ideas must be put to the test. that's why we make things, otherwise they would be no more than ideas.

Andy Goldsworthy, 1956-
English sculptor and photographer
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Andy Goldsworthy, 1956-
English sculptor and photographer

2.009 Product Engineering Processes
idea selection

lab this week
and now
a mini quiz! More estimation

name on index card, 4 minutes

i) what is energy and what are its units?
ii) define mechanical horsepower.
iii) how much power can you (personally) output, continuously, for 30 minutes?
2.009 Product engineering processes

Today

**sketch model review** broaden and deepen

**sketch models** test ideas
Sketch model review
10 days after ideas presentation!
Sketch model review
Means... development of ideas into concepts

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
<tr>
<td>first order energy feasibility</td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td></td>
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<tr>
<td>2</td>
<td>To meet weight constraint of less than 30 lbs</td>
<td></td>
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<tr>
<td>3</td>
<td>battery weight must be less than 13 lbs</td>
<td></td>
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<tr>
<td>4</td>
<td>4 Hawker 6V batteries</td>
<td>Best known solution</td>
<td></td>
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<tr>
<td>5</td>
<td>150 W-hr at 1 hour rate</td>
<td>12.3 lbs total weight</td>
<td></td>
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<td>6</td>
<td></td>
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<tr>
<td>7</td>
<td>To meet cost constraint</td>
<td></td>
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<tr>
<td>8</td>
<td>batteries must be lead-acid</td>
<td></td>
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<tr>
<td>9</td>
<td>Assume 2.5 mph</td>
<td>For 85% efficiency</td>
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<tr>
<td>10</td>
<td>with user weight of 165 lbs</td>
<td>takes 0.80 hour</td>
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<tr>
<td>11</td>
<td>and scooter weight of 29 lbs</td>
<td>with energy 150 W-hr</td>
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</tr>
<tr>
<td>12</td>
<td>187.5 W available</td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td>73 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Minimum drivetrain efficiency allowable</td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td>74%</td>
<td></td>
<td></td>
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<tr>
<td>16</td>
<td>Total mechanical power</td>
<td></td>
<td></td>
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<tr>
<td>17</td>
<td>139 W required</td>
<td></td>
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<tr>
<td>18</td>
<td>Continuous Power (W)</td>
<td></td>
<td></td>
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<tr>
<td>19</td>
<td>182</td>
<td></td>
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</tr>
<tr>
<td>20</td>
<td>Motor efficiency</td>
<td></td>
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<tr>
<td>21</td>
<td>90%</td>
<td>95%</td>
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<td>22</td>
<td>86%</td>
<td>96%</td>
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<td>23</td>
<td>82%</td>
<td>93%</td>
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<td>78%</td>
<td>92%</td>
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<tr>
<td>25</td>
<td>74%</td>
<td>91%</td>
<td>0.3</td>
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more idea generation
more research
(customer needs/benchmarking)
sketch models/testing
more feasibility estimates
And what is a sketch model?

**Definition**

Simple *physical* models made of soft, low cost, easy-to-work materials

3D analog to sketching

**Made to learn and test**

articulate an idea
understand product scale
explore user interaction issues
assess operational issues
establish common shared view
What is *NOT* a sketch model?

**anti-definition**

Simple *physical* models *that have no purpose* and are made of soft, low cost, easy-to-work materials.
Sketch modeling techniques

Cardboard
Cardboard
bending sharp corners
Cardboard
fastening (when you cannot bend)
Cardboard
bending allowance
Cardboard
making large radii
Cardboard holes
Sketch modeling techniques

foam core
Foam core

Cutting
Foam core

Sharp radii
Sketch modeling techniques

blue foam
Blue foam

cutting straights, circles and other shapes
Blue Foam
joining

water-based contact cement
Blue foam
shaping
Blue foam painting

water-based is good

organic solvent-based is bad
Wrap up
miscellaneous items

sketch modeling tutorials on website (/resources)
credit card training Thursday 4 PM in 3-434
design for product magic: Thursday 7:15 PM in Pappa
illustrator tutorial 5 PM Friday in Pappa

2009 beverage station

plotting and poster mounting schedule online
presentation practice schedule online