199: Natural world and CG: modeling

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Computer Graphics: the trinity

- Modeling:
  How do we represent (2D or 3D) objects & environments?
  How do we build these representations?

- Animation:
  How do we represent the way objects move?
  How do we define & control their motion?

- Rendering:
  How do we represent the appearance of objects?
  How do we simulate the image-forming process?

The Graphics Pipeline

Modeling	→	Animation	→	Rendering
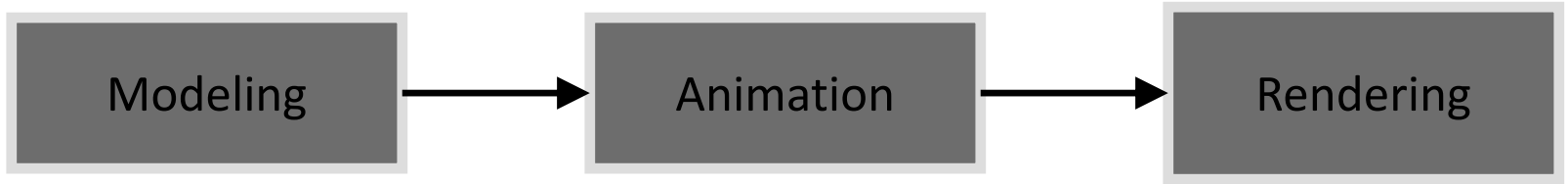
Modeling
- Geometry: points, curves, & surfaces
- Scene Objects: parts, relations, & pose
- Texture and reflectance (e.g., color, diffusivity, opacity, refractions)
- …

Animation
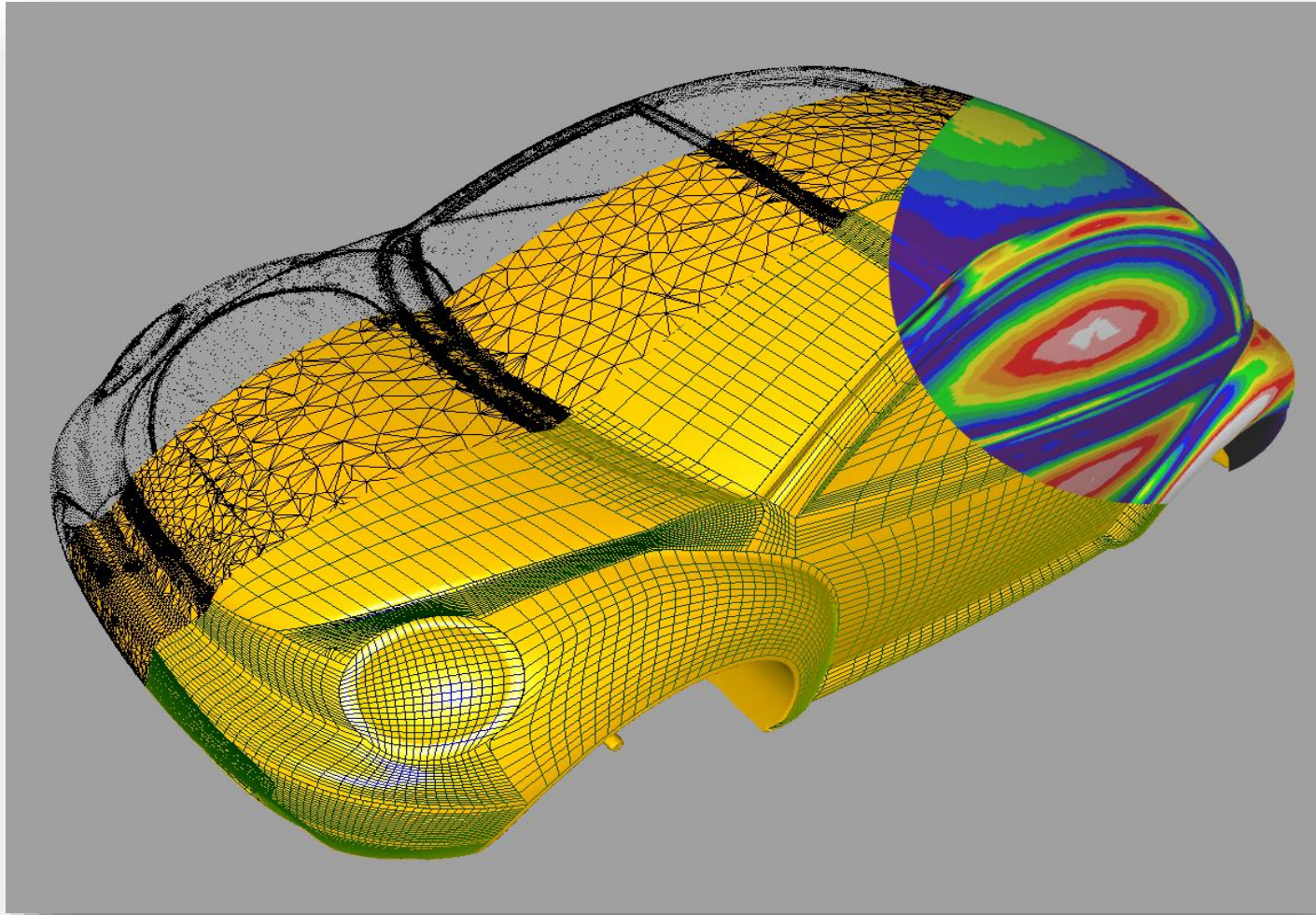- Key-frame, motion capture, inverse kinematics, dynamics, behaviors, motion planning, …

