Quality Assurance - How to apply scientific principles to trouble shooting

COLABORATORY PRESENTATION

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About me

- I have been working at Kaspersky for about four years. I began supporting home software before moving to enterprise support. Previously I was a microbiologist in the pharmaceutical industry where due to the nature of the work, it required adherence to strict rules and procedures, a large part involving quality assurance, scientific method and critical thinking. These principles have been useful outside of a scientific arena in my "non work' life. I have become a successful cyclist through planning and such skills are invaluable when providing technical support in my role as a technical support engineer.

What's in it for you?

- An understanding of and the ability to apply scientific methods day to day to solve problems and to achieve your goals.
- An ability to determine if what someone tells you, or what you read has any basis in reality.

Introduction

- In work and play, things do not always go smoothly. Sometimes you may want, or be required to investigate why something is not going to plan and provide a solution. You may want to know why you never break 50 minutes in a 10 kilometre run, why you can't cook or why your computer keeps crashing. In your job, you may be required to determine why a project failed, why there is conflict between co-workers or why a customer is having a problem with the operation of software you sell and support.
- Over the last couple of years I have used scientific principles to improve my cycling power output and climbing speed, install and build server operating systems consistently from scratch and to trouble shoot our security software.

Introduction (cont)

- Using a methodical approach ensures you define the problem, test variables and record the process and results. This can help in a number of ways:
  - Allows you to understand what went wrong so the same mistakes are not made in the future
  - Improves the process so a consistent result is more likely
  - Improves the process so future results are better or reached quicker
  - Documentation of a process means it can be shared with others (or sold) in order to provide consistency potentially planet wide.

Definitions

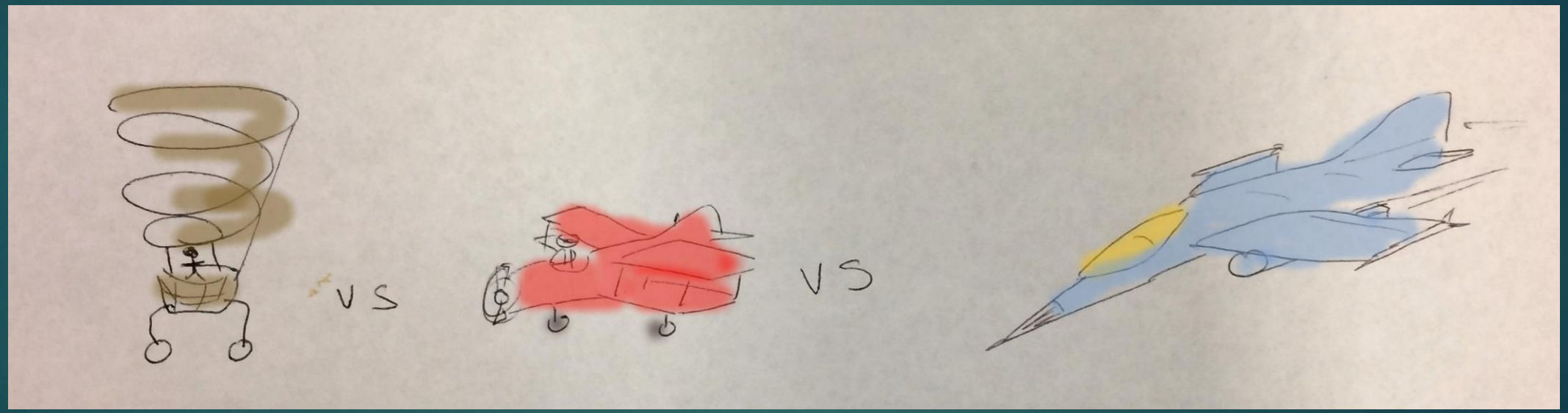
- In order to discuss this subject some definitions need to be defined:
  - Quality Assurance
  - Science
  - Scientific principles
  - Trouble Shooting
  - Critical thinking

Quality Assurance

- Quality Assurance or QA is the maintenance of a desired level of quality in a service or product by means of attention to every stage of process delivery or production.

Science

- Wikepedia defines science as a systematic enterprise that builds and organises knowledge in the form of testable explanations and predictions about the universe.



Scientific Principles

- Scientific principles utilise science in order to test hypotheses and assumes verified theories remain valid.
- There are four steps:
  1. Observation of phenomenon
  2. Development of a hypothesis.
  3. Testing through experimentation
  4. Developing a conclusion
- If the hypothesis is proven, it then becomes a theory.

Scientific Principles (cont)

- In science, a single variable is tested to determine if this influenced what is observed. Sometimes not all variables can be tested. Sometimes more than one is tested (which is poor science, but might be expedient when you are only seeking a solution and do not place much emphasis on the why).
- Controls are used. These are known variables that produce known behaviour.
- Conclusions must be based on records of observations. Here data is king. More data leads to more informed conclusions.

Trouble Shooting

- Also known as problem solving. This is the process of finding solutions to difficult or complex issues.
- Trouble shooting is very similar to scientific method:
  1. Define the problem
  2. Determine what the cause might be
  3. Test various solutions to the problem
  4. Determine what the cause of the problem was
  5. Implement corrective and preventative action so the problem is unlikely to happen again
- 1-4 is what I do every day as a technical support engineer. I like to include 5 where possible.

