Scientific Writing in English: Techniques and Tools

The Structure of a Scientific Paper
Part II

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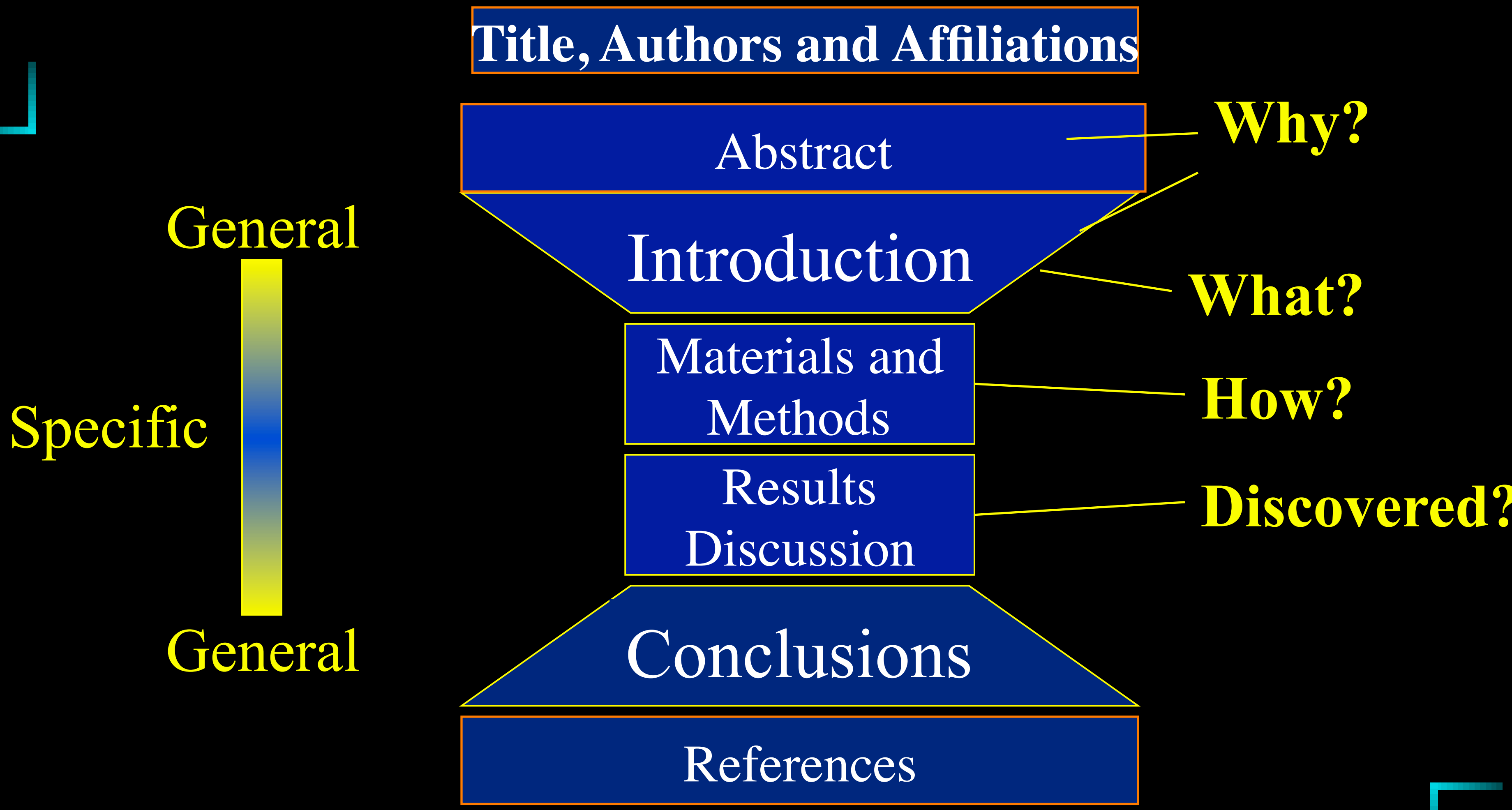
Types of Scientific Publications

