Read Sections 1.4, 1.5, and 1.13 in the textbook before reviewing the slides
Unit 2

• Limitations of Science (1.4)

• Desirability Quotient (1.5)

• Critical Thinking – the FiLCHeRS approach (1.13)
Limitations of Science (1.4)

- Lack of control of all variables
- Interpretation of results subject to judgment
Desirability Quotient (1.5)

- Scientific advances often offer benefit but also bring some level of risk
- Desirability quotient (DQ) is a means of evaluating benefit and risk and is given as:

\[
DQ = \frac{\text{Benefits}}{\text{Risks}}
\]

- A high DQ means the benefits are significant compared to the risks
Example of DQ

- Asbestos was previously used in building construction materials, particularly for insulation around pipes as in the picture to the right.
- Concerns about asbestos causing mesothelioma, a form of lung cancer, arose due to observations in the late 1970’s that asbestos workers were suffering a large number of lung-related issues.
- Since that time, when asbestos is found in buildings, it is typically removed.
- Asbestos lung cancer deaths in the United States are estimated to be barely statistically measurable.

<table>
<thead>
<tr>
<th>Benefits of removal</th>
<th>Risks of removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupants not exposed to asbestos</td>
<td>Workers exposed to airborne asbestos</td>
</tr>
<tr>
<td>Firefighters would not be exposed in case of fighting a building fire</td>
<td>Removal may put asbestos in the air, its most problematic form</td>
</tr>
<tr>
<td></td>
<td>Cost is extremely high</td>
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</tbody>
</table>
Example of DQ (cont.)

• The value of the DQ for asbestos abatement depends on the situation.

• For example, in a school with asbestos pipe insulation or flooring that is intact, the risk of removing the asbestos with the potential of making it airborne may outweigh the benefits of having it removed from the building.

• If instead, the asbestos pipe insulation is worn and shredded or asbestos flooring is not intact, the benefit of getting rid of it would probably outweigh the risks.
Critical Thinking (1.13)

• How do we evaluate the validity of a scientific claim?
• Can use an approach with the acronym of FiLCHeRS (Lett, James, The Skeptical Inquirer, Volume 14.4, Fall 1990)
• A claim **might be true** if it passes all six FiLCHeRS tests given on the next two slides
• If it fails any of the tests it is likely to be false
FiLCHeRS Criteria

- **Falsifiability** – must be possible to conceive of evidence that proves a claim false
- **Logic** – argument offered as evidence in support of any claim must be sound
- **Comprehensiveness** – evidence must be exhaustible – all evidence is considered
- **Honesty** – evidence evaluated without self-deception or bias
FiLCHeRS Criteria (continued)

• *Replicability* – experimental evidence must be reproducible

• *Sufficiency* – evidence offered in support of a claim must be adequate to establish the claim’s truth
FiLCHeRS Examples

• Consider Exercise 1.3 from page 33 of your textbook:

Some people claim that crystals have special powers. Crystal therapists claim that they can use quartz to restore balance and harmony to a person’s spiritual energy.

• How would this claim be evaluated by FiLCHeRS?
Analysis of Crystal Healing

• Falsifiability? It is impossible to measure one’s “balance and harmony”, thus the claim is not falsifiable.
• Logic? It does not seem logical that a particular crystal could somehow transmit restoring powers to an individual.
• Comprehensiveness? It is likely that support for such a claim would disregard cases in which “balance and harmony” were somehow deemed to not be restored.
Analysis of Crystal Healing

• Replicability? Since it would be difficult to evaluate the effectiveness it would also be difficult to reproduce results.

• Sufficiency? It is not likely that sufficient evidence could be provided to substantiate the claim.

If the claim fails any of the six tests, it is likely a false claim. In the case of the “healing crystal”, it is unlikely the claim could pass any of the tests and is likely a false claim.