Critical Thinking

- This is the objective analysis and evaluation of an issue in order to form a judgement.
- Critical thinking goes hand in hand with problem solving. An issue needs to be evaluated in order to determine how best to solve it.
- With the proliferation of "fake" news, pseudo (sham) science, conspiracy theories the ability for anyone to publish anything online, critical thinking and being sceptical is vitally important.
- It allows you to determine what is fact and what is fiction.
- A whole lecture could be devoted to this subject. Carl Sagan wrote a good book on the topic: *The Demon Haunted World*.

Examples of Trouble Shooting

- To demonstrate trouble shooting using QA/Science, the following examples will be discussed.

1. A light does not turn on.
2. You read in the news that the Earth is flat. Could this be true?
3. I'm "Bad" at climbing hills.
4. A computer software installation fails.

A light does not turn on.

- QA: desired and consistent level of quality
  1. Observation of phenomenon
  2. Development of a hypothesis.
  3. Testing through experimentation
  4. Developing a conclusion
- How does critical thinking help?

A light does not turn on.

- *Observation of phenomenon*
  1. Flick switch. No light.
  2. Light worked yesterday.
  3. Flicking switch on and off. Still no light.
  4. Globe present in light socket.
  5. Lights on in house next door.
  6. Fridge on and confirmed by light turning on when fridge door opened.
  7. Power meter spinning around indicating house sucking down power.
  8. No fuses in the fuse box appear blown.
  9. Other lights turn on when their switches flicked.

A light does not turn on.

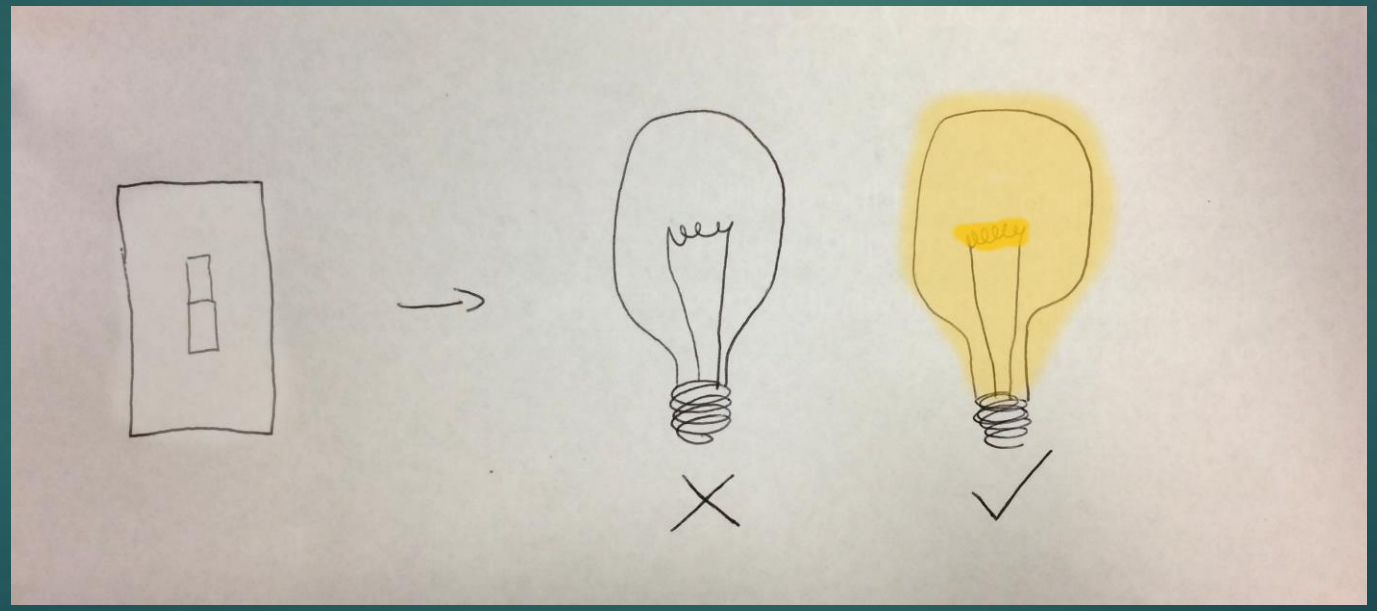
- *Development of a hypothesis.*
  - *Based on observations the possible causes are:*
    1. *Blown globe*
    2. *Loose connection at light socket*
    3. *Loose connection at light switch*
    4. *Mouse eaten through cable*
    5. *Aliens have replaced the globe with a fake globe*
- Ideally test the most likely hypothesis first before trying another solution. This is based on Occam's Razor which states the simplest explanation is most likely the right one.

A light does not turn on.

