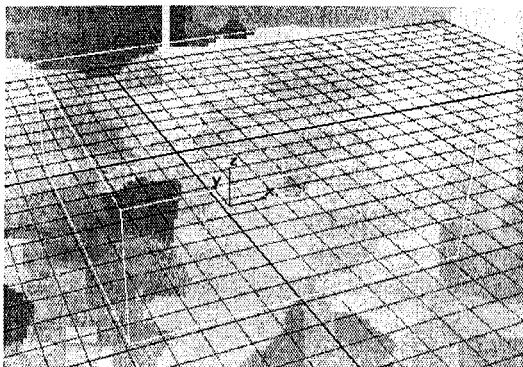


Figure 1 A box in World Space

The Grid represents World Space. The Box object is created using the XYZ axes.

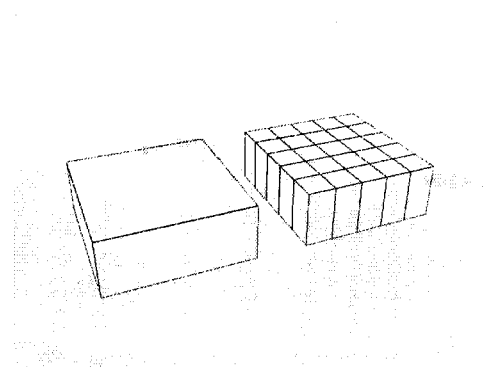


Figure 2 A Box with Segments and a Box without Segments

The Blue Box Object has only one segment and modifiers will not work very well. The Red Box Object has five segments and modifiers will work properly.

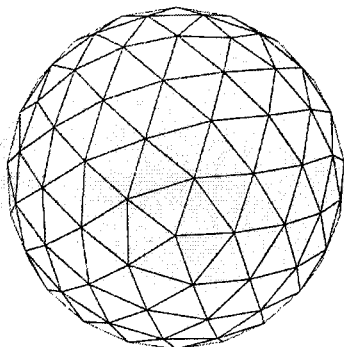


Figure 3 The Faces that make a Sphere

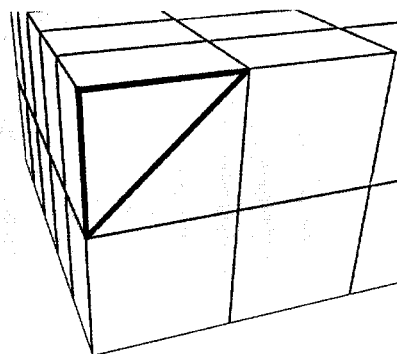


Figure 4 The Faces that make up a Box

3D Objects are made up of triangular shapes called faces. The more faces you have in an object the smoother and more organic it looks. The problem with a lot of faces is that you use more memory and it takes longer to render. The 3D animation modeller has to walk a fine line between an object looking good and the use of your systems resources.

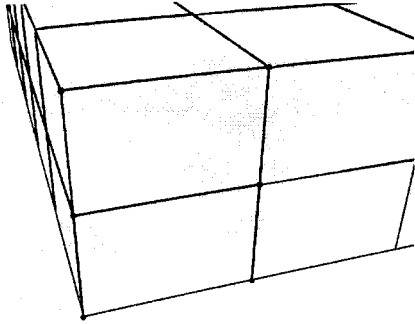


Figure 5 Vertexes of a Box

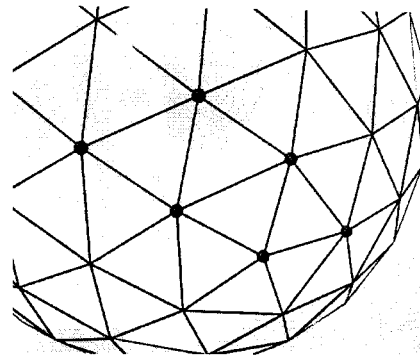


Figure 6 Vertexes of a Sphere

All faces are connected at the points by vertexes. Vertexes can be moved singularly and in groups to change the shape of the object.

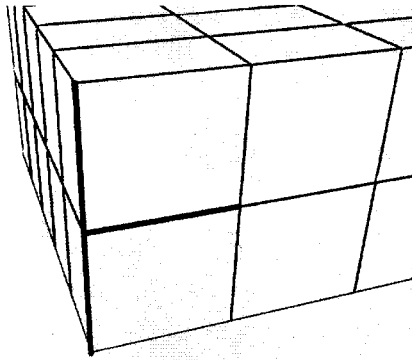


Figure 7 Selected Edges on a Box

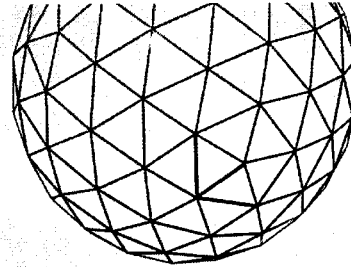


Figure 8 Selected Edges on a Sphere

The Face edges can be selected and moved.

An Example of Manipulating Faces and Vertices to Create a Hand

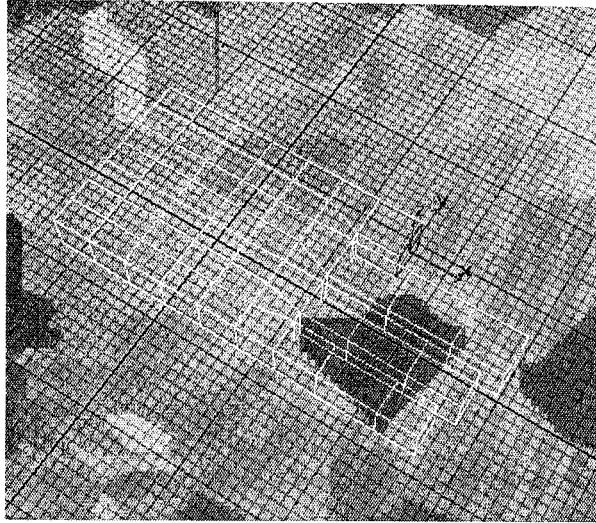


Figure 9 Extruding Faces to Create Fingers

From a simple box, (7 segments long, by 6 segments wide, by 1 segment deep) select the faces where you want the fingers to be and extrude each one separately 3 times. The faces in between the fingers must be scaled smaller.

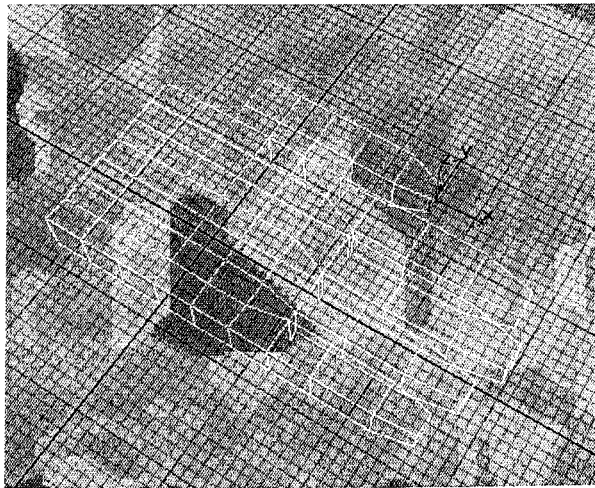


Figure 10 Extruding and Shaping the Thumb

Create the base of the thumb in the same way, by extruding the vertexes along the side of the box then extruding a face to make the thumb. Then using the Scale transformer shrink the end of the fingers and thumb to represent the ends of the digits.

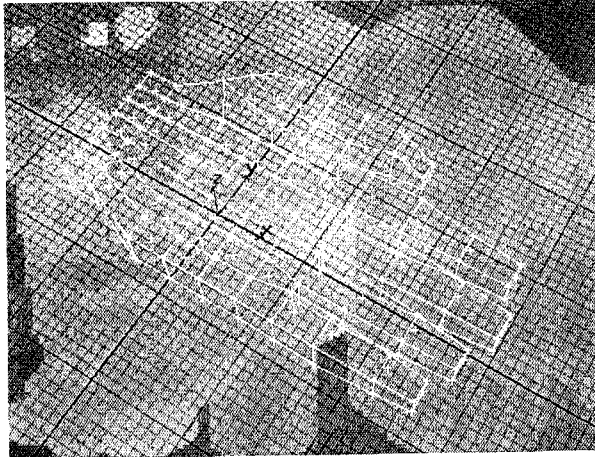


Figure 11 Editing the hand by moving vertexes

Edit the object by moving the Vertexes to make the object look more like a hand.

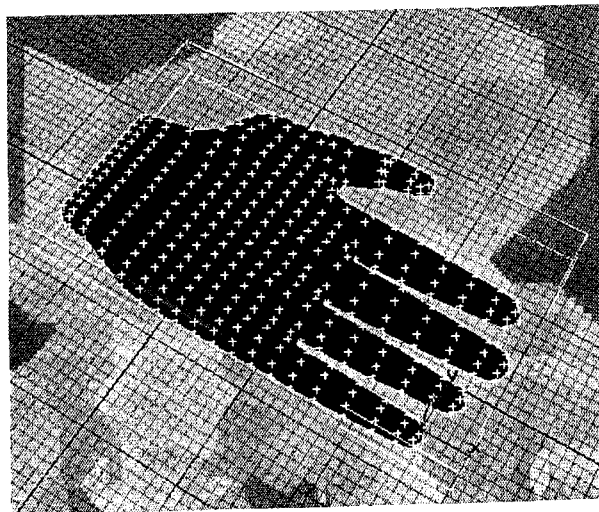


Figure 12 Apply the Modifier Smooth to object

After you are satisfied with the shape of the hand apply a smooth modifier to the object. This will give hand a more organic appearance. The next step is up to you. By manipulating the vertexes and faces of the object and then applying smooth again you can create a fairly realistic hand.



Figure 12 The Finished Hand

Continue editing the Mesh by moving vertexes and applying smooth again if needed. Then apply a material to the object to make it look more life like.