- Thesis
- Research Articles
  - Reviews
  - Papers
  - Short Communications/ Letters
- Books
- Encyclopedias

Parts of a Typical Paper

1. Title, Author(s), Affiliations
2. Abstract
3. Introduction: Background, purpose, significance of the problem and "gap"
4. Methods and Materials
5. Results and Discussion
6. Conclusion
7. References

Organization of a Paper



Hill et al., Teaching ESL students to read and write experimental papers, TESOL Quarterly, 16: 333, 1982

Now…

- Discuss each part
  - In detail
    - What makes it up?
    - How?
- One by one …

A paper begins with…

- Title …
- Author(s) …
- Affiliation(s) …

Title

- A good title
  - Describes contents of paper
- Its function:
  - Attract reader's attention

Example

- A paper describing the use of the Expansin protein to generate biofuels

Title Version 1

"Generating Biofuel from a Protein"

>> Poor…Why?

- Too general

Title Version 2

"Obtaining fermentable sugars from lignocellulose using the Expansin enzyme"

Expresses main idea of research:

- Protein used
- End results

- Keywords Included:
  - Expansin, enzyme, fermentable sugars

Title Version 3

"Expansin: a key enzyme in biofuel production"

Expresses main idea of research:

- Protein used
- End results!

- Keywords Included:
  - Expansin, enzyme, biofuel production

Authors

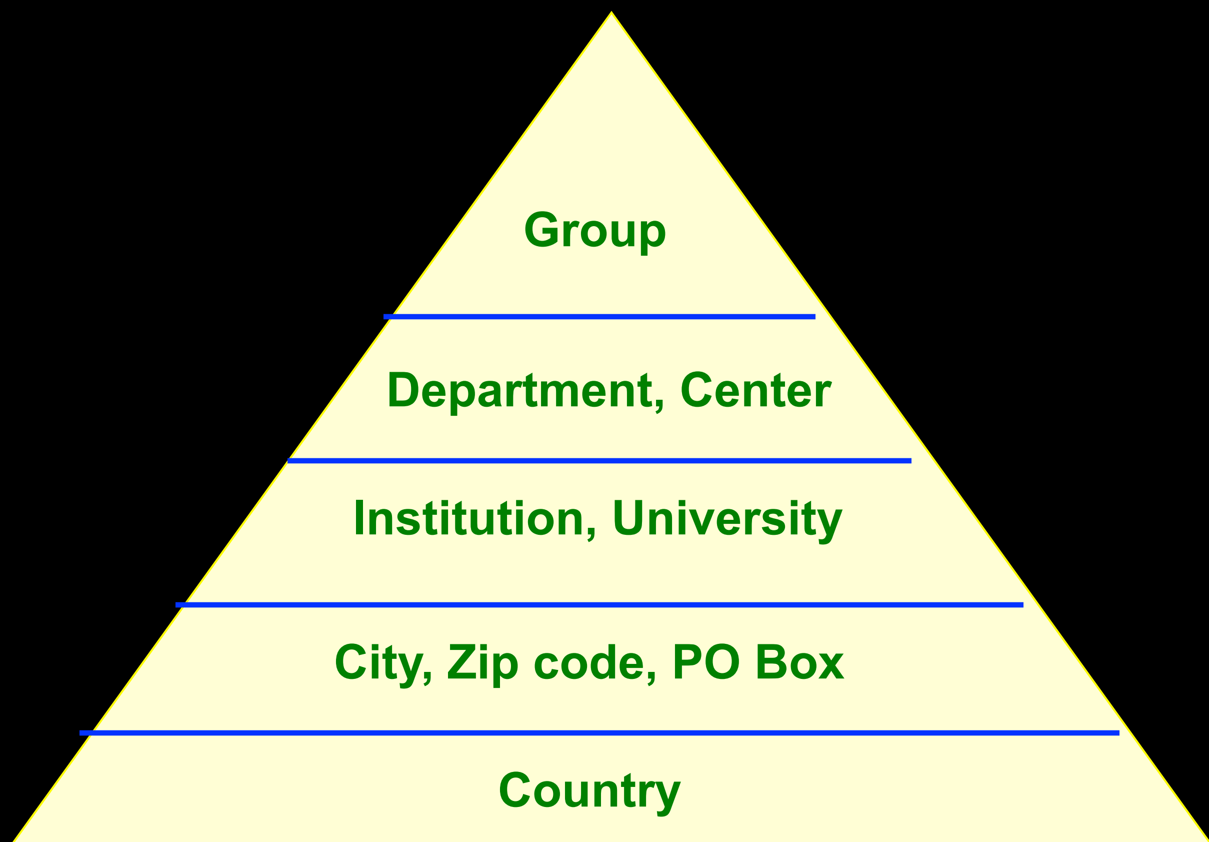
- Who are the authors of a paper?