- *Testing through experimentation*
  - *Blown globe*
    - *Look at globe for burn out.*
    - *Replace globe. Test switch*
  - *Loose connection at light socket*
    - *Wiggle globe when switch is in on position.*
    - *Remove and reseat. Test switch*
  - *Loose connection at light switch*
    - *Pull apart light switch. Is anything loose?*
  - *Mouse eaten through cable*
    - *Tricky and cannot be tested (unless pull apart wall).*
  - *Aliens have replaced the globe with a fake globe*
    - *Not falsifiable in principle and REALLY far fetched.*

A light does not turn on.

- *Developing a conclusion*
- *The results of the experimentation must support the conclusion.*

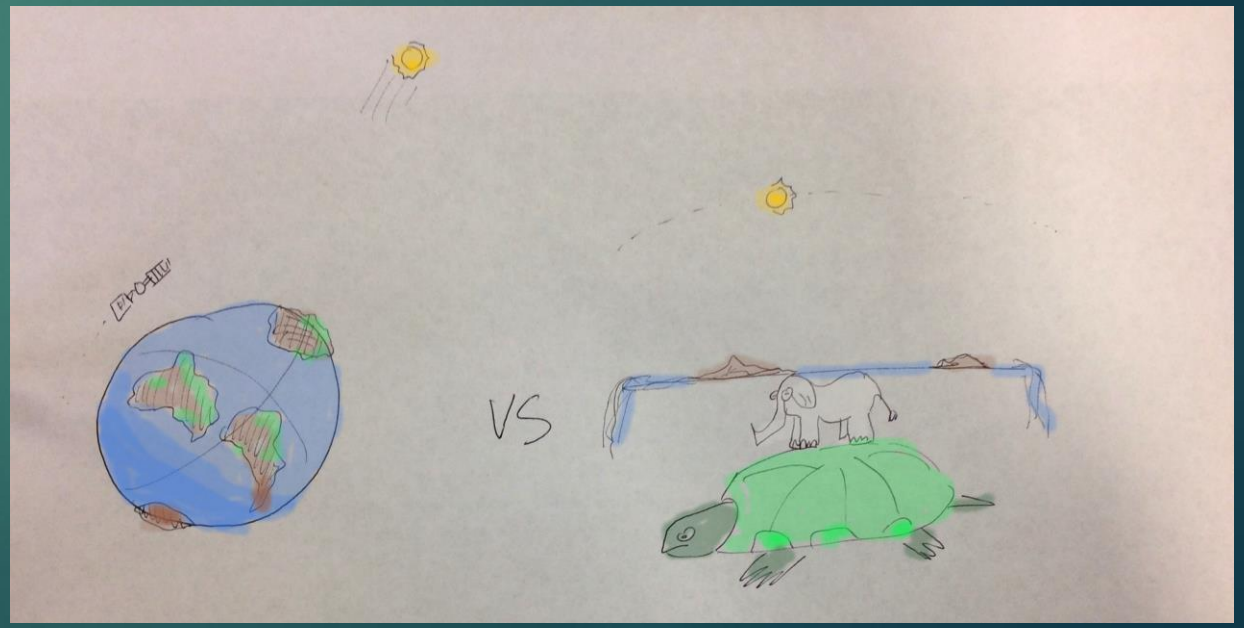


A light does not turn on.

- *How does critical thinking help?*
- *By observing the problem we can save time by not testing invalid hypothesis. Eg, no blown fuses means we do not need to replace the fuses. By testing the simplest hypothesis first, we may have seen the filament in the globe was broken, thus indicating the globe had blown.*
- *If the blown globe was replaced and the light still remained off, we could test the remaining hypothesis as perhaps the light socket was loose too. Sometimes, the cause of a problem is not limited to a single reason.*

You read in the news that the Earth is flat. Could this be true?

- QA: desired and consistent level of quality
  1. *Observation of phenomenon*
  2. *Development of a hypothesis.*
  3. *Testing through experimentation*
  4. *Developing a conclusion*
- *How does critical thinking help?*



You read in the news that the Earth is flat. Could this be true?

- *Observation of phenomenon*
  1. The horizon looks flat.
  2. I can only see a limited distance and I can see further when I am up high. I can also see more of a distant object.
  3. Time zones and sunrise/set are different across the planet.
  4. A stick in Perth and a stick in Melbourne of the same height have different shadow lengths at the same time.
  5. Objects on the horizon appear to rise (not just appear).
  6. Star constellations are different depending on where I am located globally.
  7. Photos from space indicate Earth is round and it appears to spin.

You read in the news that the Earth is flat. Could this be true?