COURSE ANI 1040: ANIMATION CONCEPTS

Level:	Introductory
Theme:	Learn how objects move and how to create basic 3D Animation.
Prerequisite:	None
Description:	Students understand the 3D world, how 3D objects are made to move and the concepts behind why they move the way they move.
Parameters:	Access to computer with 3D Animation Software that allows the creation and movement of 3D objects.
Supporting Courses:	None

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <p>Learn the history of animation and how it contributed to the development of what we know as computer animation today.</p> <p>Learn the basic Principles of Animation.</p> <p>Analyze motion to determine and create Animation through the understanding of:</p> <ul style="list-style-type: none"> - Dynamics of objects - Physical properties of motion - Timing - Keyframe 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • Research both Classical Animation and Stop Motion Animation. Create a 500-word essay describing both processes. This research can be completed with the use of the library or the Internet. • Essay requirements: <ol style="list-style-type: none"> 1. Describe the techniques involved with creating animations in both the classical style and stop motion style. 2. Give examples of work created in both styles. 3. Include illustrations or clips to demonstrate techniques. • Students must create a portfolio of animations that exhibits their best examples of the following principles: <ul style="list-style-type: none"> - Squash and Stretch - Anticipation - Staging - Slow In and Out - Secondary Action - Timing and Motion - Exaggeration - Appeal - Follow Through and Overlapping Action - Straight Ahead Action and Pose-to-Pose Action 	<p>20</p> <p>70</p>

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p>Present final animations to class for evaluation and critique.</p> <p>Work at an appropriate level of basic competencies.</p>	<p><i>Assessment Tool</i> <i>Portfolio Assessment, ANI 1030</i></p> <p><i>Standard</i> <i>Performance rating of 1 for each criteria</i></p> <ul style="list-style-type: none"> • The student's presentation of work completed in this course. <p><i>Assessment Tool</i> <i>Presentations/Reports, ANI 1040</i></p> <p><i>Standard</i> <i>Performance rating of 1 for each criteria</i></p> <ul style="list-style-type: none"> • Observations of individual effort and interpersonal interaction during the learning process. <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above.</i></p>	<p>10</p> <p>Integrated throughout</p>

Concept	Specific Outcomes	Notes
<p>Identify the history of animation and how it contributed to the development of what we know as computer animation today.</p>	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> • Working in 3-D on a computer requires that you visualize three-dimensional objects drawn on a two-dimensional medium—the computer screen. • Animation is based on a principle of human vision. If you view a series of related still images in quick succession, you perceive it as continuous motion. Each individual image is referred to as a frame. • In the past animation has been produced in two ways. The first is called traditional or classical animation. Artists create a series of drawn or painted frames, or cells, which are then combined into a film. The second way is to use actual models and stop motion photography is used to create motion. Stop motion photography is where the model is moved, the image recorded, and then moved again, the next image is recorded, and this process is continued. 	

Concept	Specific Outcomes	Notes
<p>Analyze motion to determine and create Animation thought the understanding of:</p> <ul style="list-style-type: none"> - Dynamics of objects (introduction) - Physical properties/ motion - Timing - Keyframe - storyboard (frame count) - planning 	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> • Computer animation is a combination of these two methods. Like traditional animation the computer will create successive frames where the images change from one to the other. Also as in model animation the artist creates a wire mesh model on the computer. Moving the model and creating a key frame, moving it again and creating a key frame, creating motion, and this process is continued. • Most of the frames in an animation are routine, incremental changes from the previous frame directed toward some goal. Traditional animation studios realized they could increase the productivity of their master artists by having them draw only the important frames, called keyframes. Assistants could then figure out what belonged on the frames in between the keyframes. The in between frames were called tweens. • Once all of the keyframes and tweens were drawn, the images had to be inked or rendered to produce the final images. Even today, production of a traditional animation usually requires hundreds of artists to generate the thousands of images needed. • One of the best ways to start understanding motion is by observing the world around you. Observe people walking down the street. Watch a dog walking or running in the park. Observe yourself moving and doing different things. Use a stopwatch to get a feel for how much time it takes for something to move. • Videotaping is another great way to study how things move. Taping enables you to record the motion of objects, and then play it back as many times as you want at any speed. You can even play the video back frame by frame which is essential for breaking down complex or subtle motions. For stylized or exaggerated motion, such as what you see in cartoon animation, study cartoons and comics from the traditional masters is a great way to examine timing and animation techniques. • It is best to start with simple and straightforward animation situations. You will see many beginning animators starting with a bouncing ball. This may sound too easy, but it is a great exercise in timing. Later on you can work up to more complex animations. It can be a very frustrating experience to start animating a very complex scene if you haven't experimented with and discovered some of the basic rules of animation. Over time you will develop your own instincts and methods for animating 3D characters. You will quickly be able to see when motion appears correctly. 	

Concept	Specific Outcomes	Notes
<p>Explore the basic Principles of Animation.</p>	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> • When animating with 3D animation software, what can you control. As the master animator, you create the keyframes that record the beginning and end of each animated sequence. The values at these keyframes are called keys. The software calculates the interpolated values between each key to produce the completed animation. • You can control just about any parameter in your scene, depending on the sophistication of your software. You can animate modifier parameters, such as a Bend angle of a Taper amount, material parameters, such as the colour or transparency of an object, and much more. • Once you have specified your animation parameters, the software renderer takes over the job of shading and rendering each frame. The result is a high-quality animation. • Principles of Traditional Animation: <ul style="list-style-type: none"> – Squash and Stretch - defining the rigidity and mass of an object by distorting its shape during an action. When real objects move only totally rigid ones, e.g., a chair, remain rigid in motion. Living creatures always deform in shape in some manner. For example, if you bend your arm, your bicep muscles contract and bulge out. They then lengthen and disappear when your arm straightens out. The squashed position shows the form flattened out and the stretched position shows the form extended. An important rule is that the volume of the object should remain constant at rest, squashed, or stretched. If this rule is not obeyed, then the object appears to shrink when squashed and to grow when stretched. – Anticipation - the preparation for an action. An action occurs in three parts: 1. The preparation for the action - this is anticipation. 2. The action. 3. The termination of the action. Anticipation can be the anatomical preparation for the action, e.g., retracting a foot before kicking a ball. It can also be a device to attract the viewer's attention to the proper screen area and to prepare them for the action, e.g., raising the arms and staring at something before picking it up, or staring off-screen at something and then reacting to it before the action moves on-screen. An example of this is the opening scene of Luxo, Jr. The father is looking off-screen and then reacts to something. This sets up the viewers to look at that part of the screen so they are prepared when Luxo, jr. hops in from off-screen. 	<p>See Examples of the Principles of Animation figures 1-4</p> <p>See Examples of the Principles of Animation figures 5-7</p>

Concept	Specific Outcomes	Notes
	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> <li data-bbox="495 380 1203 716">– Staging - Staging is the presentation of an idea so that it is clear. This idea can be an action, a personality, an expression, or a mood. The key idea is that the idea is made clear to the viewer. An important objective of staging is to lead the viewer's eye to where the action will occur so that they do not miss anything. This means that only one idea at a time occurs, or else the viewers may be looking at the wrong thing. So, the main object should be contrasted in some way with the rest of the scene. A good example is motion, since the eye is drawn to motion in an otherwise still scene. In a scene with everything moving, the eye is drawn to a still object. <li data-bbox="495 741 1198 1077">– Slow In and Out - the spacing of the in-between frames to achieve subtlety of timing and movement. This refers to the spacing of the in-between frames at maximum positions. It is the second and third order continuity of motion of the object. Rather than having a uniform velocity for an object, it is more appealing, and sometimes more realistic, to have the velocity vary at the extremes. For example, a bouncing ball moves faster as it approaches or leaves the ground and slower as it approaches or leaves its maximum position. The name comes from having the object or character "slow out" of one pose and "slow in" to the next pose. <li data-bbox="495 1102 1198 1312">– Secondary Action - This is an action that directly results from another action. It can be used to increase the complexity and interest in a scene. It should always be subordinate to and not compete with the primary action in the scene. An example might be the facial expression on a character. The body would be expressing the primary action while the expression adds to it. <li data-bbox="495 1337 1209 1883">– Timing and Motion - spacing actions to define the weight and size of objects and the personality of characters. The speed of an action, for example timing, gives meaning to movement. It gives both physical and emotional meaning. The animator must spend the appropriate amount of time on the anticipation of an action, on the action, and on the reaction to the action. If too much time is spent, then the viewer may lose attention, if too little, then the viewer may not notice or understand the action. Timing can also affect the perception of mass of an object. A heavier object takes a greater force and a longer time to accelerate and decelerate. For example, if a character picks up a heavy object, e.g., a bowling ball, they should do it much slower than picking up a light object such as a basketball. Similarly, timing affects the perception of object size. A larger object moves more slowly than a smaller object and has greater inertia. These effects are done not by changing the poses, but by varying the spaces or time (number of frames) between poses. 	<p>See Examples of the Principles of Animation figure 8</p> <p>See Examples of the Principles of Animation figures 9-10</p> <p>See Examples of the Principles of Animation figure 11</p> <p>See Examples of the Principles of Animation figure 12</p>

Concept	Specific Outcomes	Notes
	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> - Exaggeration - Accentuating the essence of an idea via the design and the action. Exaggeration does not mean just distorting the actions or objects arbitrarily, but the animator must carefully choose which properties to exaggerate. If only one thing is exaggerated then it may stand out too much. If everything is exaggerated, then the entire scene may appear too unrealistic. - Appeal - creating a design or an action that the audience enjoys watching. This is equivalent to charisma in a live actor. A scene or character should not be too simple (boring!) or too complex (can't understand it). One principle to achieve this is to avoid mirror symmetry. Asymmetry tends to be more interesting and appealing. Personality in character animation is the goal of all of the above. - Follow Through and Overlapping Action - the termination of an action and establishing its relationship to the next action. Follow through is the termination part of an action. An example is in throwing a ball - the hand continues to move after the ball is released. In the movement of a complex object, different parts of the object move at different times and different rates. For example, in walking, the hip leads, followed by the leg and then the foot. As the lead part stops, the lagging parts continue in motion. - Straight Ahead Action and Pose-to-Pose Action - The two contrasting approaches to the creation of movement. Straight Ahead Action in hand drawn animation is when the animator starts at the first drawing in a scene and then draws all of the subsequent frames until he reaches the end of the scene. This creates very spontaneous and zany looking animation and is used for wild, scrambling action. Pose-to-Pose Action is when the animator carefully plans out the animation, draws a sequence of poses, i.e., the initial, some in-between, and the final poses and then draws all the in-between frames (or another artist or the computer draws the in-between frames). This is used when the scene requires more thought and the poses and timing are important. 	<p>See Examples of the Principles of Animation figure 13</p> <p>See Examples of the Principles of Animation figure 14</p> <p>See Examples of the Principles of Animation figure 1</p> <p>See Examples of the Principles of Animation figures 16-21</p>

PORTFOLIO ASSESSMENT

ANI 1040

81

Student Name _____

Teacher _____

Project _____

Date _____

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	1
Teamwork	4 3 2 1 0 N/A	1
Content	4 3 2 1 0	1
Equipment and Materials	4 3 2 1 0	1

THE STANDARD IS 1 IN EACH APPLICABLE CRITERIA UNLESS OTHERWISE STATED

Rating Scale

The Student:

- 4 Exceed defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively and with confidence.
- 3 Meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.
- 2 Meets defined outcomes. Plans and solves with limited assistance. Tools, materials and/or processes are selected and used appropriately.
- 1 Meets defined outcomes. Follows a guided plan of action. Limited ranges of tools, materials and/or processes are used appropriately.
- 0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

Criteria

The Student:

Management

- Prepares self for task
- Organizes and works in an orderly manner
- Carries out instructions accurately
- Uses time effectively

Teamwork

- Cooperates with group Members
- Shares work appropriately among group members
- Exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Content

Research both Classical Animation and Stop Motion Animation. Create a 500-word essay describing both processes. This research can be completed with the use of the library or the Internet.

