Developing Student Confidence with Science and Engineering Practices

Science from Scientists
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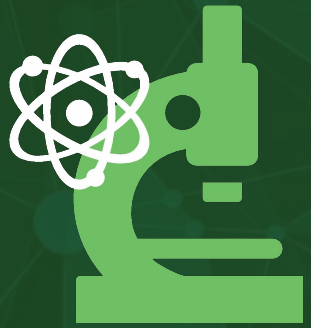
Agenda

- Introductions
- Background on SEPs
  - Scaffolding
- Planning and Carrying out an Investigation
  - DNA Extraction
  - Adjusting the lesson
- Small group activity
- Wrap up/ questions

Science from Scientists (SfS) is an award-winning nonprofit that brings real scientists into schools to teach hands-on STEM lessons.

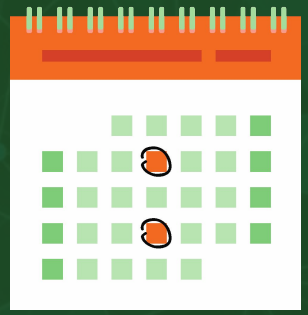
We seek to inspire students, ignite interest, and improve short- and long-term STEM outcomes for every student we reach.

The Classroom Experience



During School

Role-Model Scientists



Multi-Touch Model

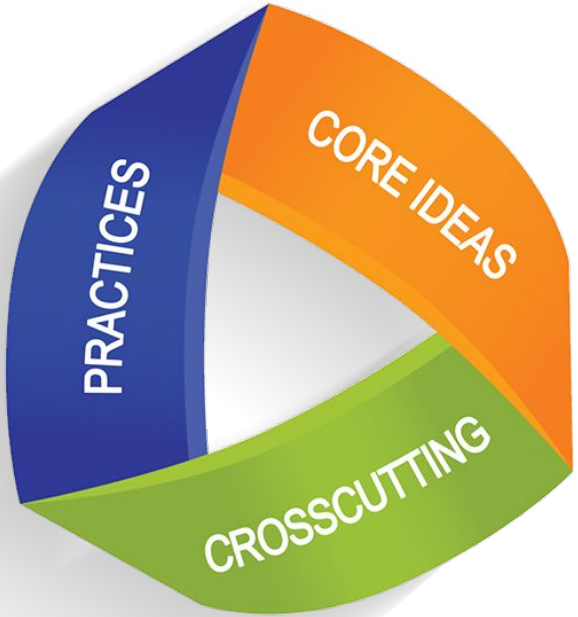
Measurable Impact

Welcome!

Please introduce yourself:

- Name/pronouns
- School
- Grade taught
- Great summer read?

Next Generation Science Standards - Three Dimensional Learning



- Science and Engineering Practices (SEPs)
- Crosscutting Concepts (CCCs)
- Disciplinary Core Ideas (DCIs)

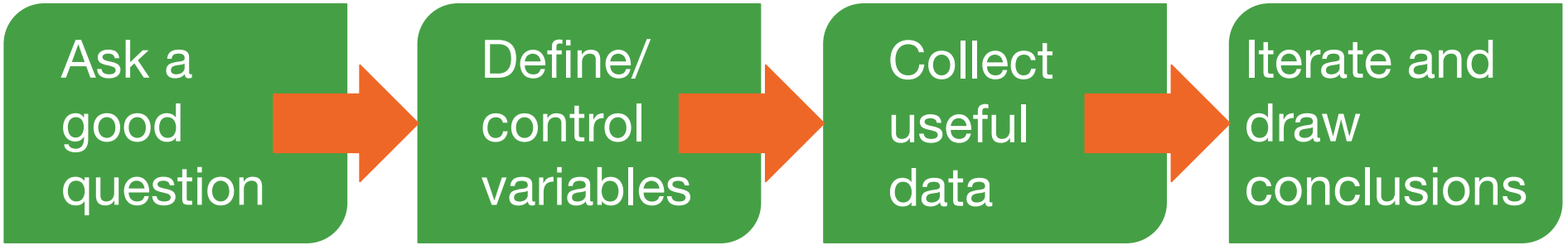
Science and Engineering Practices

- *Asking questions*
- *Plan and carry out investigations*
- *Analyze and interpret data*
- *Use math and computational thinking*
- *Develop and use models*
- *Construct explanations/Design solutions*
- *Argue from evidence*
- *Obtain, evaluate, and communicate information*

…what scientists and engineers do

Planning and Carrying out an Investigation

What does this SEP include?