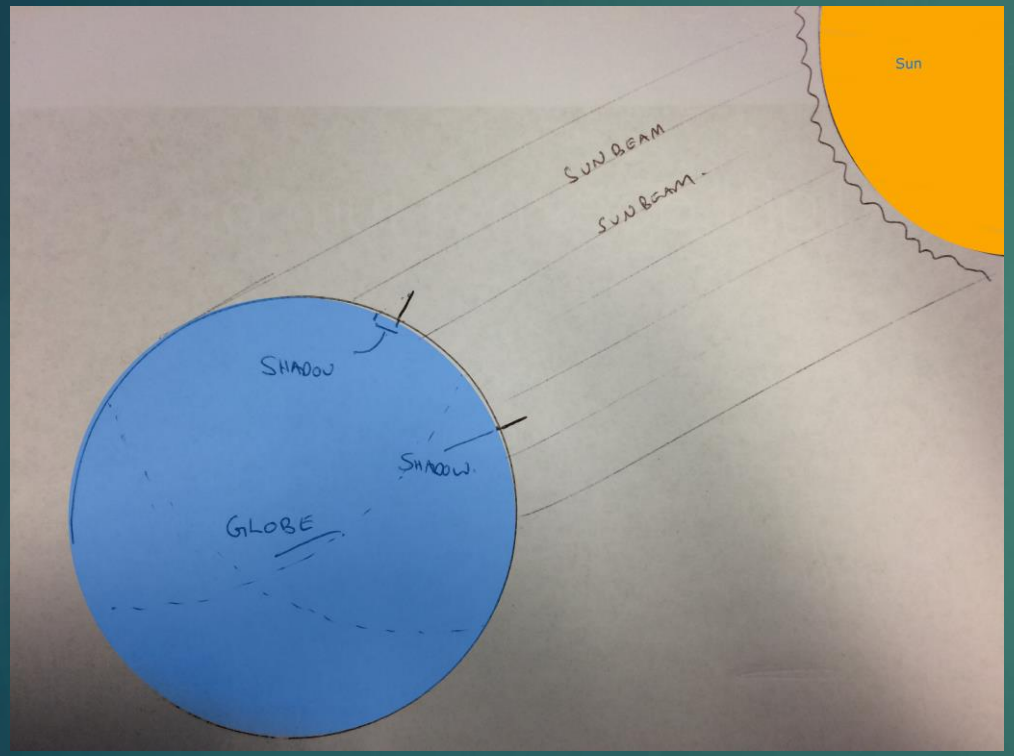
- *Development of a hypothesis.*
  - *The Earth is flat.*
  - *The Earth is round.*
- Can test fairly simply.

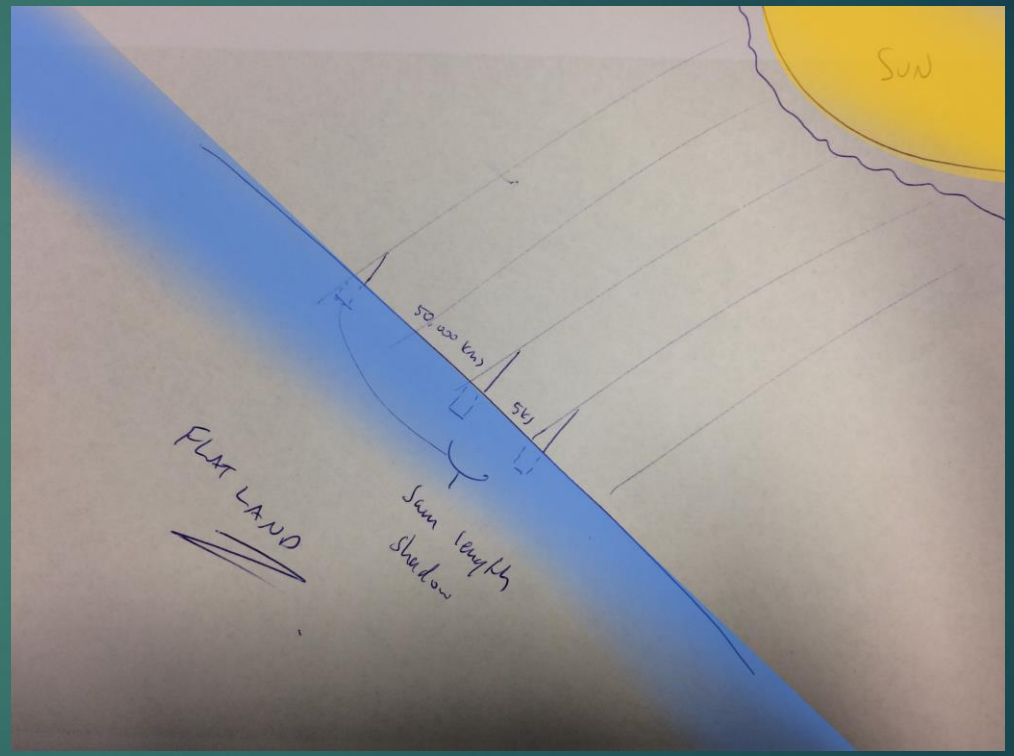
- Regarding "facts":
  - How reliable is the source? Does the claimant have an agenda?
  - Is there independent confirmation of the facts?
  - Has the hypothesis been disproved? Has anyone tried to disprove it?
  - Can the hypothesis be disproved? Can it be tested?
  - Does this idea account for the unknowns in the current theory?

You read in the news that the Earth is flat. Could this be true?