Authorship: Defined

- All authors must be able to
  - Present
  - Discuss
  - Defend the paper

Affiliations

Usually include this information:



Abstract

Well-written abstract

- allows reader to identify
  - quickly
  - accurately
    - major research contributions

Functions of Abstract

- Summarize major aspects of entire paper
- Most read part of any paper
- ONLY text

Remember…

- Readers decide whether to read whole paper
  - based on Abstract

Types of Abstracts

- Descriptive
  - Describes only nature/purpose
- Informative
  - Contains all relevant information
- Technical

"The Craft of Scientific writing", by Michael Alley

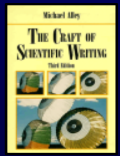
Example

This paper describes a new inertial navigation system for mapping oil and gas wells. In this paper, we will compare the mapping accuracy and speed for this new system against the accuracy and speed for conventional systems.

Descriptive

This paper describes a new inertial navigation system that will increase the mapping accuracy of oil wells by a factor of ten. The new system uses three-axis navigation that protects sensors from high-spin rates. The system also processes its information by Kalman filtering (a statistical sampling technique) in an on-site computer. Test results show the three-dimensional location accuracy is within 0.1 meters for every 100 meters of well depth, an accuracy ten times greater than conventional systems.

Informative



Abstract must address "clearly"

WHY? Missing?

WHAT? Questions investigated

- State *purpose* in first or second sentence

HOW? Experimental *methods*

- Explain design of study
- Describe methods

Abstract must include

ACHIEVED?

