SCIENTIFIC RESEARCH

ITS DIMENSIONS AND IMPORTANCE

Presentation By

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Overview

Scientific research is a systematic process of investigating phenomena, acquiring new knowledge, or validating existing theories through observation, experimentation, and analysis. It encompasses multiple dimensions, including theoretical, applied, and interdisciplinary approaches, each contributing to the advancement of science and technology. Its importance lies in driving innovation, solving complex problems, and improving societal well-being by providing evidence-based solutions. The scientific research methodology typically involves defining a problem, reviewing literature, formulating hypotheses, collecting and analyzing data, and drawing conclusions. However, researchers face challenges such as limited funding, ethical considerations, data reliability, and the need for collaboration across disciplines, making the pursuit of scientific knowledge both rigorous and demanding.

Agenda

- What is Scientific Research?
- Dimensions of Scientific Research
- Importance of Scientific Research
- The Scientific Research Methodology
- Challenges in Scientific Research
- Discussion

What is Scientific Research?

What is Scientific Research?

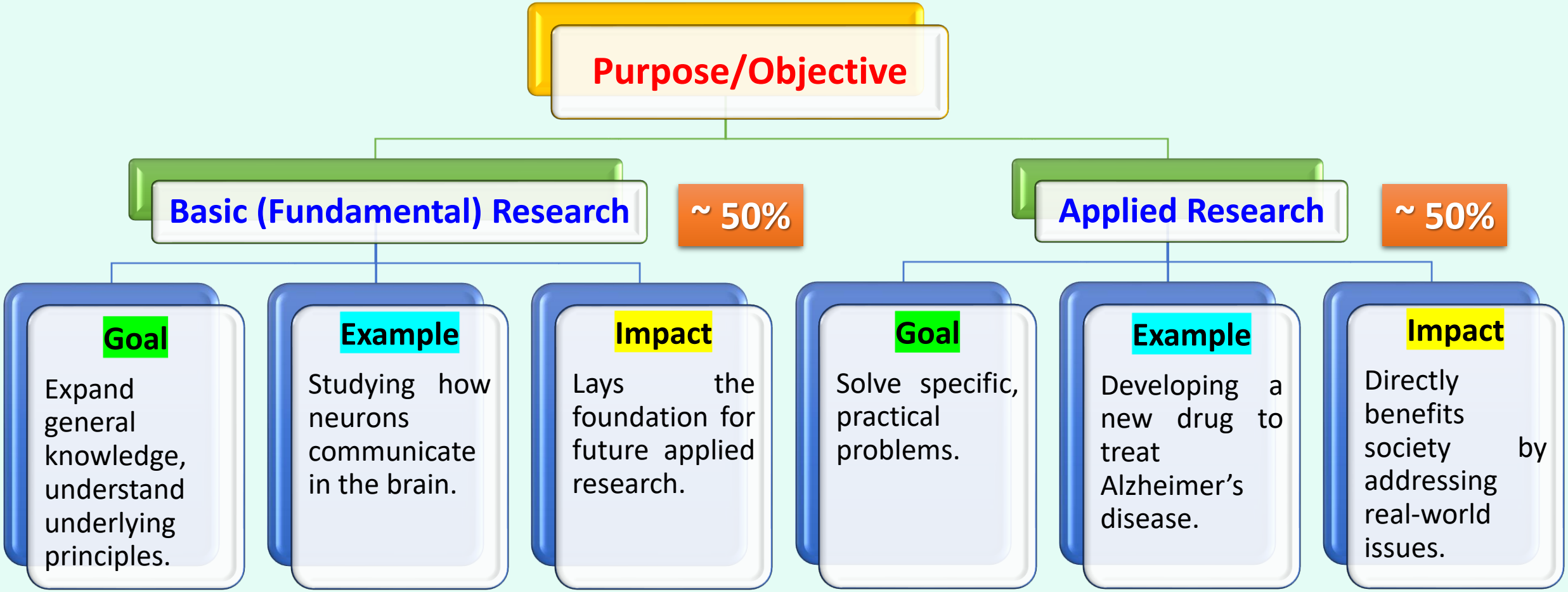
- **Scientific research** is a structured **process of inquiry** that **uses scientific methods** to ***answer questions***, ***solve problems***, or ***generate new knowledge***.