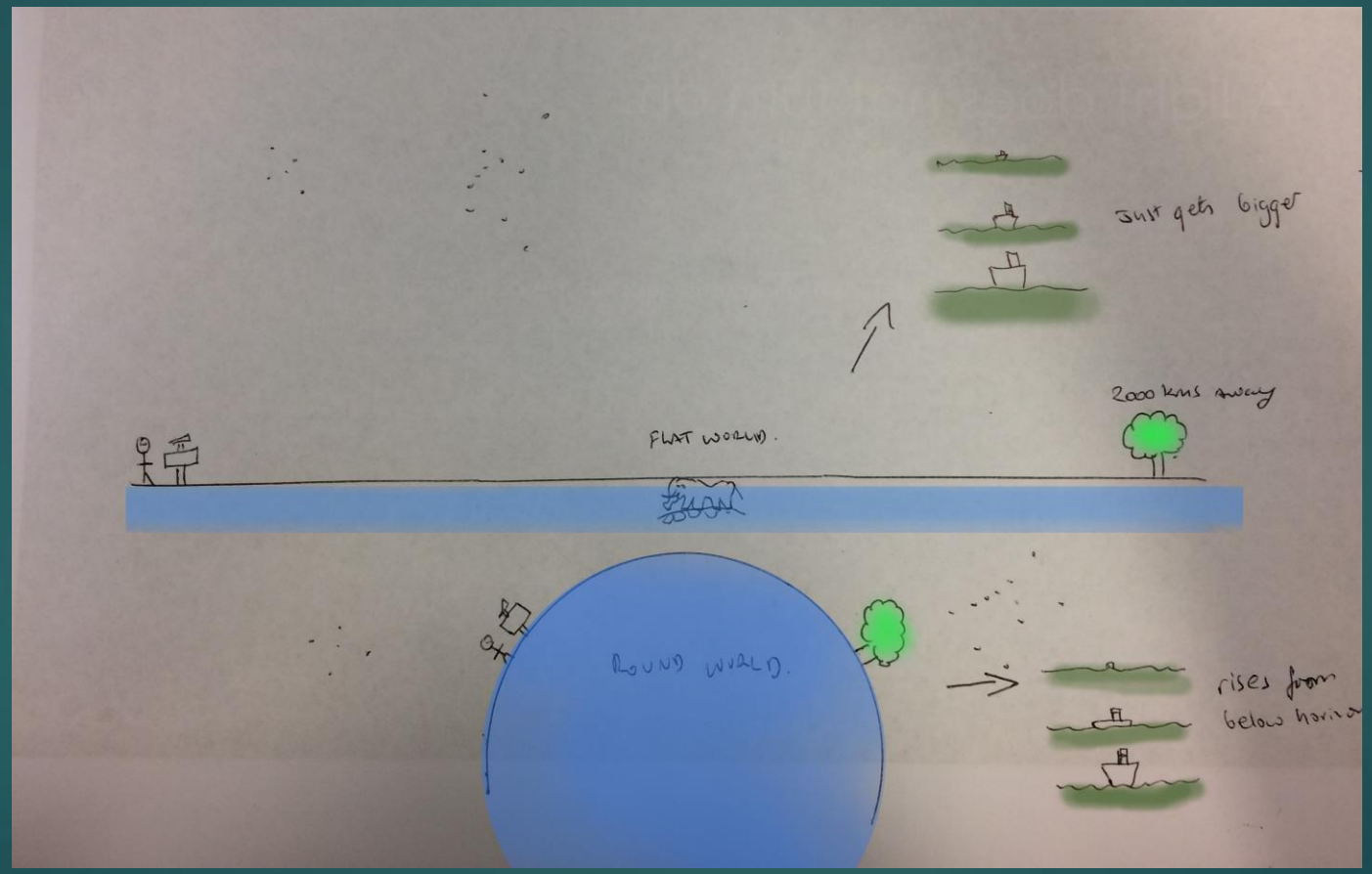
- *Testing through experimentation. Test observations.*
  1. *Look as far away as can with binoculars or a telescope while on ground. Climb hill. Look in same direction. Observe differences.*
  2. *Stick nails in an melon 2cm apart. Shine torch at melon from 2m away. Observe shadows.*
  3. Stick nails in an melon and rotate the object so nails move towards you. Observe nails.
  4. Bang nails into a flat piece of wood. Observe shadow length under sun
  5. Using setup from 4, bring wood to eye level, observe nails. Raise head. Observe nails. What would happen to the far nail if the wood could be bent so the nails fall below the horizon?

You read in the news that the Earth is flat. Could this be true?





You read in the news that the Earth is flat. Could this be true?



You read in the news that the Earth is flat. Could this be true?