Essay requirements:

- Describe the techniques involved with creating animations in both the classical style and stop motion style.
- Give examples of work created in both styles.
- Include illustrations or clips to demonstrate techniques.

Content (continued)

Students must create a portfolio of animations that exhibits their best examples of the following principles:

- Squash and Stretch**
- Anticipation**
- Staging**
- Slow In and Out**
- Secondary Action**
- Timing and Motion**
- Exaggeration**
- Appeal**
- Follow Through and Overlapping Action**
- Straight Ahead Action and Pose-to-Pose Action**

Equipment and Materials

- Selects and uses appropriate equipment and materials
- Follows safe procedures and techniques
- Returns class equipment and materials to storage areas

PRESENTATION/REPORTS

Student Name _____
 Project _____

Teacher _____
 Date _____

Criteria	Observation/ Rating	Standard
Preparation and Planning	4 3 2 1 0	1
Content	4 3 2 1 0	1
Presentation	4 3 2 1 0	1

THE STANDARD IS 1 IN EACH APPLICABLE CRITERIA UNLESS OTHERWISE STATED

Rating Scale

The Student:

- 4 Exceed defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively and with confidence.
- 3 Meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.
- 2 Meets defined outcomes. Plans and solves with limited assistance. Tools, materials and/or processes are selected and used appropriately.
- 1 Meets defined outcomes. Follows a guided plan of action. Limited ranges of tools, materials and/or processes are used appropriately.
- 0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

Criteria

The Student:

Preparation and Planning

- Sets goals and follows instructions accurately
- Responds to directed questions and follows necessary steps to find answers
- Accesses basic in-school/community information sources
- Interprets and organizes information into a logical sequence
- Records information accurately, using correct technical terms
- Uses time effectively (15 min.)

Content

- Presents assignment to teacher and peers
- Identifies/explains animation styles and techniques available and used
- Evaluates projects/exercises for possible enhancements
- Identifies/explains any difficulties encountered

Content (continued)

- Obtains and responds to feedback and based on this:
 - Consider revisions
 - Plan for revisions
 - Revise to improve quality
- Creates a portfolio or adds assignment to existing portfolio

Presentation

- Demonstrates effective use of at least one medium of communication:
 - e.g., **Written:** spelling, punctuation, grammar, basic format
 - Oral:** voice projection, body language
 - Audio Visual:** techniques, tools
- Uses correct grammatical convention and technical terms
- Provides an introduction that describes the purpose of the project
- Communicates information in a logical sequence

Examples of the Principles of Animation

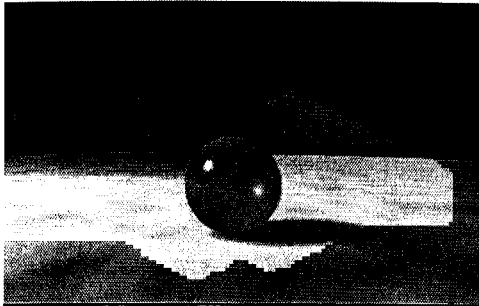


Figure 1 Ball at rest

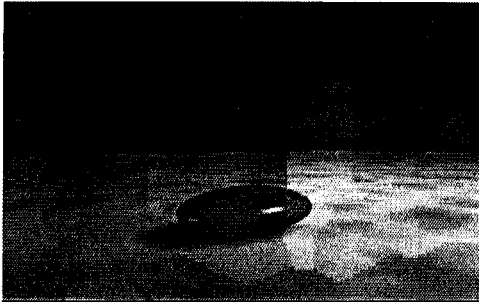


Figure 2 Ball squashed ready to jump

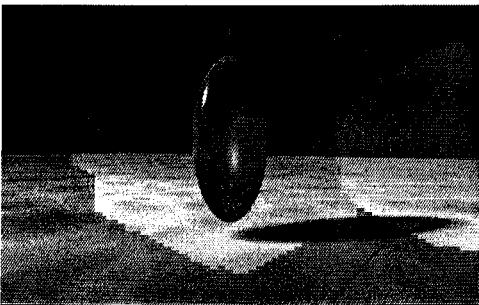


Figure 3 Ball stretched as it jumps

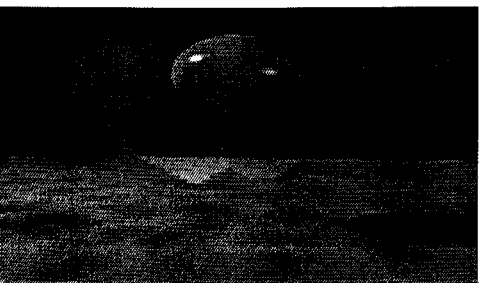


Figure 4 Ball squashes as it reaches the top of the jump

Squash and Stretch can be used to give the illusion of a ball jumping in the air. Frame one has the ball at rest, normal shaped. The ball gathers itself to jump the ball so it squashes down. Then the ball flings itself into the air, so a stretch is applied. As the ball reaches the height of its jump it gathers it self up ready to drop back down.

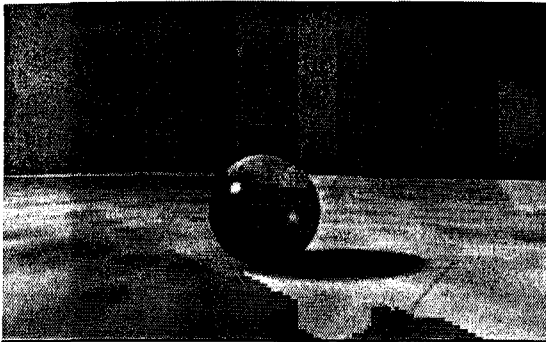


Figure 5 The ball is at rest

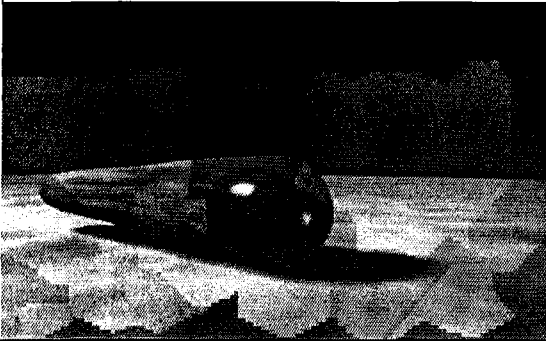


Figure 6 Ball is stretched one direction



Figure 7 The ball is released and shoots off

Anticipation: An example of anticipation is shown with the images of the ball. Image five shows the ball at rest. Then it is stretched one direction while it tries to go the opposite way. Those of us who spent hours watching Saturday morning cartoons, will recognize what happens next. When the stretched part snaps back the ball shoots off in the direction it was pulling.

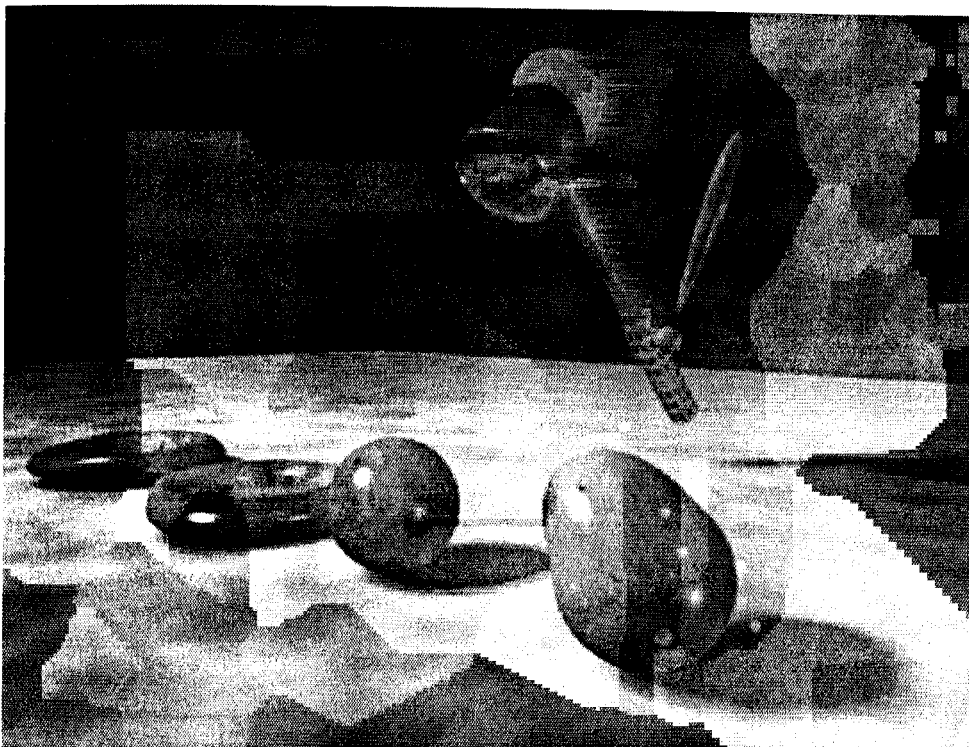


Figure 8 An example of Staging

Staging – In this example the ball on the right is watching the hammer smash the other balls flat. As the hammer gets closer the ball gets more and more alarmed. With the hammer smashing all the balls flat in a sequence the animator has set the stage for the audience. They can see the progression of movement and know what will happen next – Maybe.

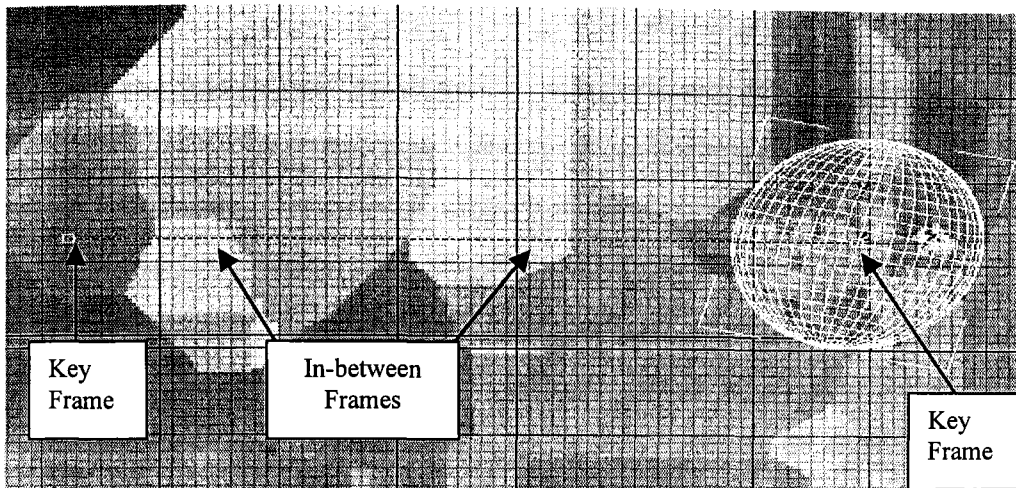


Figure 9 An example of even movement

When this ball was animated to move forward, two Key Frames were created; one at the beginning and one at the end. The motion achieved by this is one that is uniform throughout. This gives a very mechanical looking movement. When animating a character you will want a more natural motion through the use of **Slow In and Out**.