- **In simpler terms,** it is the **process** of **discovering new knowledge** or **validating existing knowledge** **using** scientific methods. **<u>It is characterized by:</u>**

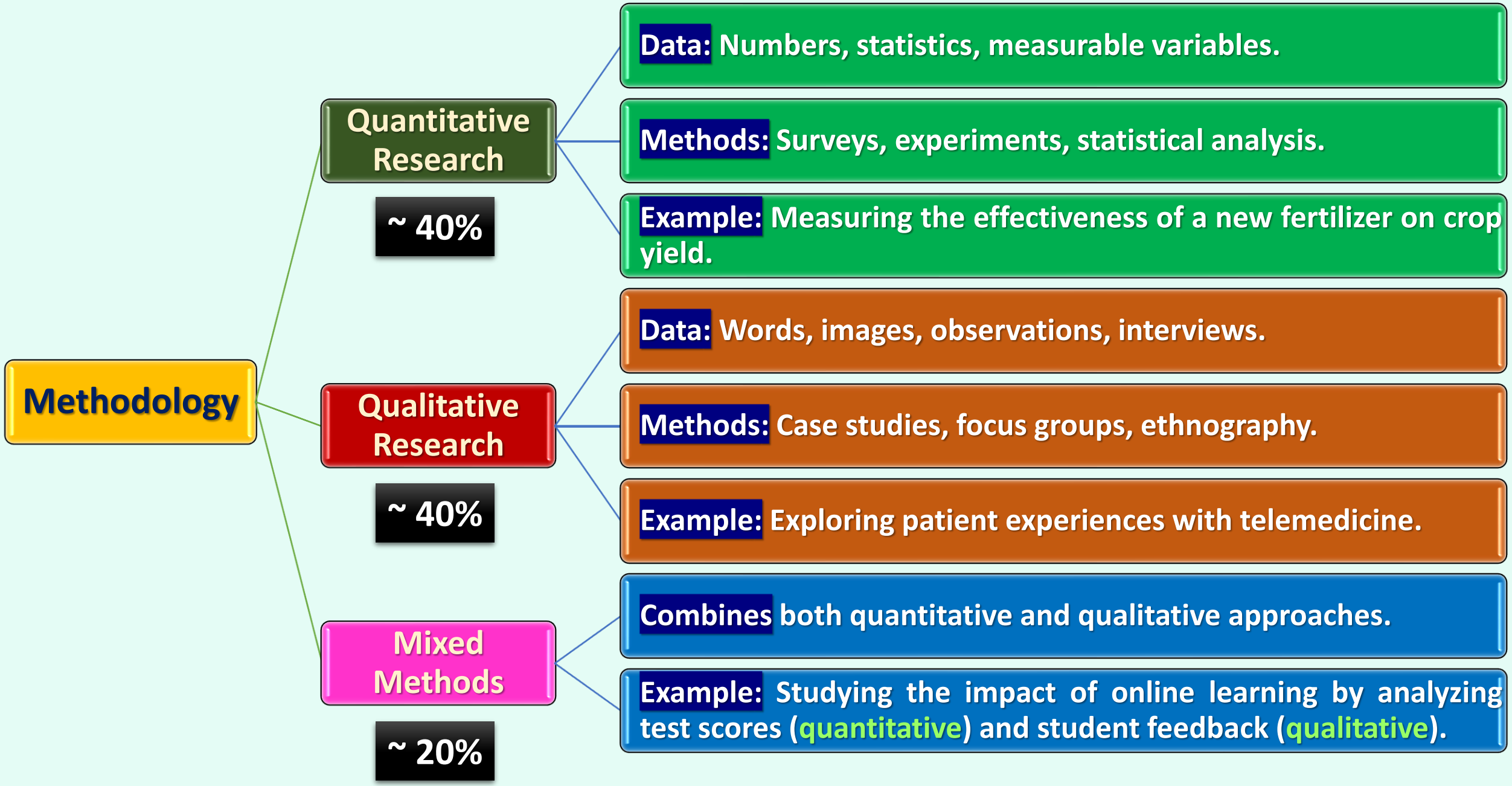
1. **Systematic planning:** Steps are organized and logical.
2. **Empirical evidence:** Based on observation or experiment.
3. **Critical analysis:** Results are scrutinized and validated.
4. **Reproducibility:** Others can repeat the study and get similar results.