Rendering
- Visibility
- Simulation of light (e.g., illuminants, emissive surfaces, scattering, transmission, diffraction, …)
- Special effects (e.g., anti-aliasing, motion blur, non-photorealism)
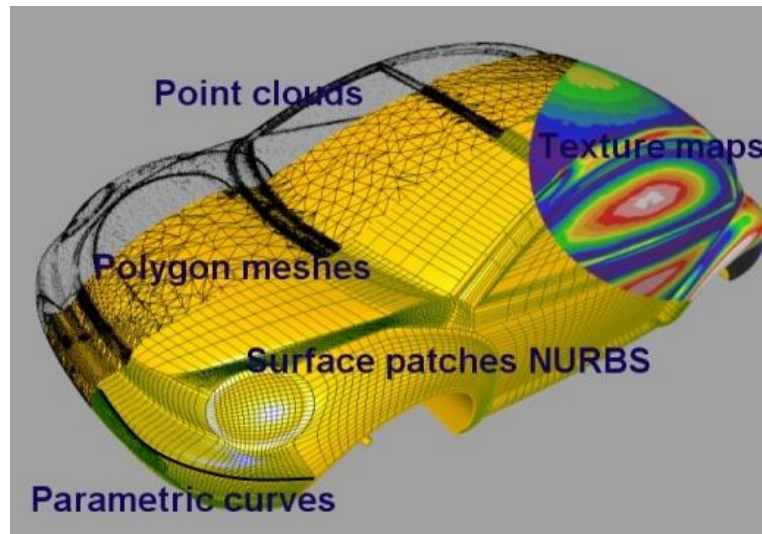
Luxo Jr.

Graphics Pipeline: Modeling

How do we represent an object geometrically on a computer?