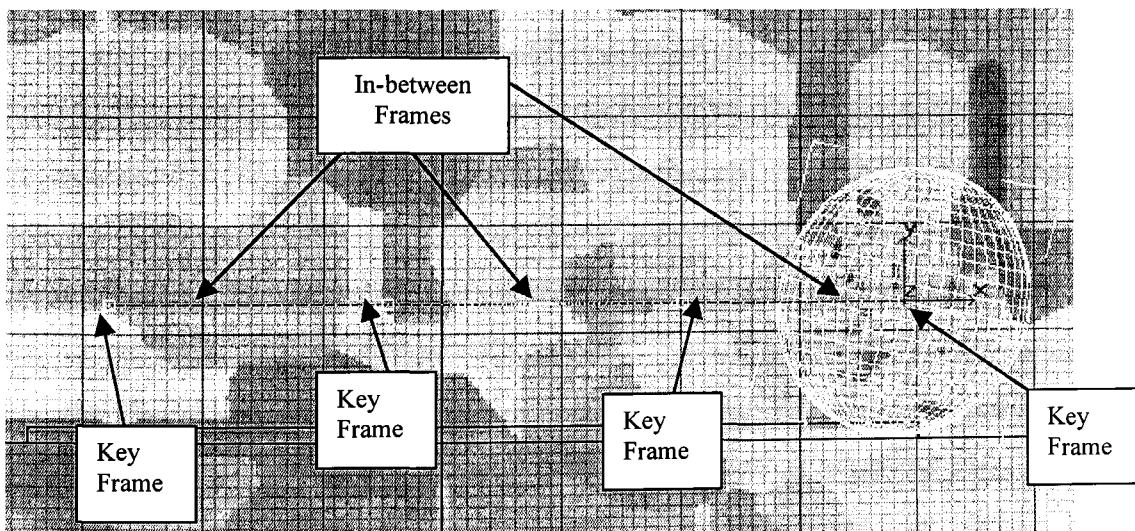


Figure 10 An example of Slow In and Out

Slow In and Out - This refers to the spacing of the in-between frames at maximum positions. It is the second and third order continuity of motion of the object. Rather than having a uniform velocity for an object, it is more appealing, and sometimes more realistic, to have the velocity vary at the extremes. For example, a bouncing ball moves faster as it approaches or leaves the ground and slower as it approaches or leaves its maximum position. The name comes from having the object or character "slow out" of one pose and "slow in" to the next pose.

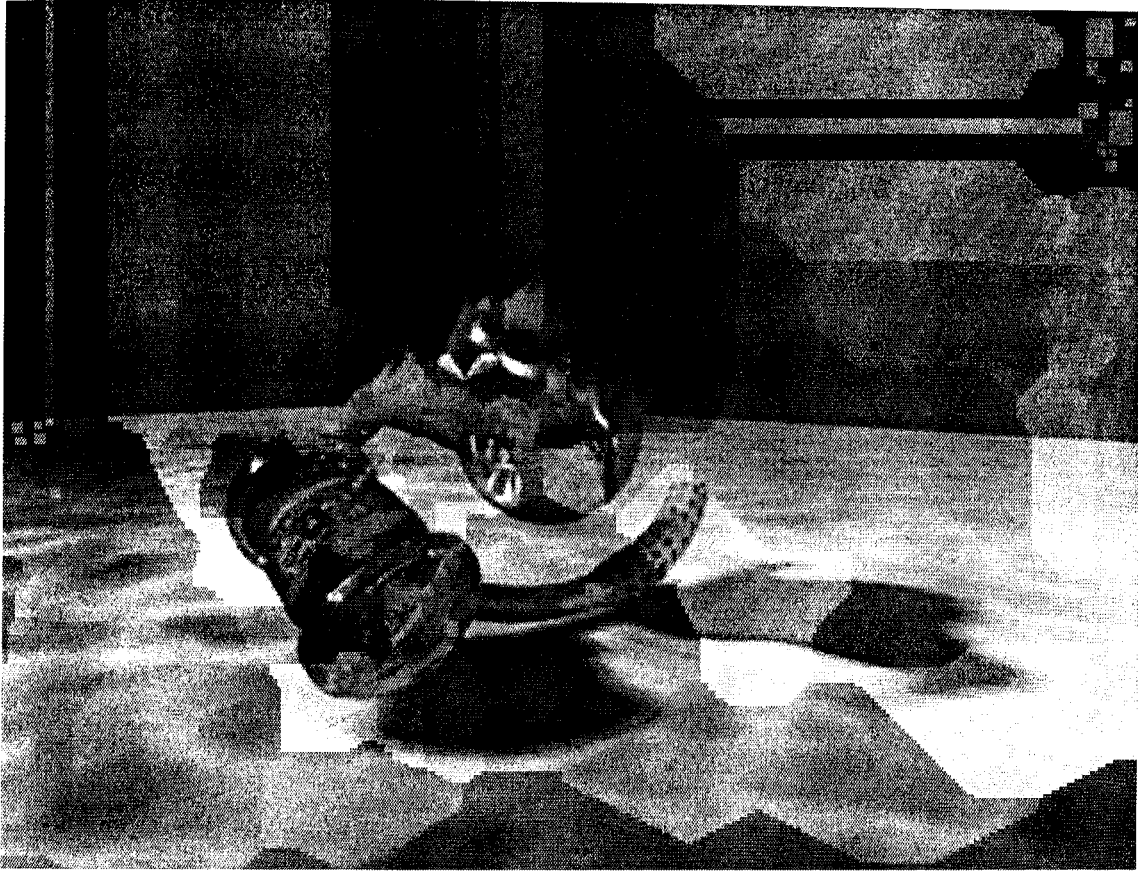


Figure 11 An example of Secondary Action

Secondary Action – In this example the primary action is the ball jumping up and down on the hammer. The secondary action is the reaction of the hammer and the facial expression of the ball.

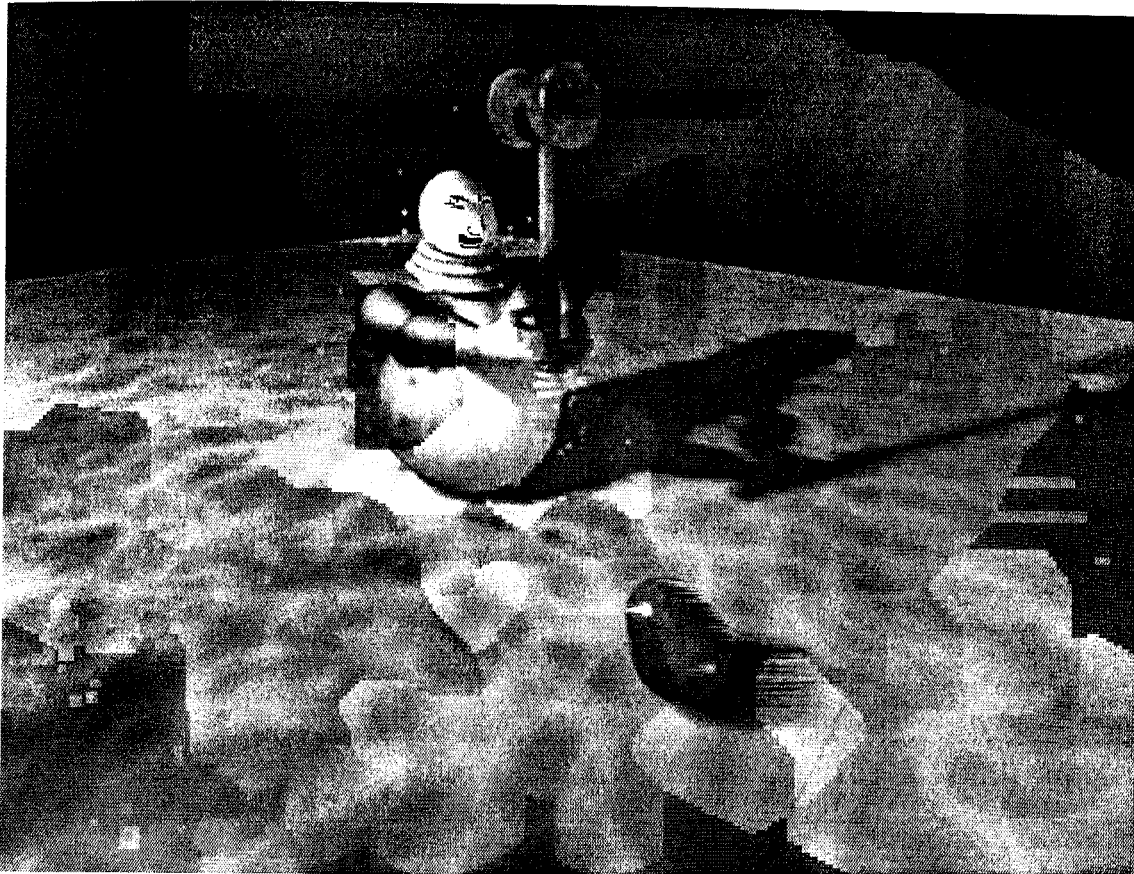
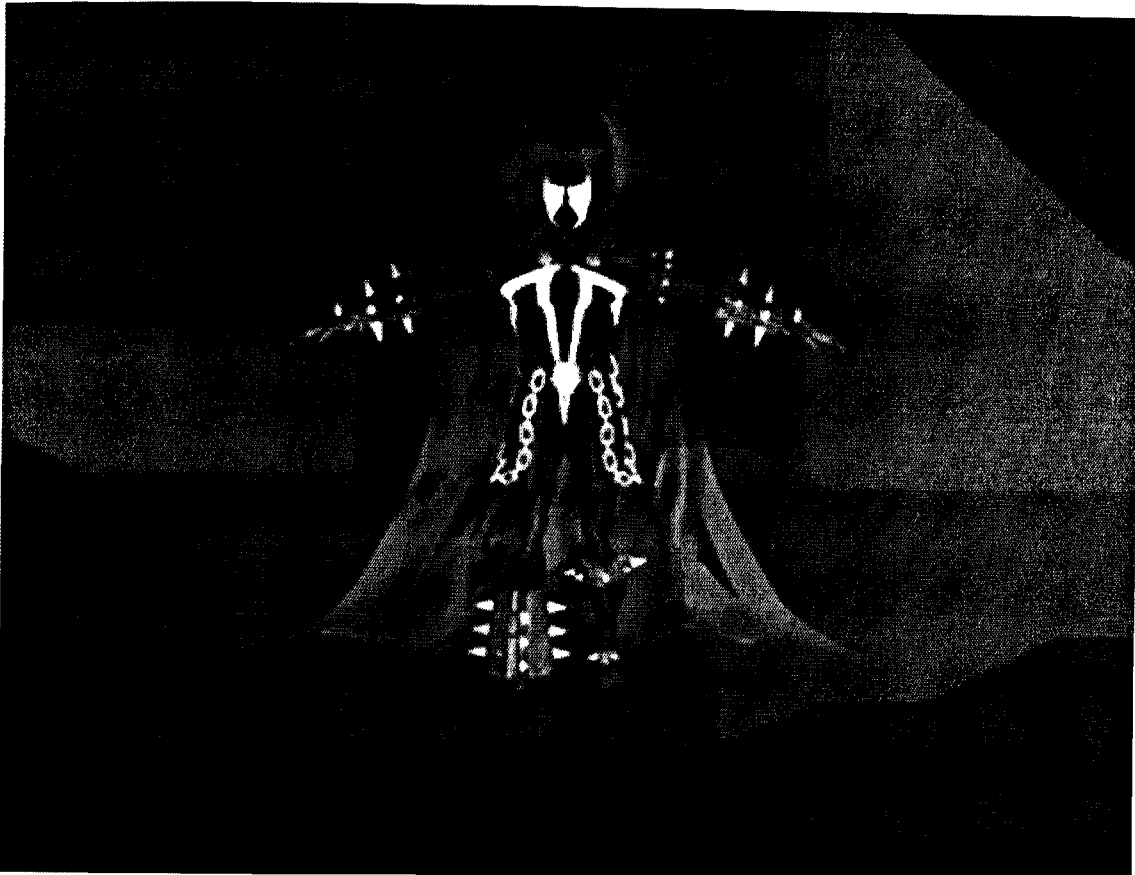


Figure 12 An example of Timing and Motion

Timing and Motion - In the above image we see a large ponderous figure carrying what looks to be a large heavy hammer. He is trying to hit the little blob that seems to be scooting along at a good pace. The motion and timing are very important here to imply the difference in size, weight and speed.