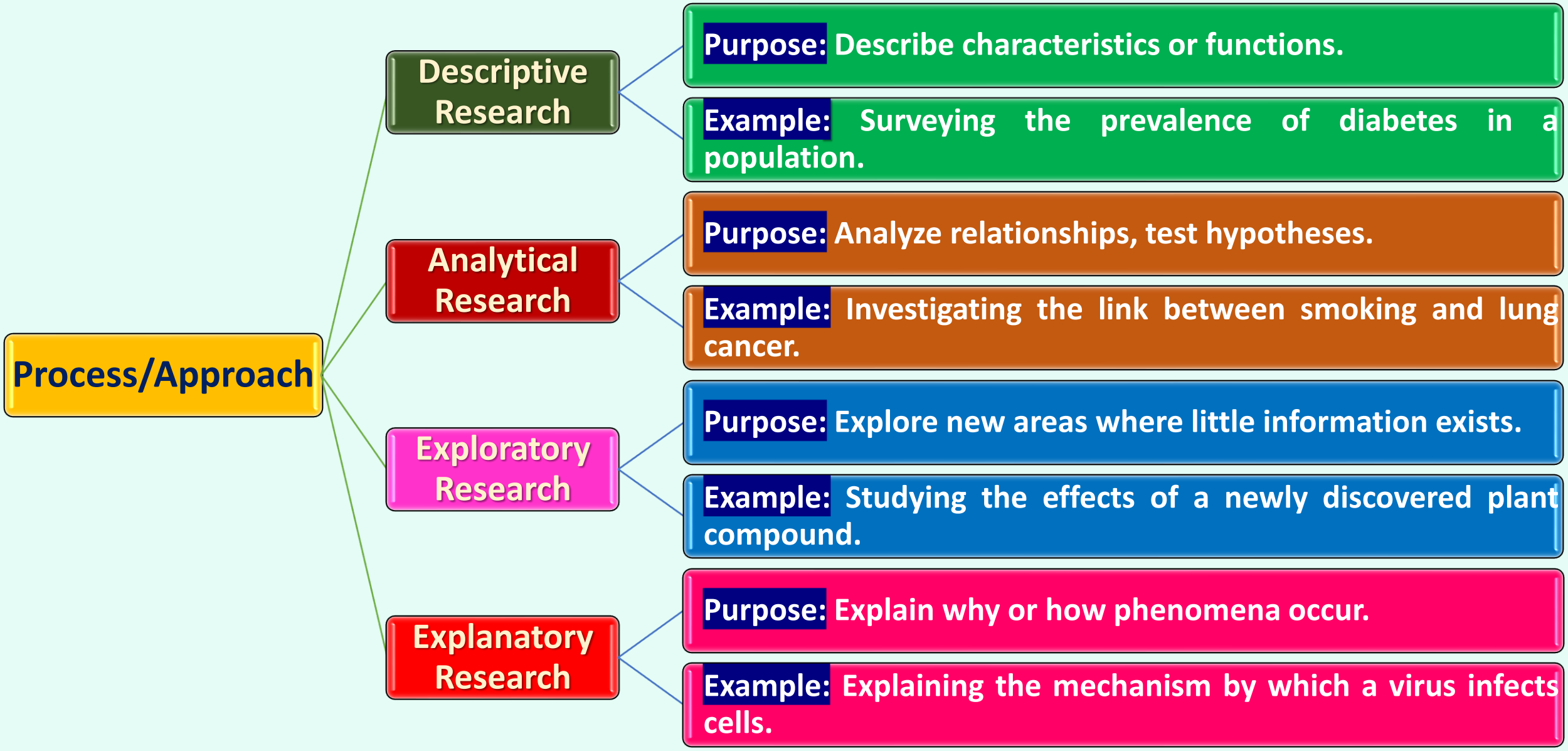
Dimensions of Scientific Research

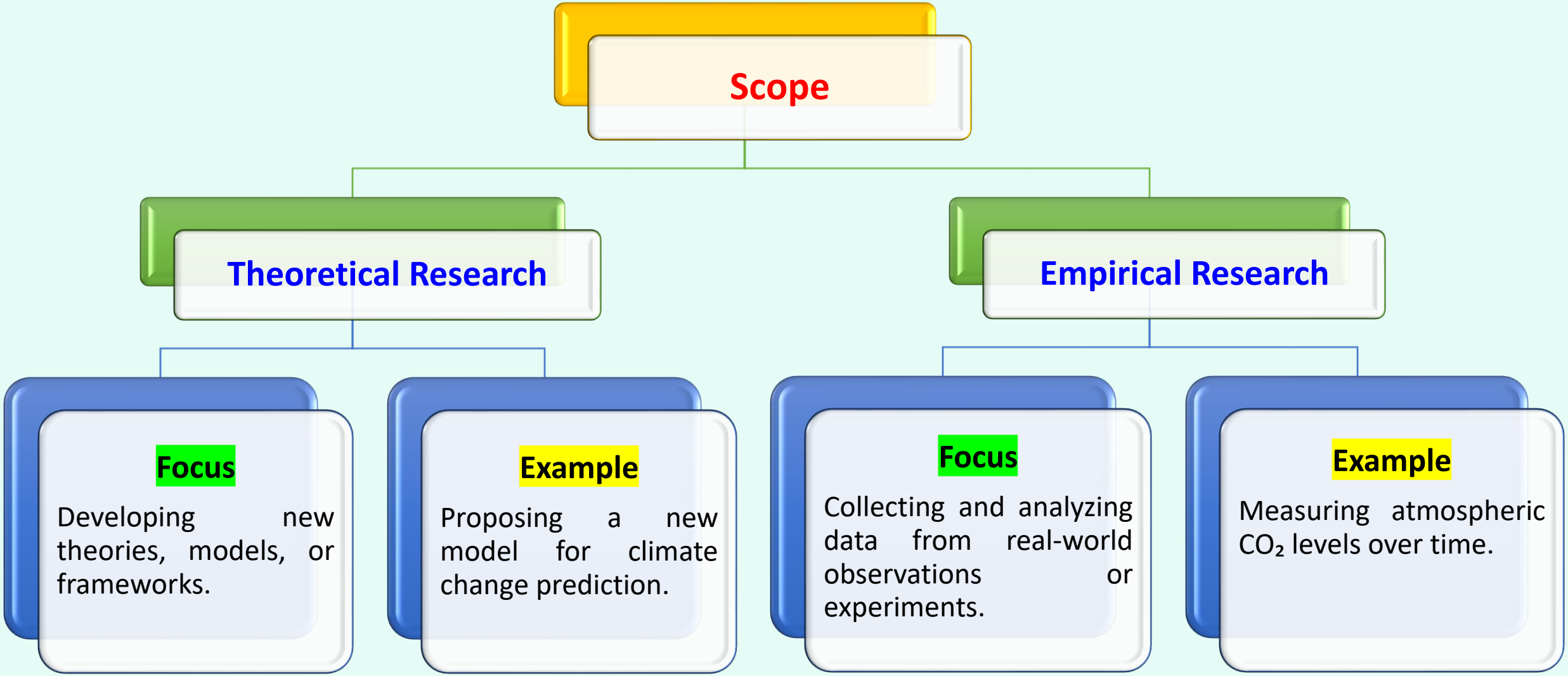
Dimensions of Scientific Research

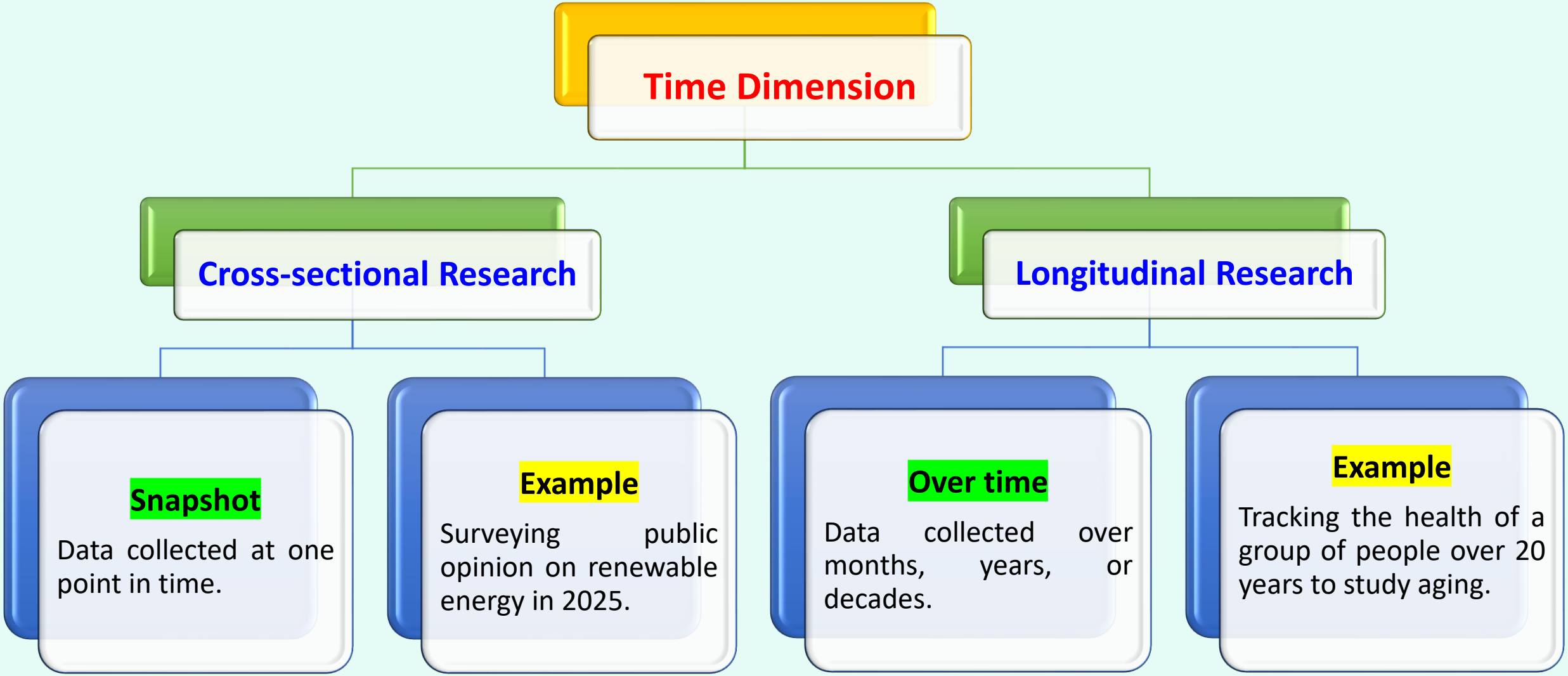


Purpose is the broad, abstract, long-term "**Why**" behind actions, while **Objectives** are the concrete, specific, short-term, and measurable "**What**" steps taken to ***achieve that purpose***.