Key quantitative *results*

- Report answers to questions addressed
- Identify trends, changes, differences

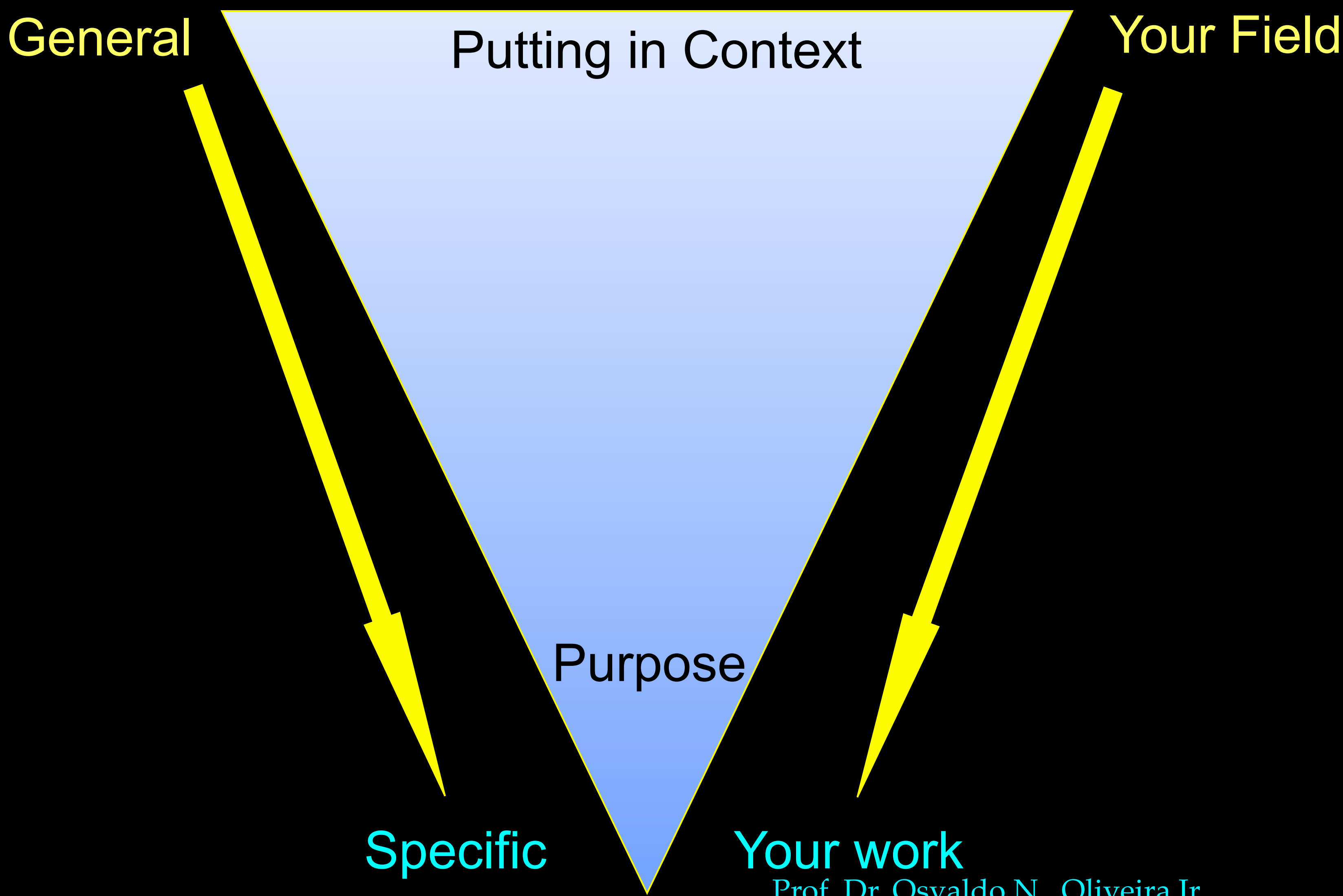
CONCLUSIONS?

- State implications of results

Components of Paper

- Introduction
  - Context
  - “Gap” (= contribution)
  - Purpose
- Methods and Materials
- Results and Discussion
- Conclusion