Spawn Mesh courtesy of WWW.3dcafe.com

Figure 13 An example of Exaggeration

Exaggeration - In comic book heroes, like the Spawn character above, we see an exaggeration of size, power and situations. Yet if we place him in a normal environment, but with exaggerated bad guys and events, we can accept this and enjoy the story. If he were the only one exaggerated in the environment we would be more inclined to scoff and disbelieve.

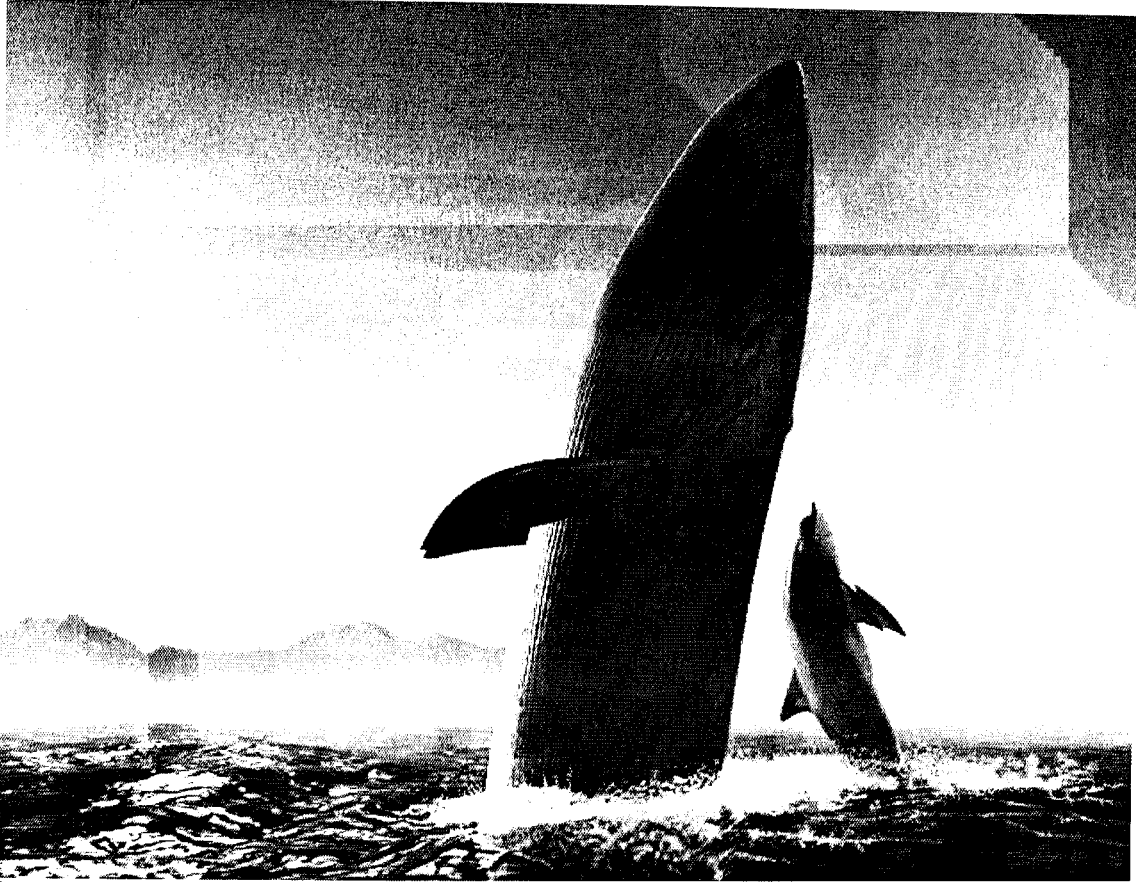
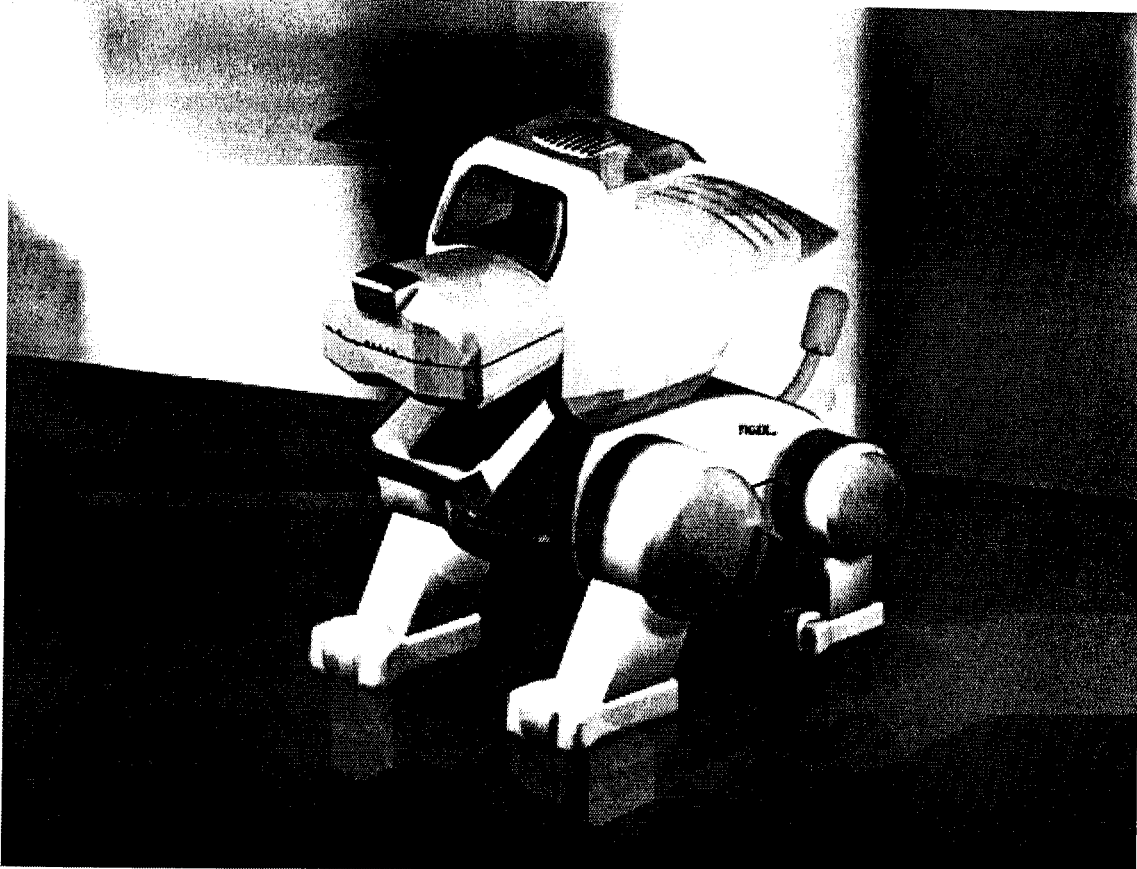


Image courtesy of Kleiser-Walczak, created in MAYA

Figure 14 An example of Appeal

Appeal - In the above image we see two friends at play. This would not have as much appeal to the viewer if both figures were whales or both dolphins.



David Kopas courtesy of WWW.3dcafe.com

Figure 15 An example of Follow Through and Overlapping Action

Follow Through and Overlapping Action – When looking at this toy and how to animate it, the artist needs to think about what would be the mechanics of its movement. It would be easy to make the object move forward, but to make it look like the legs are what drive the toy along, you would have to decide how the legs would move to give the illusion that they are what propels the body along. As the legs move they become the primary action and the body as it is pushed forward becomes the overlapping action.



Figure 16 Key
Frame one



Figure 17 Key
Frame two



Figure 18 Key
Frame three



Frame 19 Key
Frame four



Figure 20 Key
Frame five



Figure 21 Key
Frame six

Straight Ahead Action and Pose-to-Pose Action - This is used when the scene requires more thought and the poses and timing are important. In the pictures of the man throwing a ball, if we were to animate this in a Pose-to-Pose style, we would create Key Frames at all the major movement sequences (Figures 16 – 21). From here we would create those in between frames that were necessary to smooth out the motion.