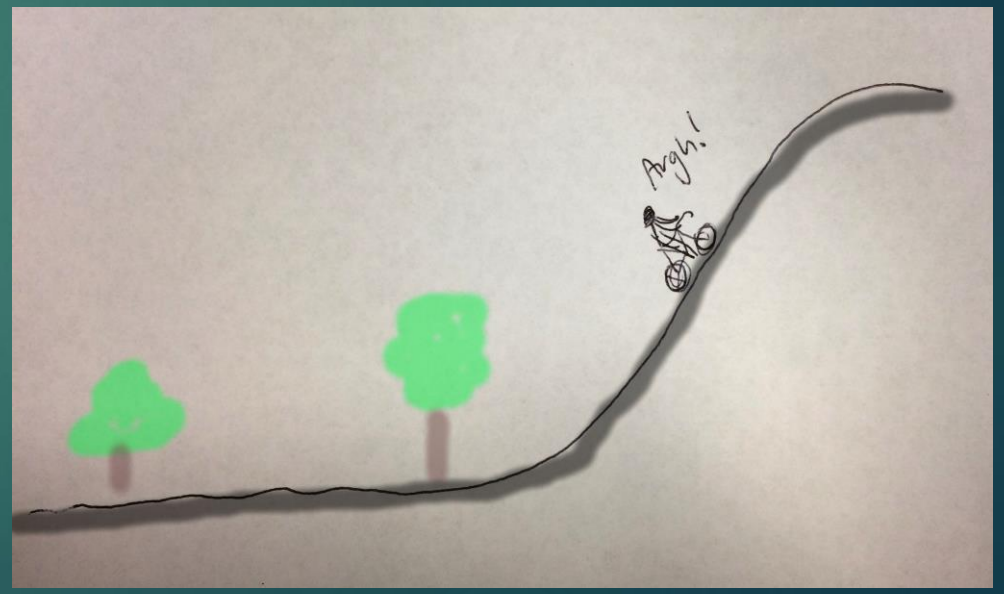
- *How does critical thinking help?*
  - *By developing your own experiments you can determine the validity of other's ideas.*
  - *Here we tested two hypothesis and made no assumptions that either was true.*
  - *The conclusions are based on evidence that can be scaled up.*
  - *In this case, it does not make sense the Earth is flat. There is no evidence of people sailing off the edge of the Earth. Satellites orbit the Earth, the moon, other plants and the sun all appear to be round so it stands to reason the Earth is too. Photos from high altitude and space show curvature. Gravity pulls down (to the centre of mass). Easy experiments indicate a curved surface to the Earth.*

You read in the news that the Earth is flat. Could this be true?

- Regarding flat Earth "facts"
  - How reliable is the source? Does the claimant have an agenda? UNKNOWN
  - Is there independent confirmation of the facts? "NO"
  - Has the hypothesis been disproved or falsified? YES
  - Has anyone tried to disprove it? YES
  - Can it be tested? YES
  - Does this idea account for the unknowns in the current theory? NO. The round Earth hypothesis came along after the flat Earth and matches the observable data.

I'm "Bad" at climbing hills.

- QA: desired and consistent level of quality
  1. Observation of phenomenon
  2. Development of a hypothesis.
  3. Testing through experimentation
  4. Developing a conclusion
- How does critical thinking help?



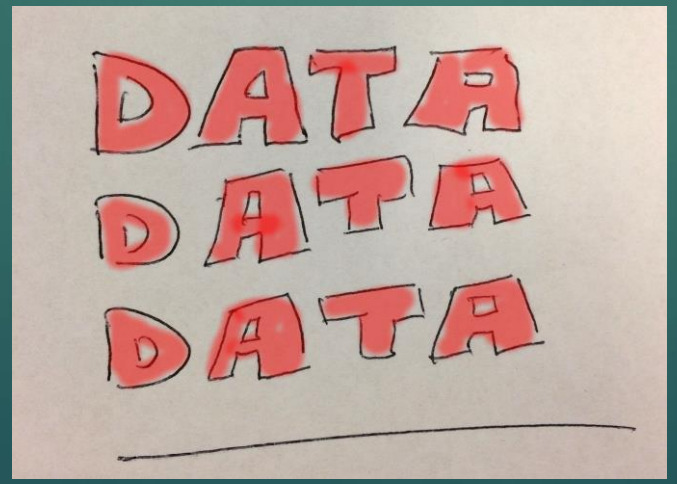
I'm "Bad" at climbing hills.

- Observation of phenomenon
  1. When cycling up hills I tend to be slower than others
  2. When I weight more, I climb slower
  3. I climb faster when I am on a light bike
  4. When I am "racing well" I seem to climb better

- Sometimes, observations do not contain hard data. Sometimes the problem needs to be rephrased. "I'm "Bad" at climbing hills." could be "I am slow when climbing hills and want to be faster."

I am slow when climbing hills and want to be faster.

- Observation of phenomenon
  1. When cycling up Mt. Pain, I am often 1 minute slower than others
  2. When I weigh 90kgs I climb slower than when I weigh 80kgs
  3. I climb faster when I am on a light bike for the same measured effort
  4. I cycle up Mt. Pain 45 seconds faster at 300W than at 250W



I am slow when climbing hills and want to be faster.

- *Development of a hypothesis.*
  - *Based on observations:*
    1. My weight affects my climbing speed.
    2. Power output determines climbing speed.
- Here a little research shows that a cyclist's power/weight (W/kg) ratio affects climbing speed. Here the initial work has been done. We can then determine ways to improve one's W/kg.
- What we really have are two theories (proven hypotheses).
  - What do we want to do to improve climbing speed? Increase power or decrease weight (or both?)

I am slow when climbing hills and want to be faster.