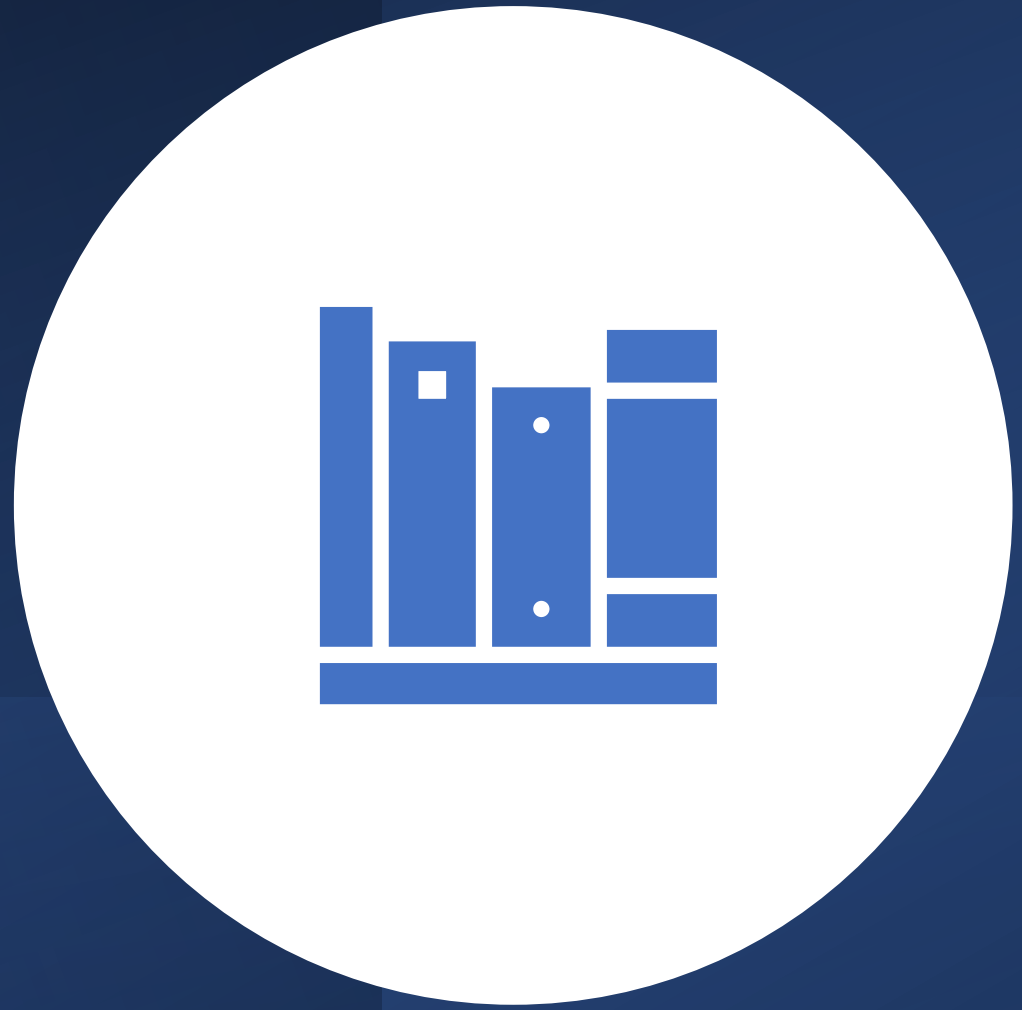

Methodology
Quantitative Research
~ 40%
Data: Numbers, statistics, measurable variables.
Methods: Surveys, experiments, statistical analysis.
Example: Measuring the effectiveness of a new fertilizer on crop yield.
Qualitative Research
~ 40%
Data: Words, images, observations, interviews.
Methods: Case studies, focus groups, ethnography.
Example: Exploring patient experiences with telemedicine.
Mixed Methods
~ 20%
Combines both quantitative and qualitative approaches.
Example: Studying the impact of online learning by analyzing test scores (quantitative) and student feedback (qualitative).