COURSE ANI 1060: STUDIO LIGHTING

Level:	Introductory
Theme:	Learning the lighting process to allow the animators to gain control over their scenes
Prerequisite:	None
Description:	Students learn the process of creating lights by type: spot, directional, and ambient. After they understand the technical distinctions between these, students can further distinguish lights by their use and build a lighting design with this knowledge.
Parameters:	Access to a studio with lights and equipment or a computer with 3D Animation Software that allows the creation and adjustment of various lights.
Supporting Courses:	None

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <p>Create a portfolio that demonstrates an understanding of the following:</p> <ul style="list-style-type: none"> • Learn the different types of lighting. • Learn lighting placement: front, side, back, fill, kickers, specials, and bounce lights. 	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> • Portfolio presentation consisting of: <ul style="list-style-type: none"> – Two 3D images with a subject that shows the use of a spot light with various cone and colour attributes. – Two 3D images with a subject that shows the use of a directional light with various size and colour attributes. – Two 3D images with and subject that shows the use of a point or omni light with various size and colour attributes. – Two 3D images with a subject that shows the use of ambient light with various size and colour attributes. – Two 3D images with a subject that shows the use of front light with various size and colour attributes. – Two 3D images with a subject that shows the use of side light with various size and colour attributes. – Two 3D images with a subject that shows the use of back light with various size and colour attributes. – Two 3D images with a subject that shows the use of fill light with various size and colour attributes. – Two 3D images with a subject that shows the use of kickers with various size and colour attributes. – Two 3D images with a subject that shows the use of specials with various size and colour attributes. – Two 3D images with a subject that shows the use of bounce lights with various size and colour attributes. – One 3D image, with a subject that has been changed or modified, that demonstrates the use of: Front lights, Side lights, Back lights, Fill lights, Kickers, Specials, and bounce lights. 	<p>20</p> <p>25</p>

<ul style="list-style-type: none"> • Learn how lights are used to create mood • Use appropriate lighting techniques to illuminate a scene. 	<ul style="list-style-type: none"> - Create one 3D image with a subject reading in front of a fireplace. There is a lamp, which casts light on the subject and a book, there is light which casts light on the subject and book, and there is light from another room. This demonstrates motivated lights. - Create one 3D image with a subject lit using Key and Fill lights. - Create one 3D image with a subject lit using a three-point lighting approach. - Create one 3D image with a room lit as if for a horror movie. This should be dark with shadows and high contrasts with respect to light and dark. Reference – Original B&W Frankenstein movie. - Create one 3D image with a room lit as if for a romantic evening. This room needs to have a warm feeling with low lights and warm colours. - Create one 3d image with a room lit as if it was early morning. The room needs to be lit with bright light coming in through a window, bright colours, happy feeling. <ul style="list-style-type: none"> • Observations of individual effort and interpersonal interaction during the learning process. <i>Assessment Tool</i> <i>Portfolio Assessment, ANI 1060</i> <p><i>Standard</i> <i>Performance rating of 1 for each criteria</i></p> <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above.</i></p>	<p>45</p> <p>10</p> <p>Integrated throughout</p>
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Concept	Specific Outcomes	Notes
Thinking through light	<p><i>The Student should:</i></p> <ul style="list-style-type: none"> • Understand the importance of colour <ul style="list-style-type: none"> - Understand your computer monitor: how to change the resolution, refresh rate, and background. - Work with a black background - Turn the lights off in the room - Determine which media format to use by running test outputs - If rendering to video or film, test render and playback the results to check colour - Colour theory is an important aspect of lighting. By understanding colour theory you will understand the difference between cool colour and warm colour. You need to understand what happens when you mix certain colours together. 	<p>The colour of your monitor and the colour that goes to video when you render will not necessarily be the same. You may be disappointed with the results if you do not prepare. Read books on colour theory.</p>

Concept	Specific Outcomes	Notes
Thinking through light	<ul style="list-style-type: none"> • Know that lighting begins at a conceptual level. Answer these conceptual questions: <ul style="list-style-type: none"> – What feelings does the director want the audience to experience? – Which characters are most important in frame? – What visual style is enforced? • Know what Spotlights are. <ul style="list-style-type: none"> – Spotlights emanate from the point of a cone; the size of the cone is determined by the attributes of the light. – All spotlights have a hot spot, defined as the region where the light is at its most intense. – All spotlights have a drop-off/fall-off attribute that can be adjusted. When set at zero the cone is at the intensity. Increasing the drop-offs/fall-offs attribute progressively darkens the edges of the angle cone, decreasing the light's hot spot. – Outside of the angle cone, you can set a separate penumbra cone. Here the light falls off in intensity until its level reaches zero at the edges of the beam. – Together, the angle and the penumbra cones make up a light's entire output cone. – Most 3D animation software uses a spotlight that uses the two cones. Some call the second cone the penumbra some call it attenuation. • Know what Directional Lights are. <ul style="list-style-type: none"> – Most light beams spread outwards as they are broadcast; this makes it possible to cast large shadows from small objects. – Parallel light is a case when light doesn't radiate from its source. – In 3D animation software parallel light sources are called directional lights. – Directional lights broadcast their light without spread, unlike other lights that diverge from their source. – When a directional light beam hits an object, the shadow it casts reflects the true size of the shadowing object. • Know what a Point Light or Omi light is. <ul style="list-style-type: none"> – Point or Omni lights are like incandescent light bulbs; they throw off light in all directions. – Point lights radiate from a central coordinate in 3D space, illuminating any objects within their sphere-shaped influence zones. (See Lighting Exemplars Figures 5 & 6) 	<p>See Lighting Exemplars Figures 1 & 2.</p> <p>Directional sources yield highly coherent, parallel light, such as the sun on a clear day. Therefore, directional lights are used mainly to simulate sunlight. Directional lights have colour, intensity, and direction but no obvious source in the scene. Directional lights do not decay with distance and are sometimes called infinite lights because their influence is not bounded by a cone. (See Lighting Exemplars Figures 3 & 4.)</p> <p>By casting light in a localized part of the scene, point lights can establish a sense of depth in the scene. Point lights are also good for streetlights, architectural accents such as sconces or torches, and otherworldly apparitions that take up a volume of space with light.</p>

Concept	Specific Outcomes	Notes
Thinking through light	<ul style="list-style-type: none"> • Know what Ambient Light is. <ul style="list-style-type: none"> – Ambient lights are similar to point lights except that only a portion of their illumination emanates from the point. – The rest of the illumination comes from all directions and lights everything uniformly. – Some designers find ambient lights useful as a soft fill light for a key/fill set-up, most just turn it off. 	(See Lighting Exemplars Figure 7)
Lighting Roles and the Angle of the light.	<ul style="list-style-type: none"> • Know what a Front Light is used for. <ul style="list-style-type: none"> – Front light is the default, both artistically and technically. – Front light is used to provide general visibility. – Although front light offers good visibility it also flattens out detail. • Know what a Side Light is used for. <ul style="list-style-type: none"> – Sidelight accentuates the 3D detail of a subject and, if used by itself, gives a good sculptural sense of the subject's form. – As Sidelight shines across a surface, it reveals a lot about the shape and texture of its subject. – Compositionally, sidelight is used to establish image depth with planes of light. • Know what Back Lights are used for. <ul style="list-style-type: none"> – Backlight boosts definition in an image by creating a lighted edge around the subject. – A back Light is also called Rim lights, edge lights, or Liners. – Backlights pop their subject out from the rest of the scene, providing three-dimensional separation and a colour accent. 	<p>(See Lighting Exemplars Figure 8)</p> <p>The dramatic quality of sidelight has been used for hundreds of years by painters who exploited its ability to draw a 3D feeling out of a 2D surface. (See Lighting Exemplars Figure 9)</p> <p>Designers mainly use back lights as a way to separate foreground objects from their background; but back light is also used to give a colour cast to a whole scene. Backlight is more about drama and less about the colour relationships in a shot. (See Lighting Exemplars Figure 10)</p>

Concept	Specific Outcomes	Notes
Lighting Roles described by their uses.	<ul style="list-style-type: none"> • Know how to create and use Fill Light <ul style="list-style-type: none"> – Fill light is a soft wash of light that seemingly comes from all directions. – Fill or ambient light is used to give a colour cast to the scene as a whole. – Using a fill light ensures that no part of your rendered frame will have completely black pixels, which provides greater flexibility in the compositing stage. • Know how to create and use Kickers. <ul style="list-style-type: none"> – Kickers are added as needed to boost an object's visibility or add definition to the frame. – Kickers are a part of a family of lights that designers may refer to as liners, shinbusters, skirt lights, or glow lights. – The basic position for a digital kicker is in a three-quarters-back position, almost in line with the camera. – The resulting light can add an edge highlight to an object or provide an accent to bring an area up in value. – Kickers are also called rovers because they may move from shot to shot as needed. – They are kept at lower intensities than the rest of the scene lighting so that their comings and goings don't upset the lighting continuity from shot to shot. • Know how to create and use Specials. <ul style="list-style-type: none"> – Specials are another family of lights. A special is any light that has a specific function: Examples include an eye light placed to accent a character's face, a pool of light that is used for a dramatic scene, or a light placed outside a window to simulate sunlight streaming into an interior. • Know how to create and use Bounce lights. <ul style="list-style-type: none"> – Bounce lights, are used to simulate the reflected light seen when a light source bounces off a surface. – 3D animation software does not support this real-world global illumination; the effect of these reflected lights could be simulated with well-placed bounce lights. – If you are lighting bright floors or walls, bounce lights – If you'd be placed to simulate the reflected light we – If you expect to see in reality. – If you're placing bounce lights, remember that the angle of incidence for a light is equal to its angle of reflection. 	<p>(See Lighting Exemplars Figure 11)</p> <p>(See Lighting Exemplars Figure 12)</p> <p>Specials are useful for drawing the eye to specific parts of the image, or focus zones. Strong compositions with light offer clear focus zones to attract the eye.</p> <p>In the real world, when light reflects off of a surface, it ends up lighting other surfaces.</p> <p>By Definition bounce lights are subtle. Their colour is based on the colour of the shader from which they simulate bounce (for example, light striking a red wall needs a red bounce light.</p> <p>(See Lighting Exemplars Figure 13)</p>

Concept	Specific Outcomes	Notes
<p>Approaches to Lighting : Creating a lighting design</p>	<ul style="list-style-type: none"> • Understand Motivated light. <ul style="list-style-type: none"> – Start a design by simulating the lights they would actually see if they were dealing with a real scene. – When lights are designed to account for scene light from a real source, they are called motivated lights. – That is, the lights are motivated by an object in the scene that would emit light. (See Lighting Exemplars Figure 14 & 15) • Understand Key and Fill Lighting <ul style="list-style-type: none"> – The practise of key and fill light has a large following among digital lighters. – With the key/fill approach, the key light is used as the primary source for a scene, and the fill light is used to filling the shadows left by the key light. (See Lighting Exemplars Figure 16) • Understand Three-Point Lighting <ul style="list-style-type: none"> – Three-point lighting is a more stylized approach to lighting a scene than the Key and Fill lighting. – The three-point approach, also called McCandless lighting as a tribute to its originator, generally consists of two front lights and a single back light. – One method is to place the front lights at 45 degrees up and over the subject. These angles give balanced lighting with some sculptural interest when compared with straightforward front light. For variation, one of the front lights is often a warm colour (rose, amber) and the other is cool (pale blue/green) – The back light component of the three-point approach, also tipped at 45 degrees or more in relation to its subject's height, is usually projected without an angle in plan. The result is that the backlight accents the edge of the subject. Sometimes the back light colour is neither warm nor cool, but instead a pivotal colour such as lavender that complements both warm and cool ranges. 	<p>Consider a woman seated in front of a fireplace at night; a standing lamp at her side illuminates a book she is reading. In this case you would have point sources emitted from the lamp, light from the fire itself that will play into the rest of the scene, and light outside to mimic moonlight. Again, bounce light has to be simulated. Because in reality the light from our floor lamp bounce off the book and up-light the seated woman's face.</p> <p>The idea is most useful for relatively simple lighting schemes. If you are lighting an outdoor shot, the sun is your key lighting and a colour corrected fill light or two works as your fill. The result is a scene predominately lit by sunlight, but with a soft accent to soften the shadows, balance the scene, and catch detail. (See Lighting Exemplars Figure 17)</p>