- *As we have a theory, here we are implementing corrective action*
  - *Weight now: 80kgs*
  - *Power output now: 250W*
  - *Time to climb hill: 5 minutes on a calm sunny say.*
    - *What is easier to do, get stronger or get lighter? So we only test one variable, we will eat less. Through training we might get stronger. We will keep our power the same in testing later on.*
  - *Months pass…weight 75kgs. Climbing hill at 250W gets me up it in 4mins 30. The weather conditions were the same as the initial testing.*
  - *We can assume as I've concentrated on my hill climbing, my power output has also increased.*

I am slow when climbing hills and want to be faster.

- *Developing a conclusion*
- *Here we want to see if our corrective action attained the desired goals.*
  - *Did we lose weight? Yes.*
  - *Did we get stronger. We did not test this.*
  - *How long does it take us to climb up a hill now we are 75kgs and producing 250W. 30 seconds less.*
- Conclusion: At 250w Mt. Pain can be climbed at 75kgs 30 seconds faster than when I weigh 80kgs.
  Was the corrective action successful?
  - Yes: I am now climbing hills faster.

I am slow when climbing hills and want to be faster.

- How does critical thinking help?
  - It enabled us to rephrase or redefine the problem.
  - By developing measurable actions with measurable outcomes, we can show whether the actions taken were successful.
  - Showing positive outcomes is important when it comes to things such as website click through rates, return on investment, determining the success of training. A negative outcome can help refine and improve future plans to improve the likelihood of a successful outcome.

A computer software installation fails.

- QA: desired and consistent level of quality
  1. *Observation of phenomenon*
  2. *Development of a hypothesis.*
  3. *Testing through experimentation*
  4. *Developing a conclusion*
- *How does critical thinking help?*

A computer software installation fails.

- *Observation of phenomenon*
  - Normally when a program fails to install there is an error message: What exactly is the error/problem?
  - Gather information and eliminate variables: eg: Is the software supported on the operating system / have prerequisites been met?
  - Can issue be reproduced? Can a hypothesis of the root cause be formulated?
  - Does the fix based on observations / hypothesis fix the problem?

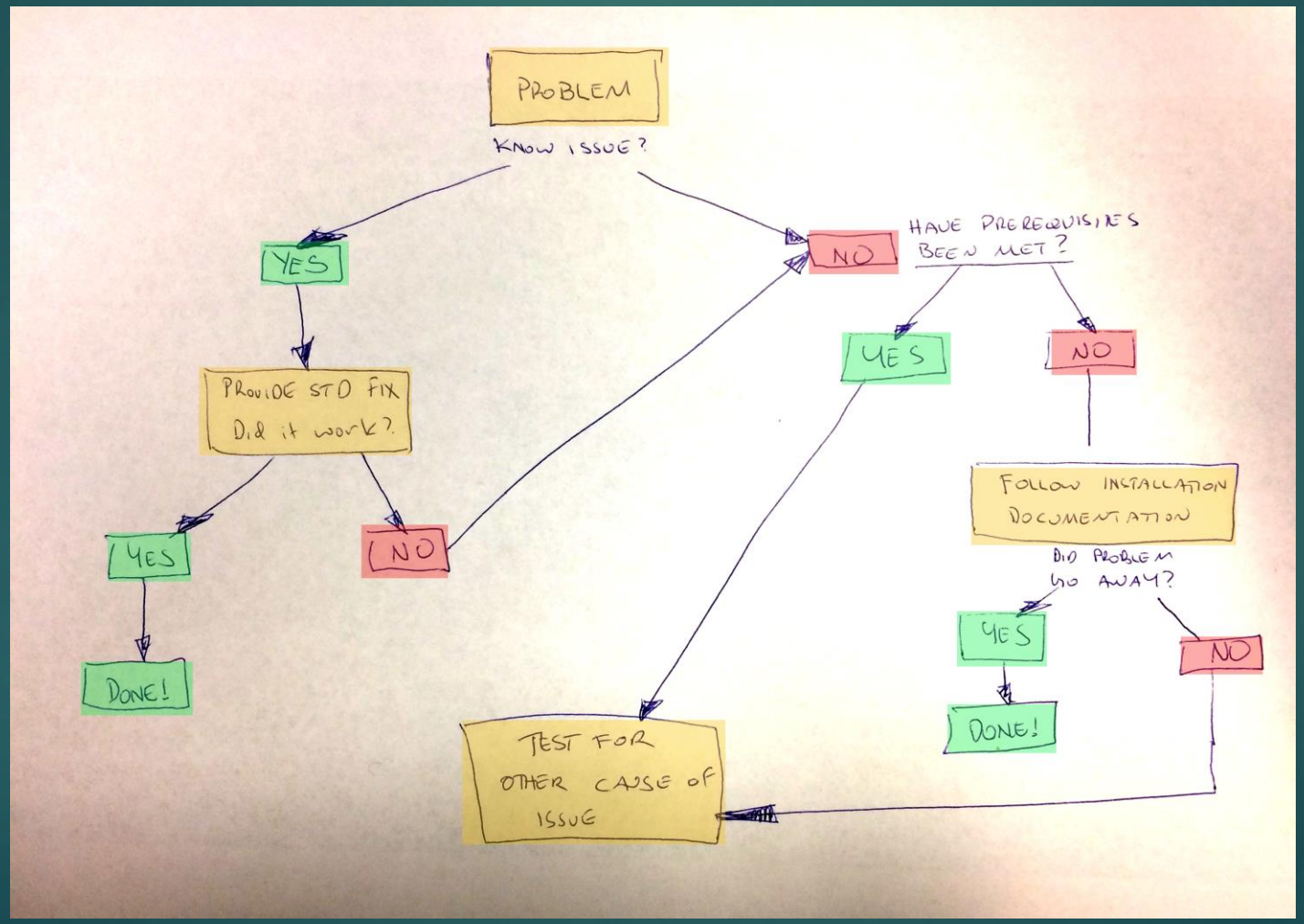
A computer software installation fails.