3D geometric representations

- Point.
- Point-cloud.
- Poly-line.
- Polygon mesh: Quads, Triangles…
- Parametric curve/surface: Hermite, Bezier, B-Spline, NURBS…
- Subdivision curve/surface: Chaikin's curve, Catmull-Clark…
- Voxels.
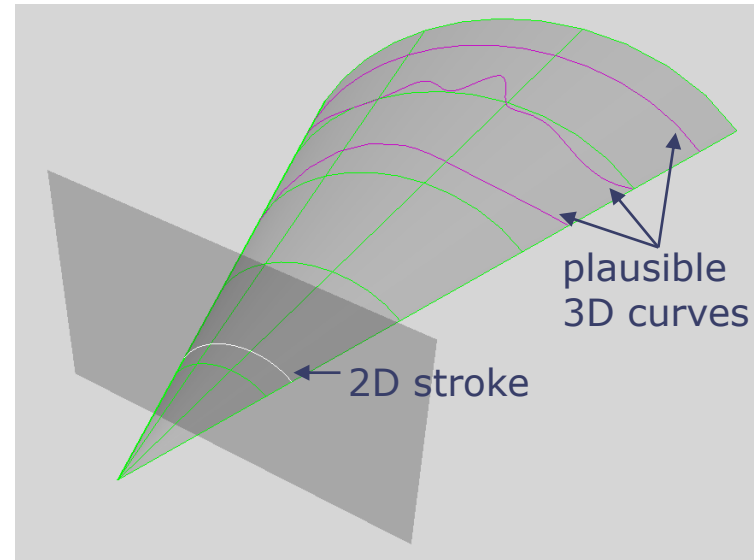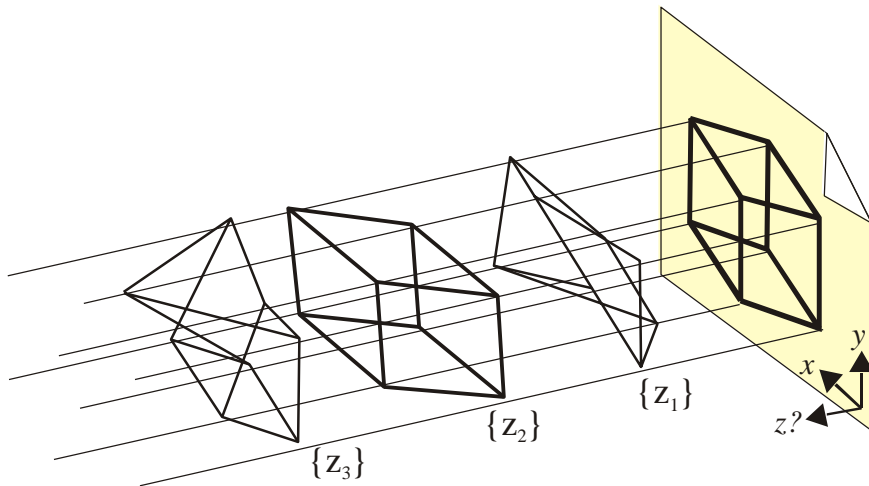- Implicit functions, level-sets, blobby models.
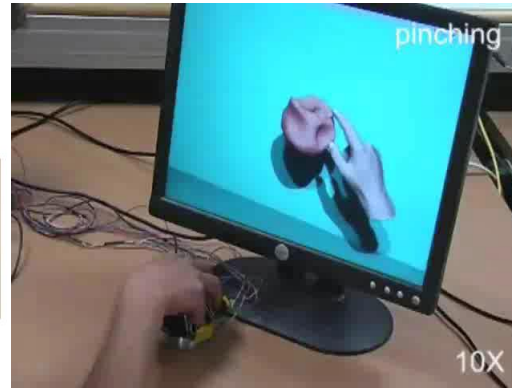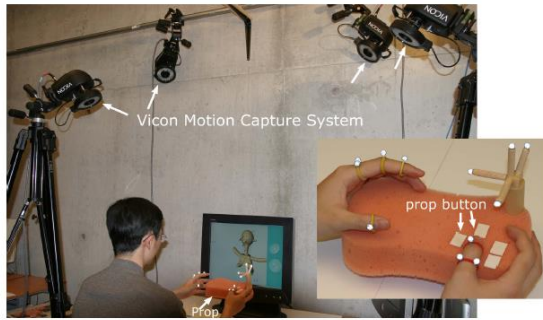- Texture maps.