PORTFOLIO ASSESSMENT

Student Name _____

Teacher _____

Project _____

Date _____

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	1
Teamwork	4 3 2 1 0 N/A	1
Content	4 3 2 1 0	1
Equipment and Materials	4 3 2 1 0	1

THE STANDARD IS 1 IN EACH APPLICABLE CRITERIA UNLESS OTHERWISE STATED

Rating Scale

The Student:

- 4 Exceed defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner Tools, materials and/or processes are selected and used efficiently and effectively and with confidence.
- 3 Meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.
- 2 Meets defined outcomes. Plans and solves with limited assistance. Tools, materials and/or processes are selected and used appropriately.
- 1 Meets defined outcomes. Follows a guided plan of action. Limited ranges of tools, materials and/or processes are used appropriately.
- 0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

<p>Criteria <i>The Student:</i></p> <p>Management</p> <ul style="list-style-type: none"> <input type="checkbox"/> Prepares self for task <input type="checkbox"/> Organizes and works in an orderly manner <input type="checkbox"/> Carries out instructions accurately <input type="checkbox"/> Uses time effectively <p>Teamwork</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cooperates with group Members <input type="checkbox"/> Shares work appropriately among group members <input type="checkbox"/> Exhibits basic teamwork skills; e. g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing <p>Content</p> <ul style="list-style-type: none"> <input type="checkbox"/> Two 3D images with a subject that shows the use of a spot light with various cone and colour attributes. <input type="checkbox"/> Two 3D images with a subject that shows the use of a directional light with various size and colour attributes. <input type="checkbox"/> Two 3D images with and subject that shows the use of a point or omni light with various size and colour attributes. <input type="checkbox"/> Two 3D images with a subject that shows the use of ambient light. <input type="checkbox"/> Two 3D images with a subject that shows the use of front light. <input type="checkbox"/> Two 3D images with a subject that shows the use of sidelight. <input type="checkbox"/> Two 3D images with a subject that shows the use of back light. 	<p>Content (continued)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Two 3D images with a subject that shows the use of specials. <input type="checkbox"/> Two 3D images with a subject that shows the use of bounce lights. <input type="checkbox"/> One 3D image, with a subject that has been changed or modified, that demonstrates the use of: Front lights, Side lights, Back lights, Fill lights, Kickers, Specials, and bounce lights. <input type="checkbox"/> Create one 3D image with a subject reading in front of a fireplace. There is a lamp, which casts light on the subject and a book, and there is moonlight coming through a window. <input type="checkbox"/> Create one 3D image with a subject lit using Key and Fill lights. <input type="checkbox"/> Create one 3D image with a subject lit using three- point lighting. <input type="checkbox"/> Create one 3D image with a room lit as if for a horror movie. <input type="checkbox"/> Create one 3D image with a room lit as if for a romantic evening. <input type="checkbox"/> Create one 3d image with a room lit as if it was early morning. <p>Equipment and Materials</p> <ul style="list-style-type: none"> <input type="checkbox"/> Selects and uses appropriate equipment and materials <input type="checkbox"/> Follows safe procedures and techniques <input type="checkbox"/> Returns class equipment and materials to storage areas
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Lighting Exemplars

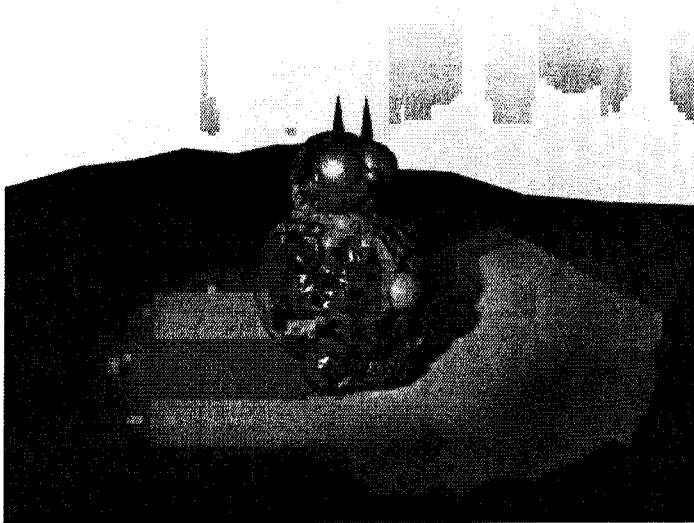


Figure 1 Example of a Spot Light

As you can see by figure one, the edge of the spot light starts to fade. By adjusting the lights attributes you can adjust the fall-off.

The shadow is an important item to note. It is the one way you can tell the difference between a spot light and a directional light. The shadow here is elongated and large.

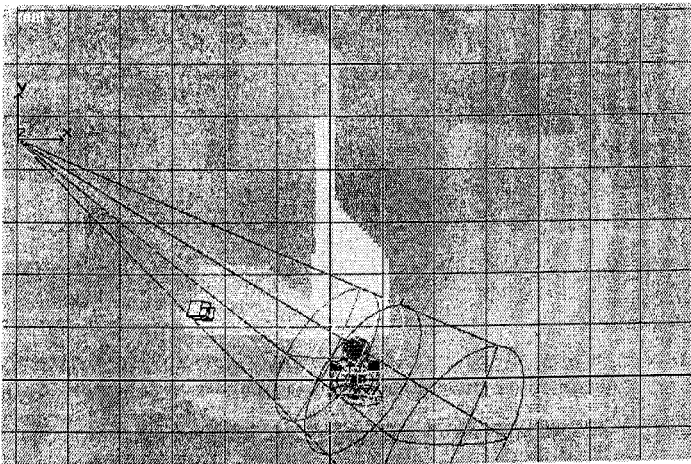


Figure 2 An Example of Spot Light Cones

As you can see in Figure 2, there are a number of attribute cones that you can adjust. This image was created in 3D Studio Max 2.5. Your ability to adjust the lights will depend on your software.



Figure 3 An Example of Directional Light

Figure 3 shows the difference between a spot light and a directional light. The shadow here is smaller and accurately depicts the objects shadow.

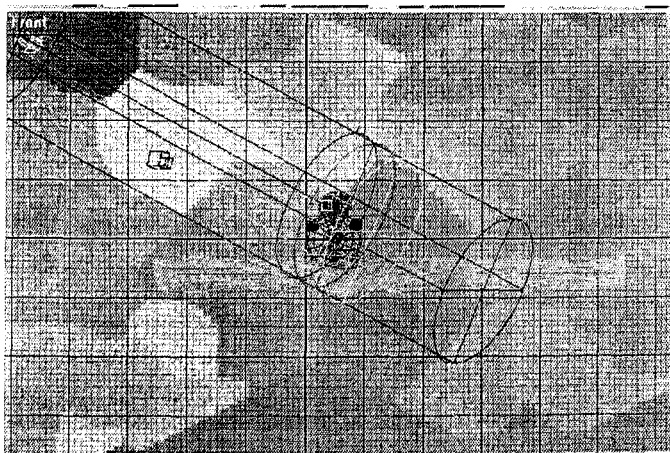


Figure 4 An Example of Directional Light Attributes

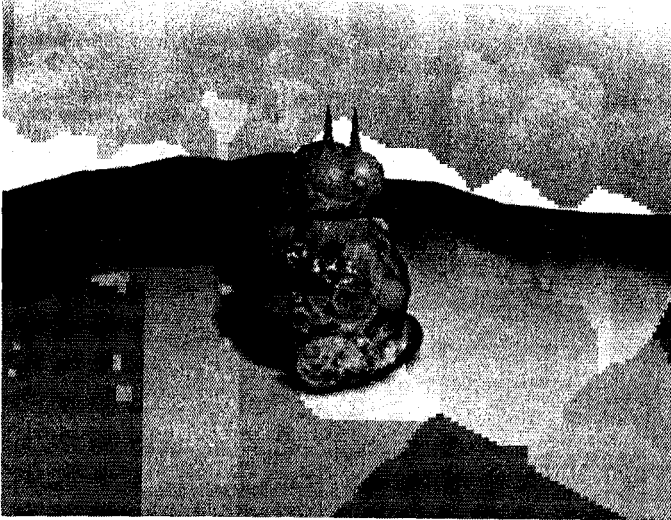


Figure 5 An Example of a Point/Omni light

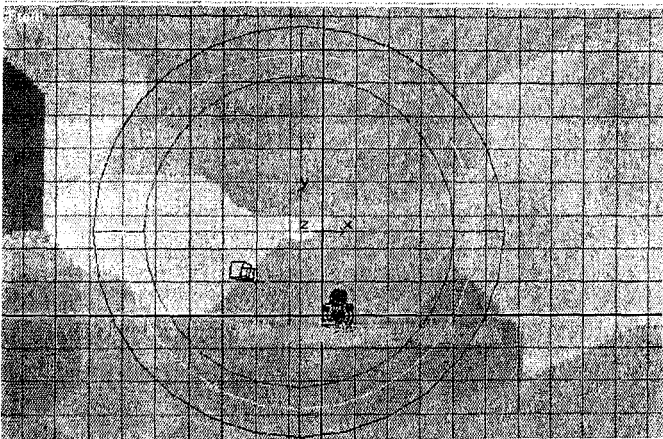


Figure 6 An Example of Point/Omni Attributes

While Point/Omni lights do shine light in a 360-degree circle, depending on your software you can choose what objects you wish illuminated.

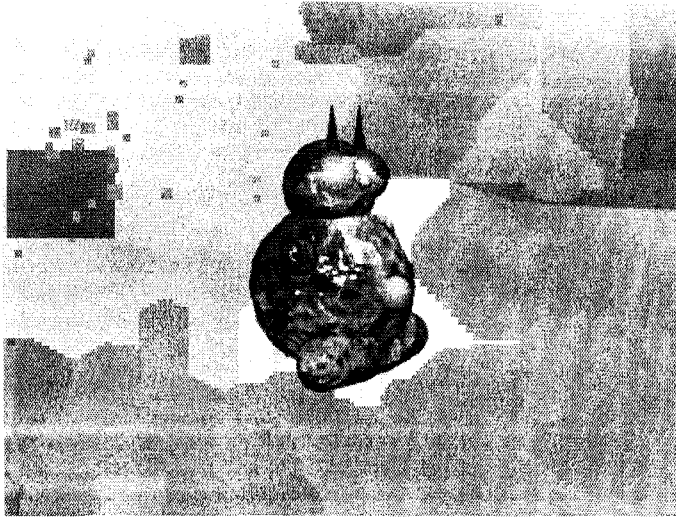


Figure 7 An Example of Ambient Light

In figure 7 the Ambient Light fills the area with even uniform light. You have very little control over ambient light other than colour and intensity.