Process/Approach
Descriptive Research
Purpose: Describe characteristics or functions.
Example: Surveying the prevalence of diabetes in a population.
Analytical Research
Purpose: Analyze relationships, test hypotheses.
Example: Investigating the link between smoking and lung cancer.
Exploratory Research
Purpose: Explore new areas where little information exists.
Example: Studying the effects of a newly discovered plant compound.
Explanatory Research
Purpose: Explain why or how phenomena occur.
Example: Explaining the mechanism by which a virus infects cells.


Scope
Theoretical Research
Empirical Research
Focus
Developing new theories, models, or frameworks.
Example
Proposing a new model for climate change prediction.
Focus
Collecting and analyzing data from real-world observations or experiments.
Example
Measuring atmospheric CO_2 levels over time.


Time Dimension
Cross-sectional Research
Longitudinal Research
Snapshot
Data collected at one point in time.
Example
Surveying public opinion on renewable energy in 2025.
Over time
Data collected over months, years, or decades.
Example
Tracking the health of a group of people over 20 years to study aging.

Importance of Scientific Research



Importance of Scientific Research

Advancement of Knowledge

- **Expands understanding** of natural and social phenomena.
- **Example:** Discovery of penicillin revolutionized medicine.

Problem Solving

- **Addresses challenges** in health, technology, environment, etc.
- **Example:** Research on renewable energy helps combat climate change.

Informs Policy and Decision Making

- **Evidence-based decisions** in government, business, and healthcare.
- **Example:** Public health policies during pandemics rely on scientific studies.

Economic Growth

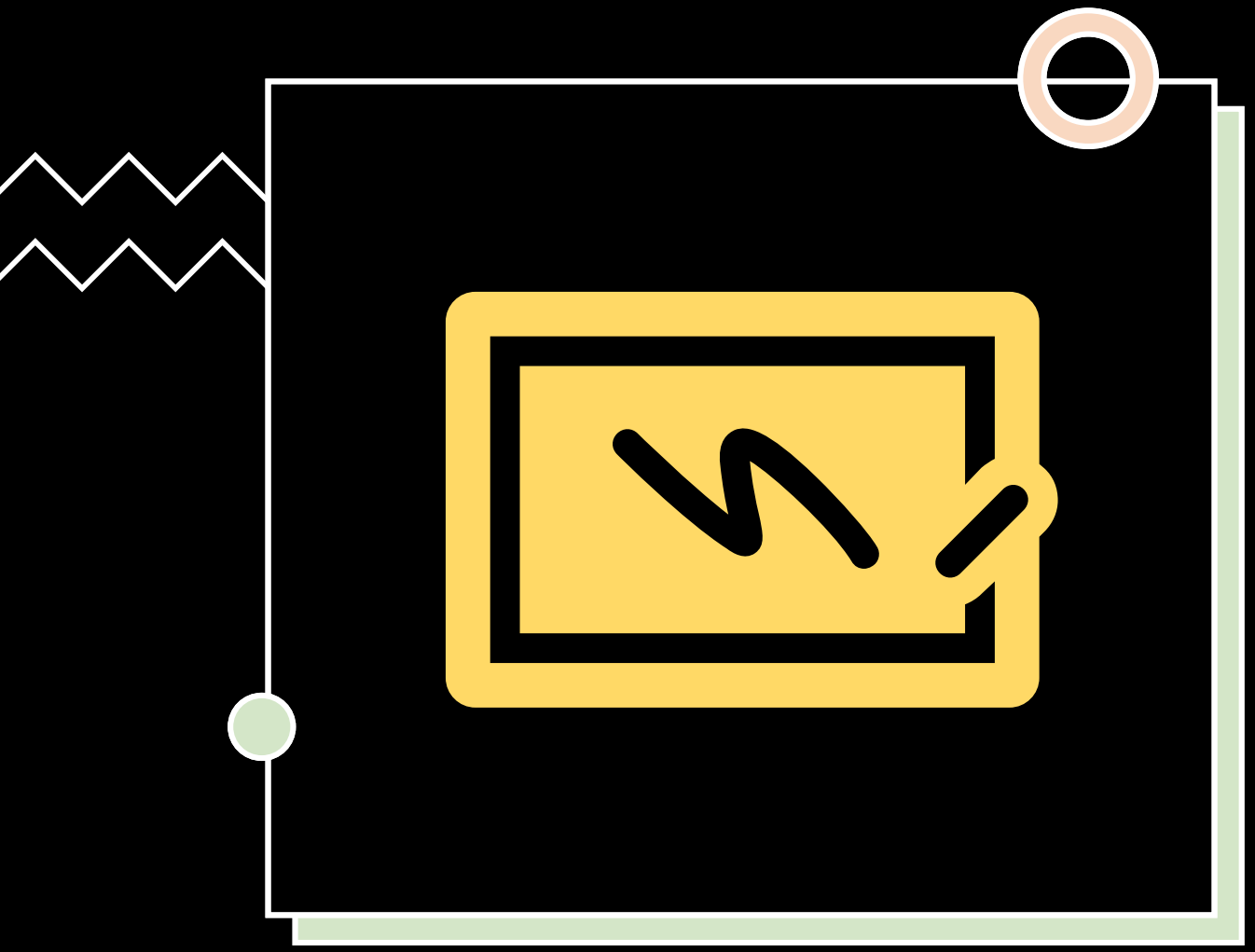
- **Drives innovation** and creates new industries.
- **Example:** Research in information technology led to the digital economy.

