I. Coordinate Systems - A system for numerically locating a specified point in space.
- A. Cartesian Coordinate System - System defined by a set of mutually perpendicular axes.
- B. A Coordinate - The numbers that identify a point.
- C. World Coordinate System (WCS)- The modeling environment is considered World Space
- D. Origin - Center point of any coordinate system. (0,0) (0,0,0)

II. Cartesian Coordinate System Standards
- A. Left-handed - Positive X right, positive Y up, positive Z into the frame.
- B. Right-handed - Positive X right, positive Y up, negative Z into the frame. (Maya Default)
- C. Aviation - Positive X right, positive Y into the frame, positive Z up

III. Viewing Windows
- A. Orthographic Projection
  - i. Parallel lines do not converge, objects in the distance don't appear any smaller.
  - ii. Orthographic windows - Front, Top, Right (in most 3-D Animation software)
  - iii. Front, Top, and Right - define the XZ, XY, ZY planes respectively.
- B. Perspective Projection
  - i. Parallel lines converge in the distance, and objects in the distance appear smaller than objects close to the viewer.
  - ii. Perspective windows also known as a Camera Window

IV. Transformations
- A. Translate - When you move an object in space. (*tx, ty, tz*)
- B. Rotate - When you tilt an object or change the direction in which it is facing. (*rx, ry, rz*)
  - i. Generally given in degrees - 360 degrees is a complete rotation.
  - ii. Left-Handed Rotation - Left thumb points down positive axis of rotation. Finger curl direction indicates positive rotation.
  - iii. Right-Handed Rotation - Right thumb points down positive axis of rotation. Finger curl direction indicates positive rotation.
- C. Scale - When you change the size or the proportions of an object. (*sx, sy, sz*)
  - i. Proportional - Overall size change, original proportions stay the same.
  - ii. Nonproportional - Scaling operations do not retain the original proportions of the object,
- D. Matrices
  - i. Every object has an associated Transformation Matrix which holds the object's current Translation, Rotation, and Scaling information.

tx	ty	tz
rx	ry	rz
sx	sy	sz
  - ii. Each object is created with a default orientation, translation and scale factor. This is represented by the Identity Matrix.

0	0	0
0	0	0
1	1	1
  - iii. The Identity Matrix is a set of values you return to if you ever want to "remove" all of the transformation applied to an object, or the world.
- E. Absolute vs. Relative in transformations. (*Maya allows you to specify which to use*)
  - i. Absolute - Refers to an absolute location, orientation, or size in the World Coordinate System, regardless of current location, orientation, and size.
    move *to* (3, 0, 2) rotate *to* (45, 0, 0) scale *to* (.5, .5, .5)
  - ii. Relative - Refers to a translate, rotate, or scale relative to the objects current position, orientation, and size.
    move *an additional* (3, 0, 2) rotate *an additional* (45, 0, 0) etc.
  - iii. Numeric Input box - on right of feedback line.
    - a. Used to add values to your transformations using accurate input.
    - b. ABS/REL - toggle ebtween absollute and relative vallues.
    - c. You can select a manipulator handle and then type one parameter into the numeric input box. (otherwise input a triplet of values.)
- F. Local coordinate system (LCS)/ Pivot Points
  - i. All objects have a Local coordinate system that is centered on the local origin, or pivot point of the object.
  - ii. All transformations occur in the object's local coordinate system, so placement of the pivot point is critical.
  - iii. Transformations applied to an object are also applied to it's local coordinate system. *Example: If you translate an object (3,2,0), it's LCS origin is at (3,2,0). If you were to move the objects pivot point to(-1,0,0), the LCS origin would still*

be at (3,2,0), however the objects position in space would be different, because it was moved within it's own LCS.

V. Types of Modeling
- A. Surface Modeling - The surfaces that enclose an object, define the shape of that object. Objects possess a skin, but remain hollow inside.
- B. Solid Modeling - An object is defined as a solid mass, often with density, weight, and other attributes. Objects cut in half exhibit no hollows.
- C. Particle System Modeling - Attempts to deal with such ephemeral phenomena like clouds, mist, fire, and water, which are composed of neither surfaces nor solid volumes and which do not have a stable shape.

VI. Geometry
- A. Point - Location in space.
- B. Line - A point moved in exactly one direction.
- c. Plane - A line pushed through space. (You need a minimum of three points to define a plane).
- D. Vertex - The point at which at least two lines meet.

VII. Primitive Models
- A. A set of geometric shapes that is so easily defined mathematically, and so widely used, that almost all 3D applications handle them separately.
- B. Circle, Sphere, Cube, Cylinder, Torus, Cone, Plane.
- C. Excellent building blocks, usually combined to make more complex objects.

VIII. Primitives - use the **Create** menu to access NURBs or Polygon primitive Tools.
- A. Sphere
  - i. Pivot - Center of object.
  - ii. Axis - Determines the axis about which it's drawn.
  - iii. Sweep - Angle of sweep, 360=sphere, 180=hemisphere.
  - iv. Radius - Size of the sphere
  - v. Surface Degree - Linear(Polygon) Cubic(NURB)
  - vi. Sections - Vertical Isoparms
  - vii. Spans - Horizontal patches.
- B. Cylinder
  - i. Similar to Sphere
  - ii. Ratio of height to radius - determines the length of cylinder.
  - iii. Caps - allows you to close the surface at one, both, or no end.
- C. Cube
  - i. Ratio of hieght to width - determines shape of cube in relation to adjacent dimensions.
  - ii. Ratio of width to height - see above.
  - iii. U / V Patches - Used to determine number of spans across a face. (Mostly used for resolving Hardware texturing and lighting.)
- D. Cone - See Cylinder
- E. Plane
  - i. U / V Patches - used to resolve lighting and hardware texturing. The more spans, the finer the definition of lighting effects on the surface.

IX. Text Workflow
- A. Create -> Text
  - i. Enter text into text field
  - ii. Font - Maya has a wealth of fonts, choose wisely. The more curvature, the longer it takes to model and render.
  - iii. Select Text type -
    - a. Nurbs - generates the text as a Nurbs curves.
    - b. Trim - Creates a trimmed planar surface.
    - c. Poly - Creates text as polygons.
- B. Extruding Text(Non-beveled)
  - i. Select the trim text using the curve selection mask. (Select an extrude path if you have one.)
  - ii. Surfaces -> Extrude.
    - a. Style -
      1. Distance - simply asks for an axis to push the text along.
      2. Flat - Profile curve doesn't bank with the path.
      3. Tube - Profile curve banks with the path.

b. Result Position
    1. At profile - Extrude in place
    2. At Path - move all elements to the path and extrude.
c. Rotation / Scale - Amount to transform over path.
d. Output Geometry - NURBs.

iii. To reshape the extruded text, simply scale the extrude path.

C. Beveling Text

i. Select the trim text. using the curve selection masks.

ii. Surfaces -> Bevel

a. Attach Surfaces - check so the bevel and extrude stay together.
b. Select Sides to bevel.
c. Bevel Width/Height - determines size of bevel
d. Extrude Height - the amount the text is pushed in space.
e. Bevel Corners, and Cap Edge - determine character of bevel.
f. Output geometry - Nurbs, always Nurbs.

iii. Voila!