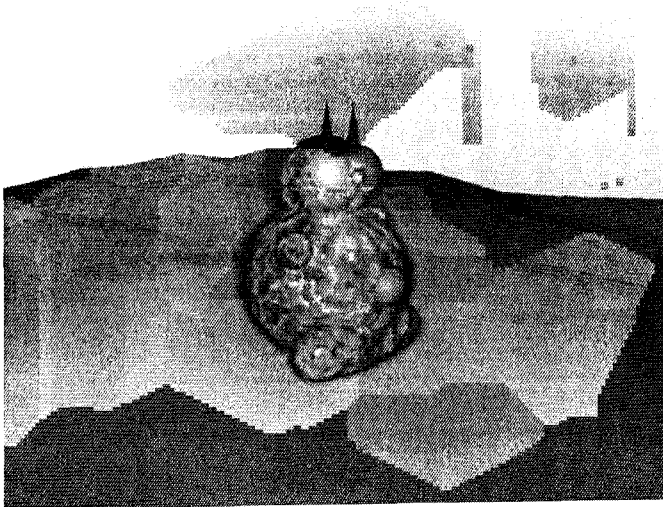
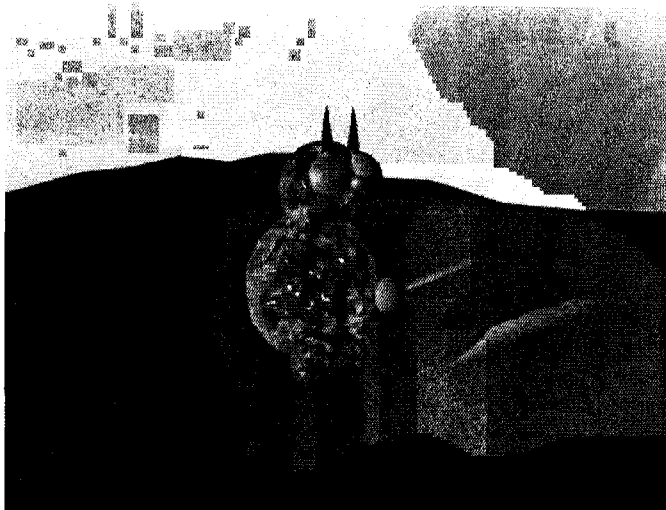


Figure 8 An Example of a Front Light

In figure 8 you can see how the front light flattens the image out. You lose the sense of depth in the image.



Note the dramatic quality the side light provides.

Figure 9 An Example of a Side Light



Figure 10 An Example of a Back Light

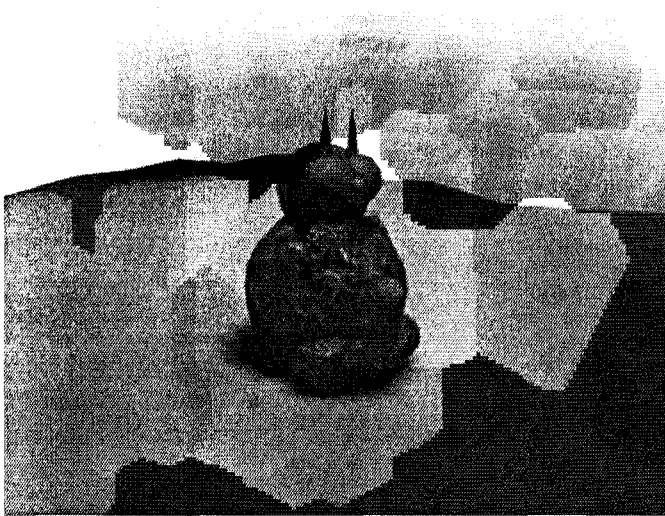


Figure 11 An Example of a Fill Light



Figure 12 An Example of Kickers

Compare Figure 11 An Example of a Fill Light to figure 7 An Example of Ambient Light and note the difference in look, feel and quality. You get a real sense control when you create fill lighting by using a different type of light than ambient.



Figure 13 An Example of Bounce Light

Since the environment in 3D computer software does not allow the simulation of light bouncing off of an object you have to simulate it. To do that you need to create two lights. One light is the bright beam and the second is the softer reflected light. In figure 13 the bright light hits the wooden floor and a second light shining at the object creates the illusion of bounce light.

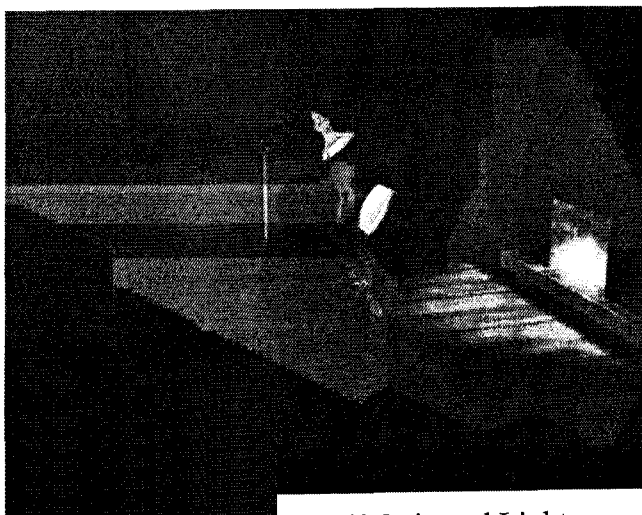


Figure 14 An Example of Motivated Light

To properly light a scene from a motivated lighting point of view, you have to take into consideration all aspects of the scene.

Look at the next example and try to find all the lights. You should be able to find 5 different lights.

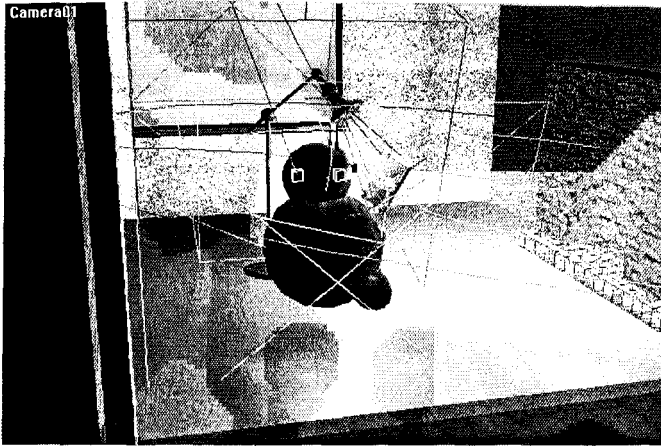


Figure 15 A Non Rendered Example of Motivated Lighting

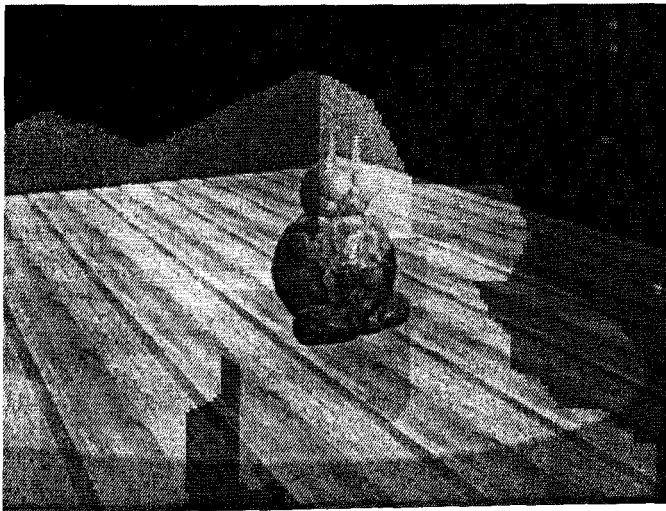


Figure 16 An Example of Key/Fill Lighting



In Figure 17 the three lights with three different colours converging on the object give an interesting effect. The combination of cool light warm light and neutral light are what make this type of lighting work.

Figure 17 An Example of Three Point Lighting

References

- Alberta Learning. (1997) *CTS - Guide to Standards and Implementation, Communications Technology*. Edmonton: Government of The Province of Alberta.
- Alias/Wavefront, a division of Silicon Graphics, (2000). *The Art of MAYA*. Toronto: Author.
- Autodesk, Inc (1997). *3D Studio MAX R2 User's Guide*. San Rafael, CA: Author.
- Billups, Scott. (2000) *Digital Moviemaking: The Filmmaker's Guide to the 21st Century*. The Cyber Film School, Movie School Encyclopedia. Retrieved February 18, 2001 from the World Wide Web: <http://www.cyberfilmschool.com/mschool/startpg.htm>
- Crawford, Duke. *Storyboards*. Retrieved March 2, 2001 from the World Wide Web: <http://www.storyborg.com/storyboards.html>
- Dean, Zero Z. Batzell. (2000) *A Demo Reel Primer*. Retrieved March 8, 2001 from the World Wide Web: <http://www.3dark.com/archives/demoreels/index.html>
- Deemer, Charles (1995-2000) *The Importance of Three-Act Storytelling*. Internet Film Group Inc. Retrieved March 8, 2001 from the World Wide Web: http://www.cyberfilmschool.com/columns/deemer_2.htm
- Deemer, Charles (2000) *Making Sense of Screenplay Format*. Internet Film Group Inc. Retrieved March 8, 2001 from the World Wide Web: http://www.cyberfilmschool.com/columns/deemer_2.htm
- Druxman, Michael B. (2000) *How to Write a Story - Any Story: The Art of Storytelling*. 30961 W. Agoura Rd., Suite 223B Westlake Village, CA 91361: The Center Press.

Gatto, Joseph A. Porter, Albert W. Selleck, Jack. - Consultants – Brommer, Gerald F. Horn, George F. (1978) *Exploring Visual Design – What is Design* (pp. 8-14). Worcester, Massachusetts, U.S.A.: Davis Publications, Inc.

Lasseter, John. (1987) *Principles of Traditional Animation Applied to 3D Computer Animation, Computer Graphics* (pp. 35-44, 21:4). Paper presented at SIGGRAPH 87.

Kuchanek, Doris. Bartels, Richard. (1984) *Interpolating Splines with Local Tension, Continuity, and Bias Control, Computer Graphics* (18:3, pp. 33-41). Paper presented at SIGGRAPH 84 Los Angeles.

Maestri, George (1996) *Digital Character Animation*. 201 west 103rd Street Indianapolis, IN 46290 USA: New Riders Press.

Maestri, George (1997) *Inside 3D Studio Max Volume III: Animation*. 201 west 103rd Street Indianapolis, IN 46290 USA: New Riders Press.

ScreenTalk. Vol. 2 No.3, 2000, Retrieved March 8, 2001 from the World Wide Web: <http://www.screentalk.org/index.htm>

Vogel, Nathan. Sheridan, Sherri. Coleman, Tim - Contributions by Alvarez, Alex. Andrewartha, Jesse. Cain, Kevin. Ontiveros, Matt. Tart, David. (2000) Chapter 1 – Creating Story Concepts for 3D Animation. *MAYA 2 – Character Animation* pp. 2-39 New Rider Publishing.

Vogel, Nathan. Sheridan, Sherri. Coleman, Tim - Contributions by Alvarez, Alex. Andrewartha, Jesse. Cain, Kevin. Ontiveros, Matt. Tart, David. (2000) *MAYA 2 – Character Animation*. 201 west 103rd Street Indianapolis, IN 46290 USA: New Riders Press.