Education and Training

- **Develops skills** in critical thinking, analysis, and problem-solving.
- **Example:** University research projects train future scientists.

Social and Cultural Benefits

- **Improves quality of life** through better healthcare, safety, and communication
- **Example:** Research on vaccines has eradicated diseases like smallpox.



The Scientific Research Methodology

The Scientific Research Methodology

Identifying the Problem/Question
- **Define** a clear, focused research question.
- **Example:** “What factors contribute to antibiotic resistance?”

Reviewing Literature
- **Study** existing research to understand what is already known.
- **Example:** Reading journal articles on antibiotic resistance.

Formulating Hypotheses
- **Develop** testable predictions.
- **Example:** “Increased use of antibiotics in livestock leads to higher resistance.”

Designing the Study
- **Choose** methods, select samples, plan data collection.
- **Example:** Designing experiments with control and experimental groups.

Collecting Data
- **Gather** information through experiments, surveys, or observations.
- **Example:** Testing bacteria samples from different farms.

Analyzing Data
- **Use** statistical or qualitative methods to interpret results.
- **Example:** Comparing resistance rates using statistical tests.

Interpreting Results
- **Draw** conclusions, relate findings to hypotheses.
- **Example:** Concluding whether livestock antibiotic use is linked to resistance.

Reporting and Publishing Findings
- **Share** results in journals, conferences, or public reports.
- **Example:** Publishing in “Nature” or presenting at a scientific conference.

Challenges in Scientific Research

Challenges in Scientific Research

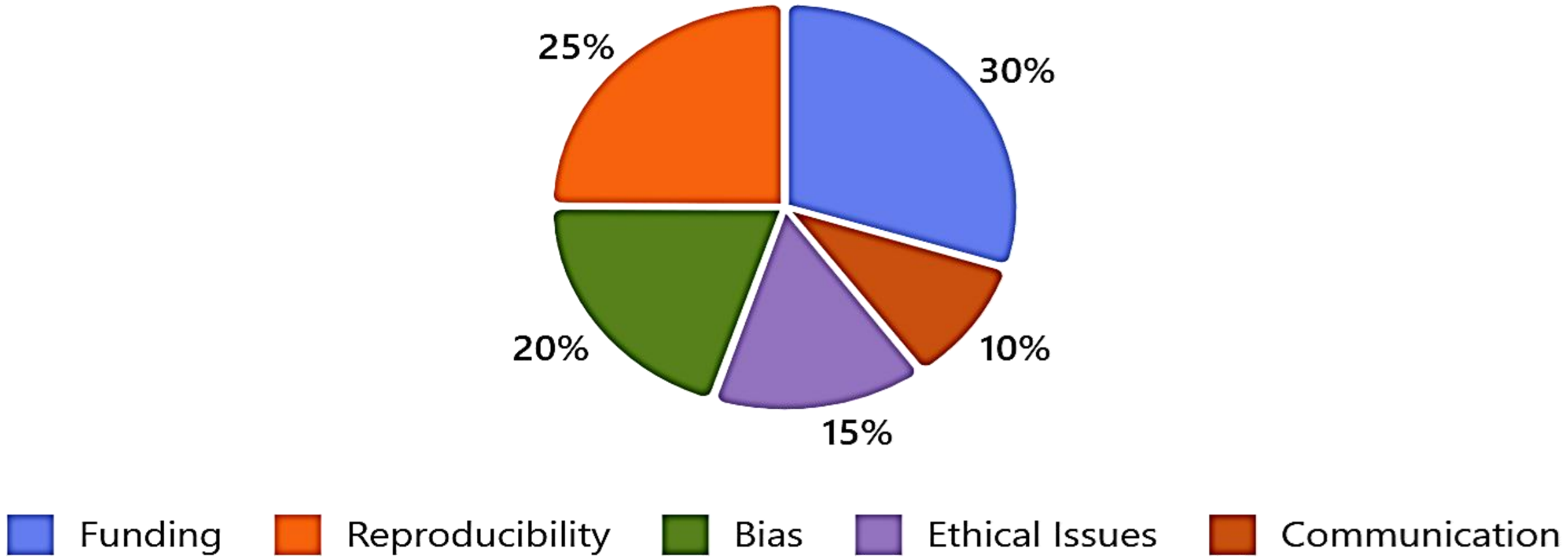
Ethical Issues: Ensuring research does not harm participants or the environment.

