Lesson 1: What is Research?

# Scientific and Engineering Research Methods

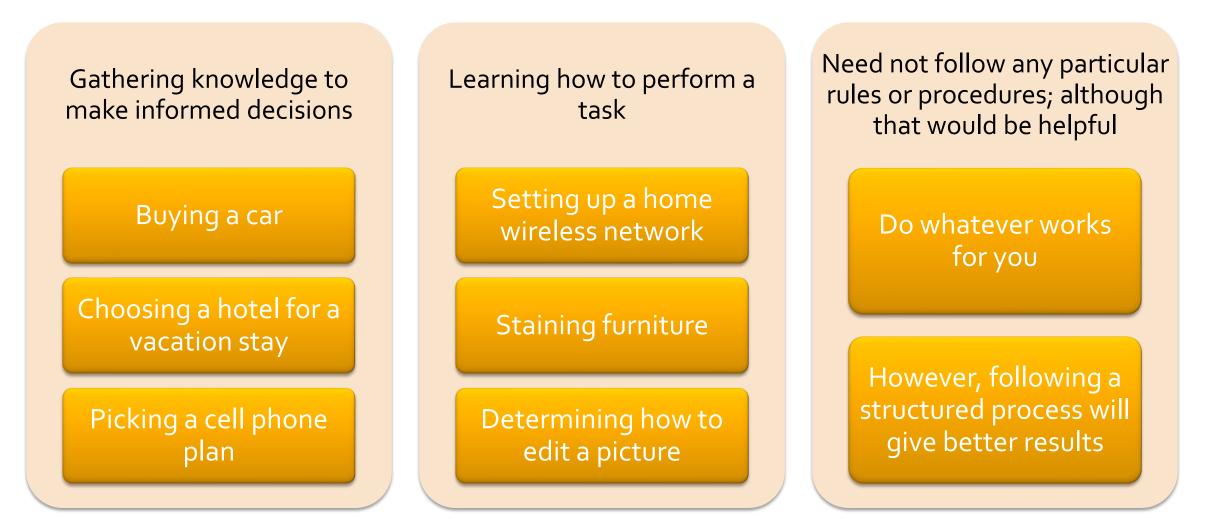
#### Definition

# What is Research?

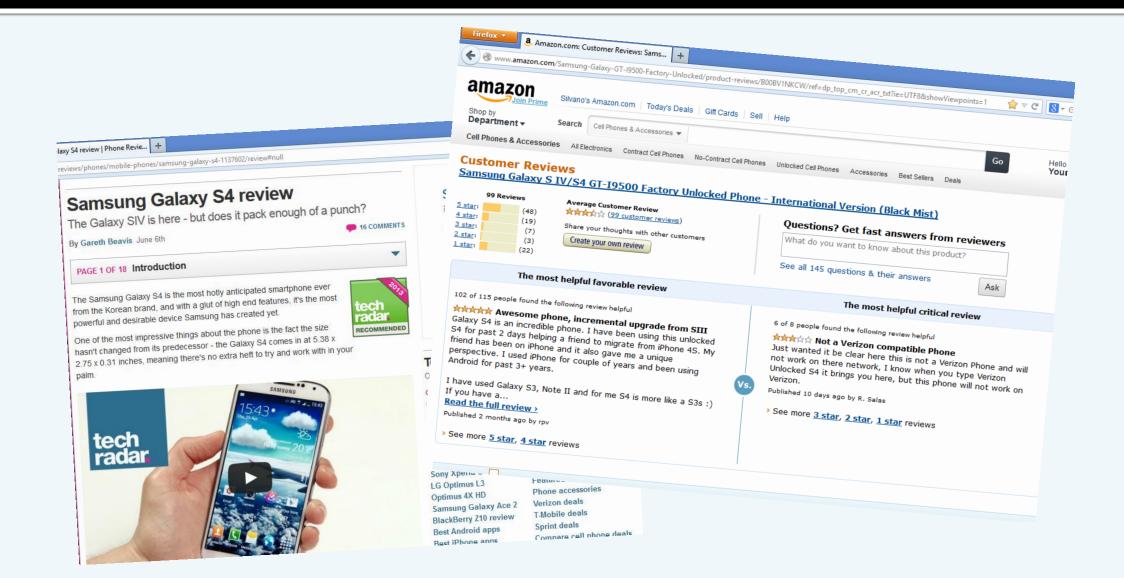
# Research is a process for obtaining knowledge on a particular topic

It could be something that is well established, but is unknown to you (Informal research) It could be a brand new discovery; something no one knew before (Formal research)

## Informal or Everyday Research



#### **Read Customer or Expert Reviews**



#### Ask Someone Who Knows

Depending on what you want to know, you can

- Ask a friend
- Ask a salesperson
- Call a product's support number or go to their website (Support/FAQs)
- Ask a teacher
- Read a book

#### **Formal Research**

- Used when seeking to create new knowledge or to design a new or improved product or service
- One needs to follow a formal process or methodology
- Methods differ depending on the area
  - A historian will use methods very different from a scientist or engineer
  - We will learn about formal *scientific* research

#### **Formal Scientific Research**

Applies to areas of Science, Technology, Engineering, and Mathematics (STEM)

• Examples: Cancer, Climatology, Green energy, Diabetes, Smartphones, Transportation, Data Mining

Must follow a formal research process or methodology such as: • The Scientific Method

- Used in areas of science which often involve experimentation
- The Engineering Design Process
  - Used when designing and building a product or service

Following the process is at least as important as the end results

- Helps achieve results more efficiently
- Helps validate the results you get
- Allows others to repeat what you did (so they can improve on your work)
- Allows you to protect your work (patents, recognition)

## Formal Scientific Research (cont.)

- Makes use of well established experimental, mathematical, statistical, or engineering techniques as appropriate
- Is well documented
  - Keep a project notebook
  - Write a research paper
  - Give oral presentations

#### What is Good Research?

Good Research

- Is in an important area
- Uses appropriate scientific and mathematical techniques
- Achieves useful or interesting results
- Can be defended as valid and correct
- Is complete within the given scope
- Points to applications or next steps

## **Main Points**

- Formal research must follow a formal process or methodology
- For projects in PACE, follow either the Scientific Method or the Engineering Design Process
- Following a formal process has several benefits: it is efficient, it helps validate results, it is repeatable, it demonstrates you are responsible for the results
- In addition to using a formal process, good research tackles important questions, is thorough, and uses appropriate techniques to achieve correct and valid results