- *Development of a hypothesis.*
  - *Based on observations (in this case experience) the possible causes are:*
    1. *Known issue*
    2. *Something not being done correctly*
    3. *Something new*
- Ideally test the most likely hypothesis first before trying another solution. Here this *should* lead to a faster solution for the customer.

A computer software installation fails.

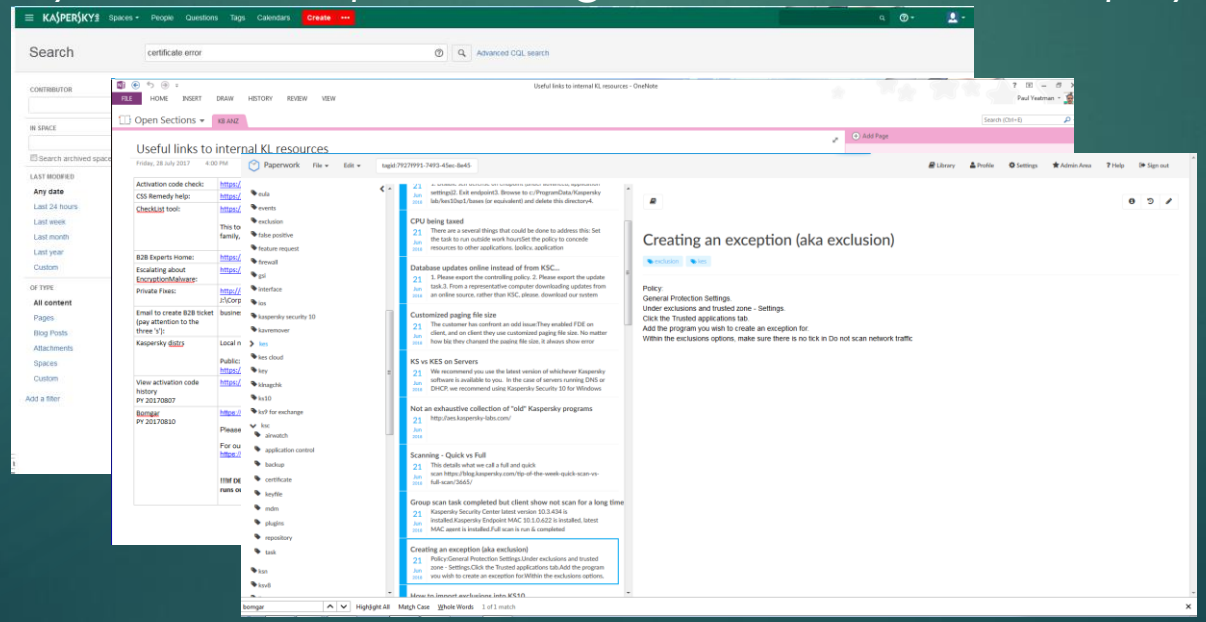
- *Testing through experimentation (flow chart next page)*
  1. *Known issue*
     - *Provide standard fix*
     - *Did it work? If no, continue to 2…*
  2. *Something not being done correctly*
     - *Have the prerequisites been met and the correct procedure been followed?*
     - *If yes, follow them. Did that fix the issue? If no, continue to 3…*
  3. *Something new*
     - *Try and determine what is the cause of the issue. Gather data. Attempt to reproduce. Offer work around (if there is one).*

A computer software installation fails.



A computer software installation fails.

- *Developing a conclusion and updating trouble shooting guide.*
- *I like my trouble shooting guide to be an indexed database not unlike Evernote or Onedrive. That way I can reference solutions to known issues and update the database with improved solutions or add entries for new issues. I supplement this with various resources such as Kaspersky's online help, admin guides and internal help systems.*



A computer software installation fails.

- *How does critical thinking help?*
- *It speeds up providing a solution to known issues and allows new issues to be problem solved in a consistent manner. >>enables efficiency.*
- *If the same issue is unknown today and a solution is developed, next time it is known so a solution can be provided immediately.*

Conclusion

- Quality Assurance allows for a consistent methodology for problem solving.
- Scientific principles help trouble shooting by breaking down the analysis process.
  - Combine these and you get efficient and consistent trouble shooting.
- Critical thinking allows you to make the best decisions while problem solving
- Critical thinking examine “facts” as well as the data you produce.
- Scientific thinking can benefit everyone.

Questions