Interaction Devices

KINECT
for XBOX 360.

www.inition.com

hci.stanford.edu

www.pocketpcmag.com

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Sketching

2D to 3D: "Depth" component is ambiguous

$\{z_1\}$
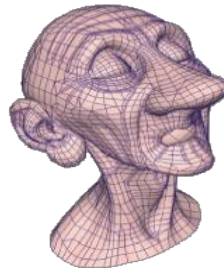
$\{z_2\}$

$\{z_3\}$

y

x

$z?$

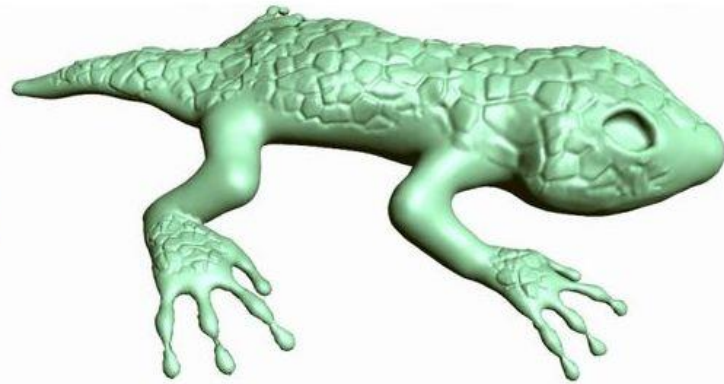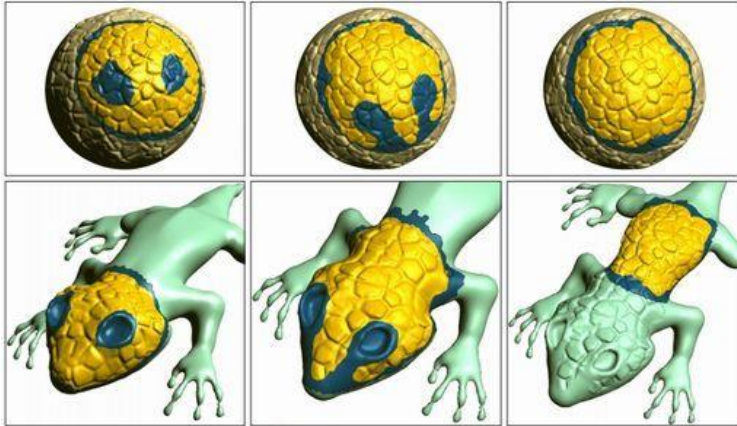plausible
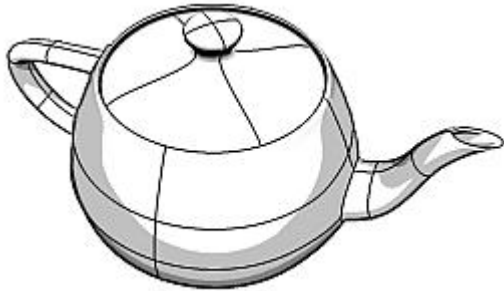3D curves

2D stroke

Sculpting

digital

physical

3D modeling operations

- CSG.
- Extrusion.
- Revolve.
- Loft.
- Cut and Paste.
- Clone Brush.