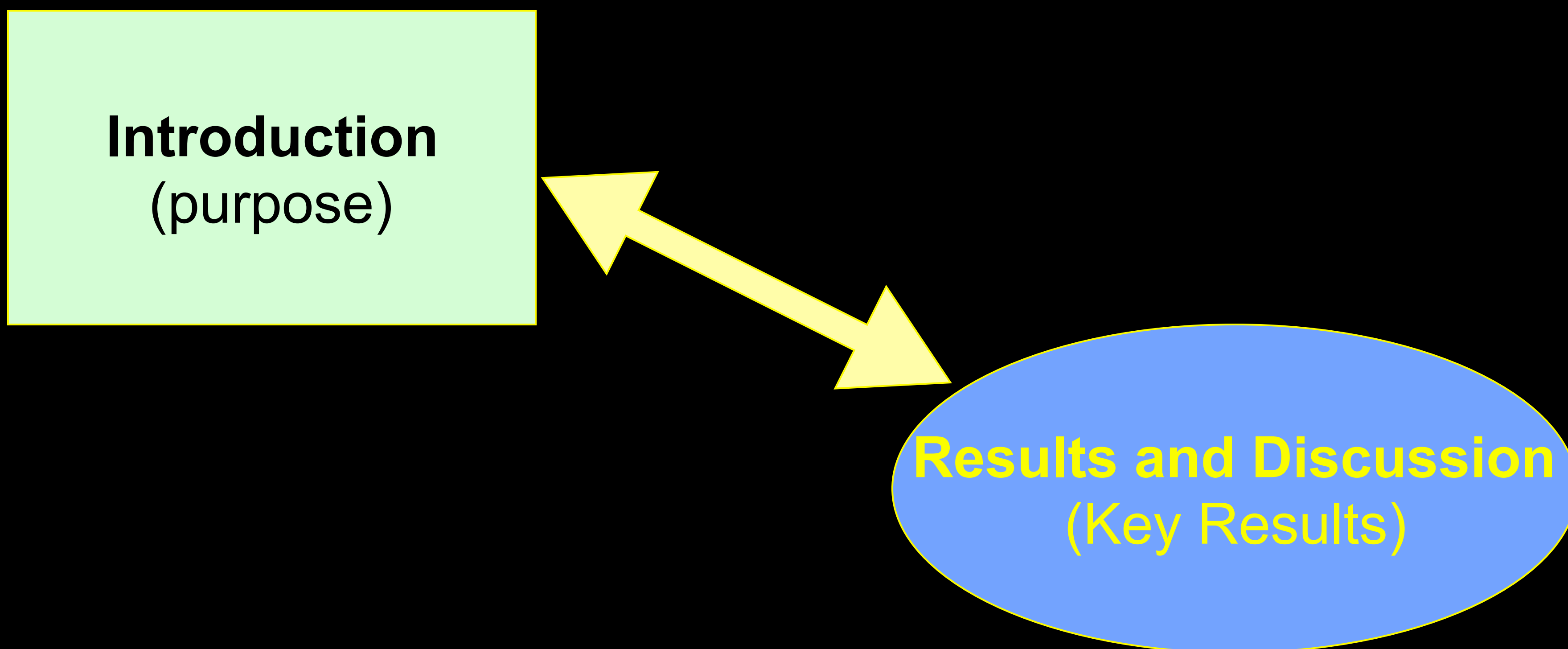
Introduction



Methods and Materials

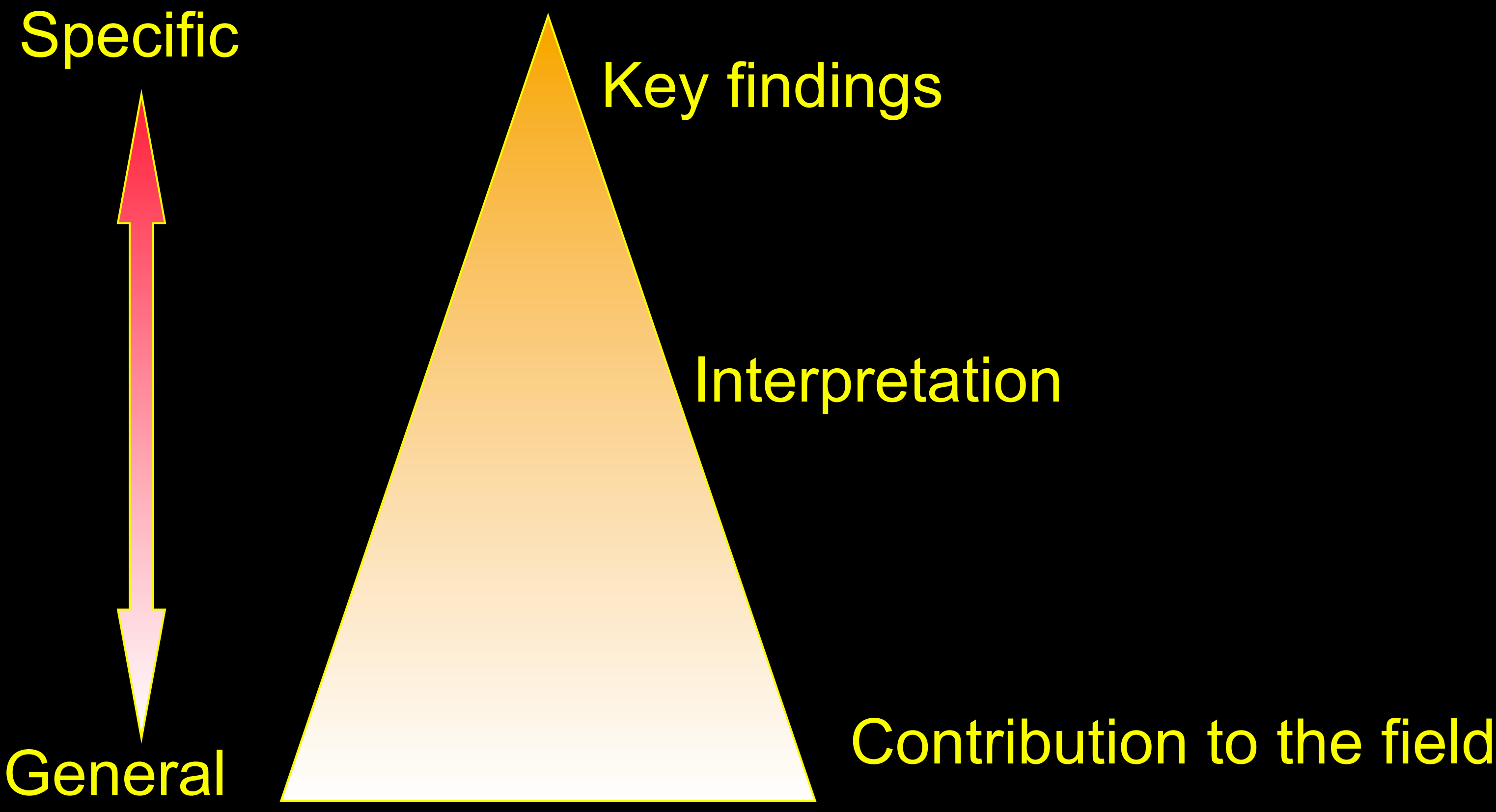
- Materials
  - What was used?
- Procedures
  - Which?
- Equipment
  - What type(s)
- Data analyses
  - Which, how many?

Results and Discussion



Conclusion

Pyramidal Structure



Case studies

- Some examples

Case 1

Self-assembly of components larger than molecules into ordered arrays is an efficient way of preparing microstructured materials with interesting mechanical and optical properties. Although crystallization of identical particles or particles of different sizes or shapes can be readily achieved, the repertoire of methods to assemble binary lattices of particles of the same sizes but with different properties is very limited. This paper describes electrostatic self-assembly of two types of macroscopic components of identical dimensions using interactions that are generated by contact electrification. The systems we have examined comprise two kinds of objects (usually spheres) made of different polymeric materials that charge with opposite electrical polarities when agitated on flat, metallic surfaces. The interplay of repulsive interactions between like-charged objects and attractive interactions between unlike-charged ones results in the self-assembly of these objects into highly ordered, closed arrays. Remarkably, some of the assemblies that form are not electroneutral—that is, they possess a net charge. We suggest that the stability of these unusual structures can be explained by accounting for the interactions between electric dipoles that the particles in the aggregates induce in their neighbors.

G.M. Whitesides et al., *Electrostatic self-assembly of macroscopic crystals using contact electrification,* Nature Materials 2, 241-245 (2003)

Case 1: Components

<context>Self-assembly of components larger than molecules into ordered arrays is an efficient way of preparing microstructured materials with interesting mechanical and optical properties. </context>

<gap> Although crystallization of identical particles or particles of different sizes or shapes can be readily achieved, the repertoire of methods to assemble binary lattices of particles of the same sizes but with different properties is very limited. </gap>

<purpose>This paper describes electrostatic self-assembly of two types of macroscopic components of identical dimensions using interactions that are generated by contact electrification. </purpose>