SEPs are a progression

Planning and Carrying out an Investigation

K-2

With guidance, plan and carry out an investigation with peers

Evaluate different methods to decide which one will answer a question

Take data to make comparisons

Make predictions based on prior experience

3-5

Builds on the K-2 abilities

Adds the concepts of controlling some variables

Make predictions about what would happen if a variable were changed.

Share results and ideas about their observations (use results to explain)

6-8

Extends K-5 concepts to include independent and dependent variables

Revise an experimental process (or design collaboratively/individually)

Predict how data could be affected with using different tools

Strategies for scaffolding

- Start small - Ask students to do only one aspect of the process
- Model the process
- Use graphic organizers to help students keep track of the steps
- Work in groups
- Do part of the activity as a large group and part as a small group
- Focus on simple achievable activities
- Use sentence frames - use the same language each time

DNA Extraction

Let’s get started…

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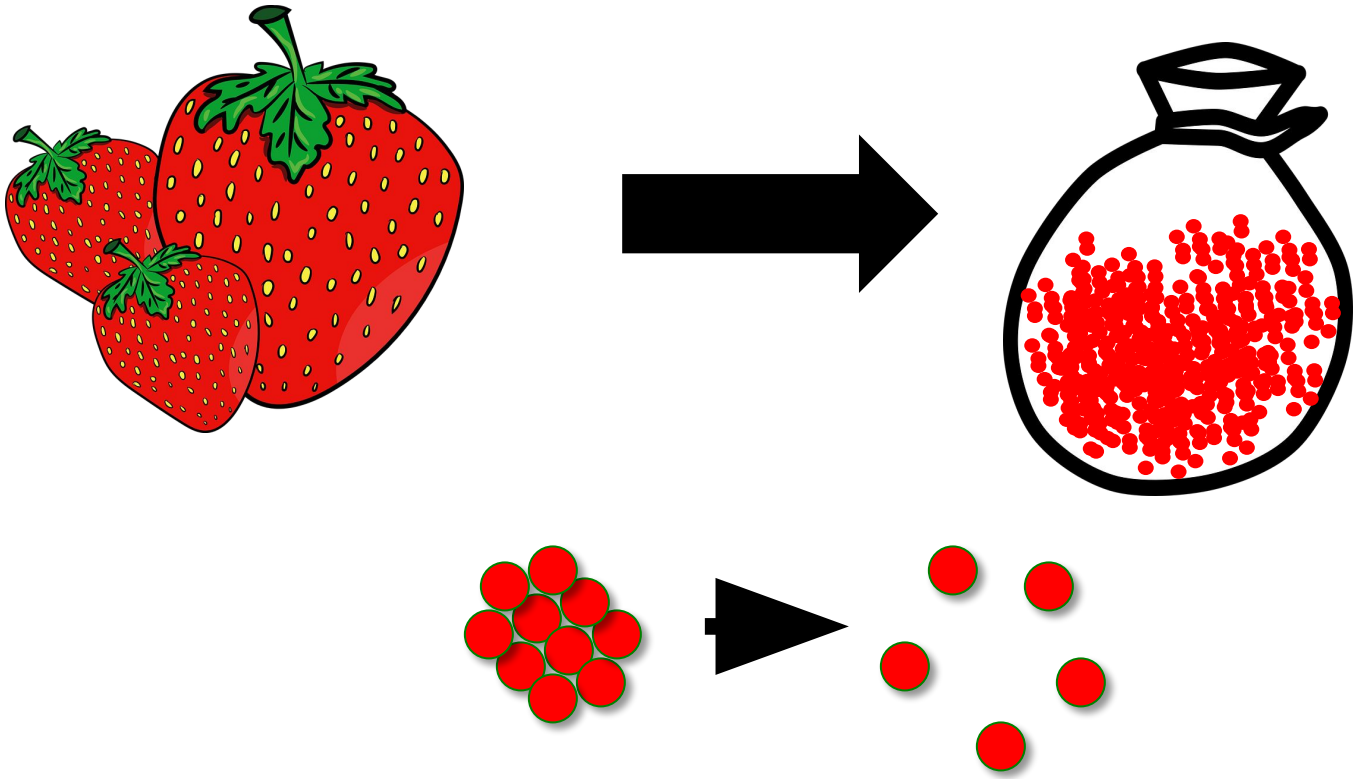
DNA: What is it and what does it do?

How would you isolate the DNA?