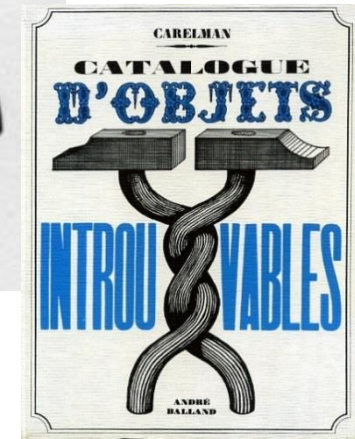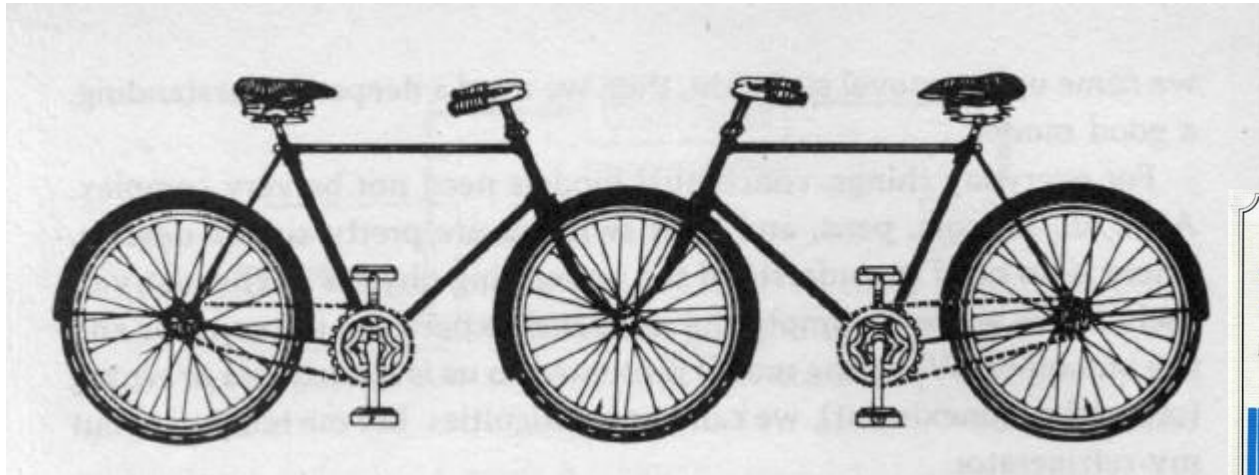…interactive session (chaikin, bezier, extrude, revolve, loft patch, trim, mesh, subd, blobby).

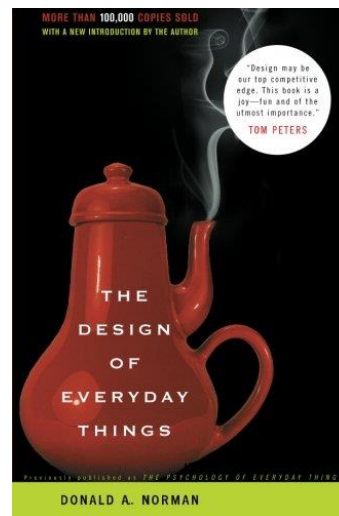# 3D modeling: form + function

What do these objects do?

3D modeling: good design

- Affordance.
- Visibility.
- Conceptual Model.
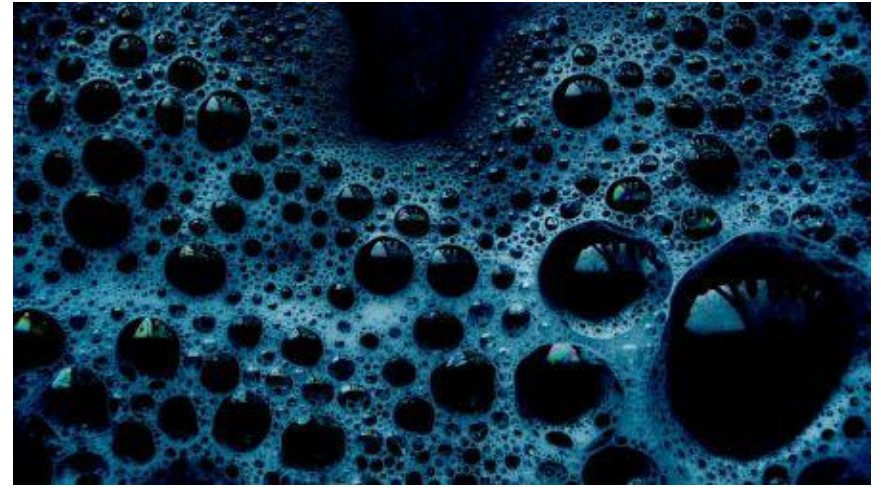- Mapping.
- Feedback.

3D modeling: good design

"Darn these hooves! I hit the wrong switch again! Who designs these instrument panels, raccoons?"