Funding: Securing resources for long-term or high-cost projects.

Bias: Avoiding personal or methodological biases that can skew results.

Reproducibility: Ensuring others can replicate findings.

Communication: Translating complex findings for the public and policymakers.

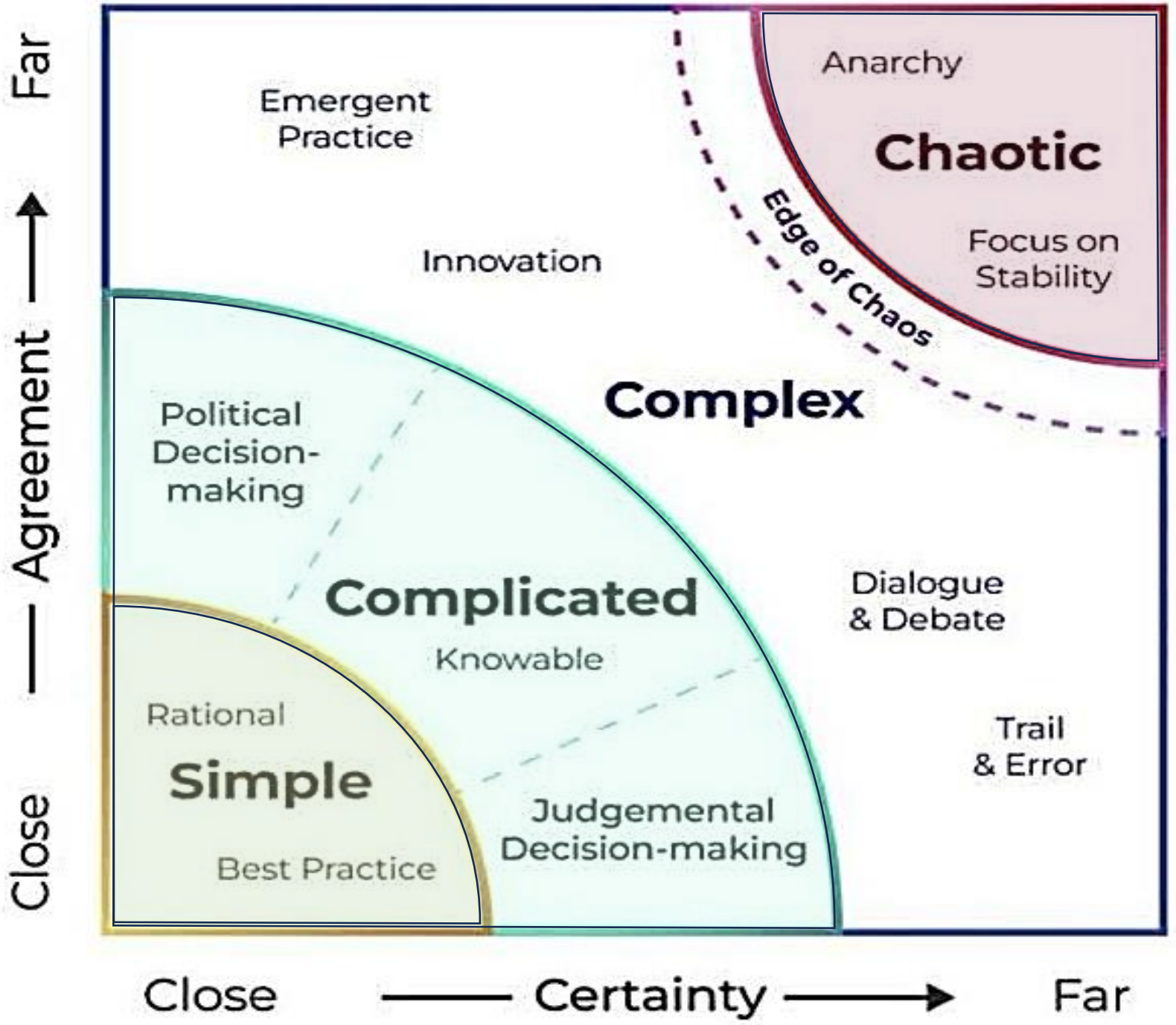


Challenges Percentage in Scientific Research (*approximate*)

Challenges Overlapping in Scientific Research (*approximate*)

Strategy In The Face of Complexity

Agreement refers to the level of shared understanding or consensus among experts on a given topic, while **certainty** refers to the strength of the evidence and the resulting confidence in the reliability of a finding.



Thank You

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