<method>The systems we have examined comprise two kinds of objects (usually spheres) made of different polymeric materials that charge with opposite electrical polarities when agitated on flat, metallic surfaces</method>
<result>The interplay of repulsive interactions between like-charged objects and attractive interactions between unlike-charged ones results in the self-assembly of these objects into highly ordered, closed arrays. Remarkably, some of the assemblies that form are not electroneutral—that is, they possess a net charge. </result>

<conclusion>We suggest that the stability of these unusual structures can be explained by accounting for the interactions between electric dipoles that the particles in the aggregates induce in their neighbors. </conclusion>

Case 2

A growing number of applications depend on accurate and fast 3D scene analysis. Examples are model and lightfield acquisition, collision prevention, mixed reality, and gesture recognition. The estimation of a range map by image analysis or laser scan techniques is still a time-consuming and expensive part of such systems. A lower-priced, fast and robust alternative for distance measurements are Time-of-Flight (ToF) cameras. Recently, significant improvements have been made in order to achieve low-cost and compact ToF-devices, that have the potential to revolutionize many fields of research, including Computer Graphics, Computer Vision and Man Machine Interaction (MMI). These technologies are starting to have an impact on research and commercial applications. The upcoming generation of ToF sensors, however, will be even more powerful and will have the potential to become “ubiquitous real-time geometry devices” for gaming, web-conferencing, and numerous other applications. This STAR gives an account of recent developments in ToF-technology and discusses the current state of the integration of this technology into various graphics-related applications

Kolb, Andreas, et al. "Time-of-flight sensors in computer graphics." *Proc. Eurographics (State-of-the-Art Report)*. 2009.

Case 2: components

- Let's do it!
  - Context?
  - Gap?
  - Purpose?
  - Method?
  - Result?
  - Conclusion?

Reference

- Kolb, Andreas, et al. "Time-of-flight sensors in computer graphics." *Proc. Eurographics (State-of-the-Art Report)*. 2009. http://www.inb.uni-luebeck.de/publikationen/pdfs/KoBaKoLa09.pdf

- Categories and Subject Descriptors (according to ACM CCS): I.3.7 [Computer Graphics]: Three-Dimensional
- Graphics and Realism I.3.8 [Computer Graphics]: Applications

Case 3

Dendrimers are branched, synthetic polymers with layered architectures that show promise in several biomedical applications. By regulating dendrimer synthesis, it is possible to precisely manipulate both their molecular weight and chemical composition, thereby allowing predictable tuning of their biocompatibility and pharmacokinetics. Advances in our understanding of the role of molecular weight and architecture on the *in vivo* behavior of dendrimers, together with recent progress in the design of biodegradable chemistries, has enabled the application of these branched polymers as anti-viral drugs, tissue repair scaffolds, targeted carriers of chemotherapeutics and optical oxygen sensors. Before such products can reach the market, however, the field must not only address the cost of manufacture and quality control of pharmaceutical-grade materials, but also assess the long-term human and environmental health consequences of dendrimer exposure *in vivo*.

Lee C. C., *et al., Designing dendrimers for biological applications,* Nature Biotechnology 23, 1517 – 1526 (2005) *(Review)*

Case 3: components

<context>Dendrimers are branched, synthetic polymers with layered architectures that show promise in several biomedical applications. By regulating dendrimer synthesis, it is possible to precisely manipulate both their molecular weight and chemical composition, thereby allowing predictable tuning of their biocompatibility and pharmacokinetics. Advances in our understanding of the role of molecular weight and architecture on the *in vivo* behavior of dendrimers, together with recent progress in the design of biodegradable chemistries, has enabled the application of these branched polymers as anti-viral drugs, tissue repair scaffolds, targeted carriers of chemotherapeutics and optical oxygen sensors.</context>

<gap>Before such products can reach the market, however, the field must not only address the cost of manufacture and quality control of pharmaceutical-grade materials, but also assess the long-term human and environmental health consequences of dendrimer exposure *in vivo*.
</gap>

Case 3

- Context + Gap
- What type of abstract?
  - Descriptive or
  - Informative?

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