Modeling nature
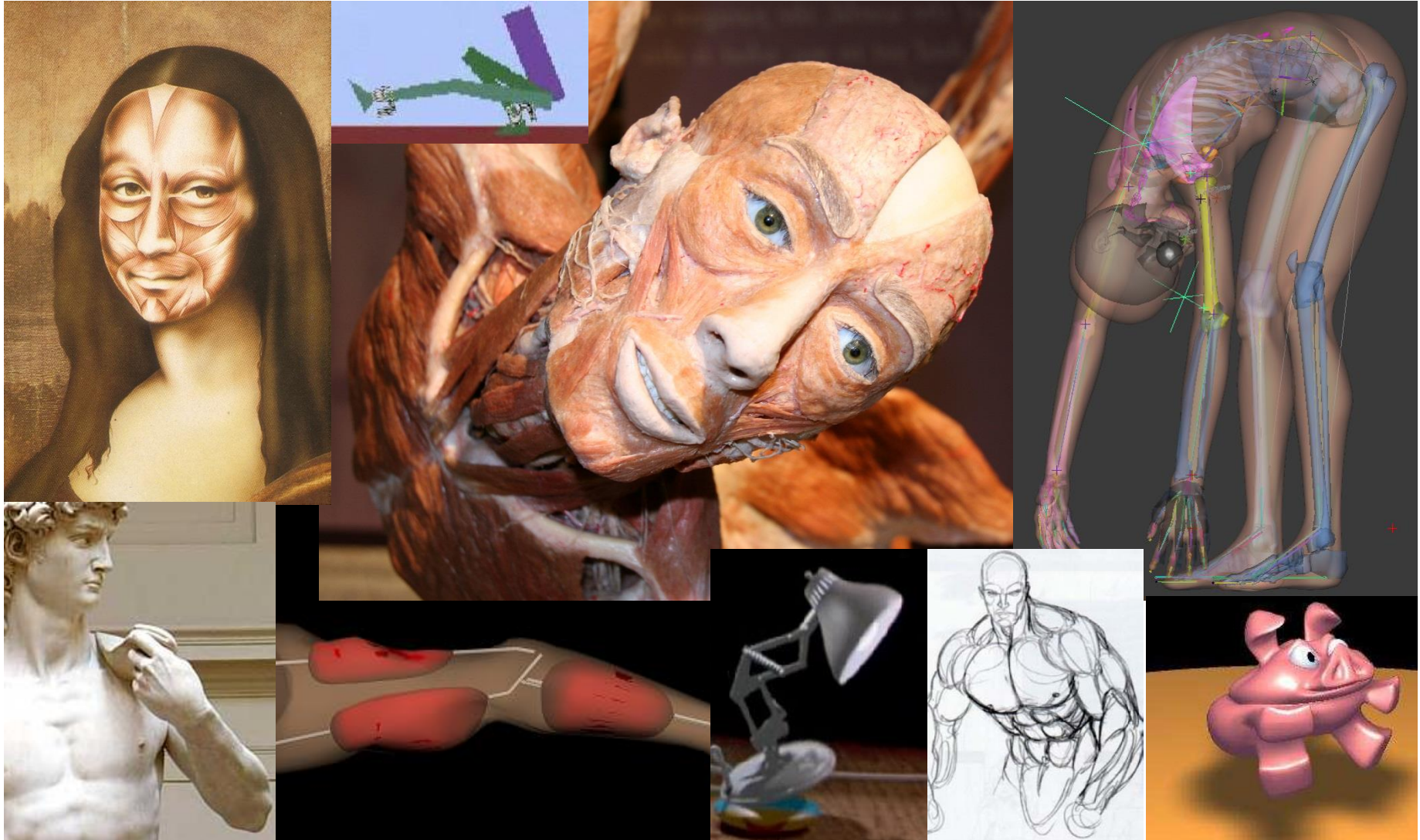
What else is there to model?

Modeling us

Anatomy

Projects: the natural world

Next: Animation