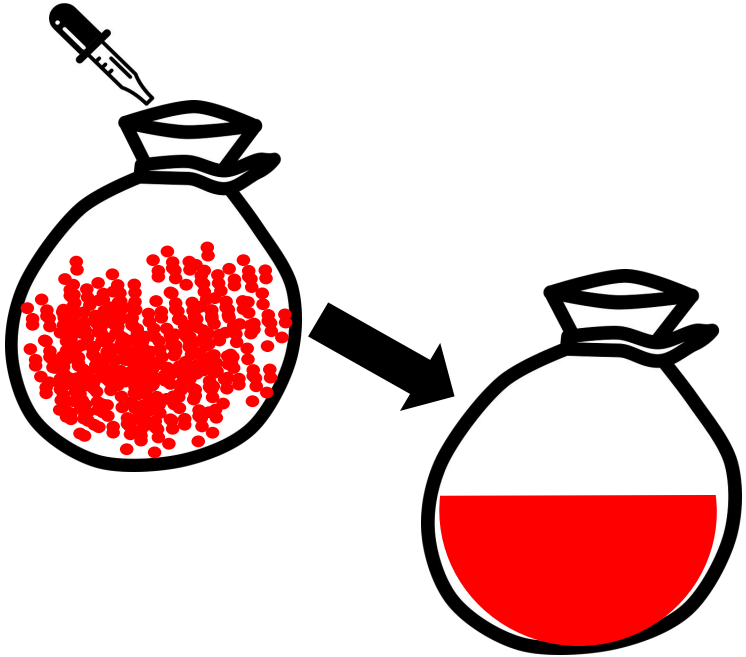
Separating the Cells

Step 1: Separate the cells by mashing

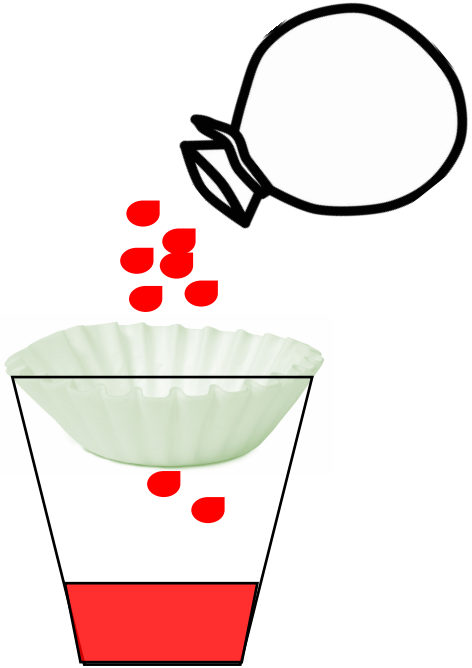


Releasing the DNA from the Nucleus

Step 2:
Add detergent to break up cell membranes and release DNA

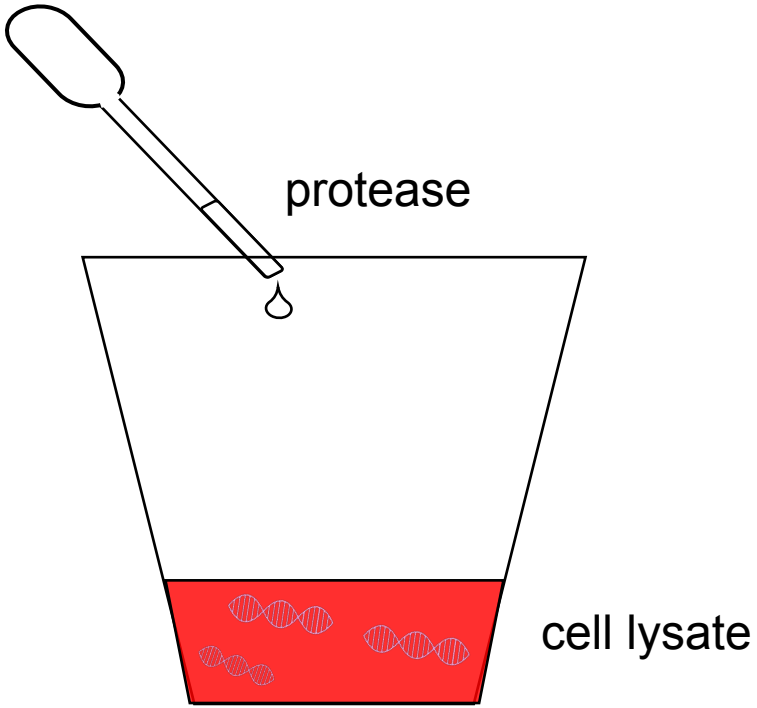


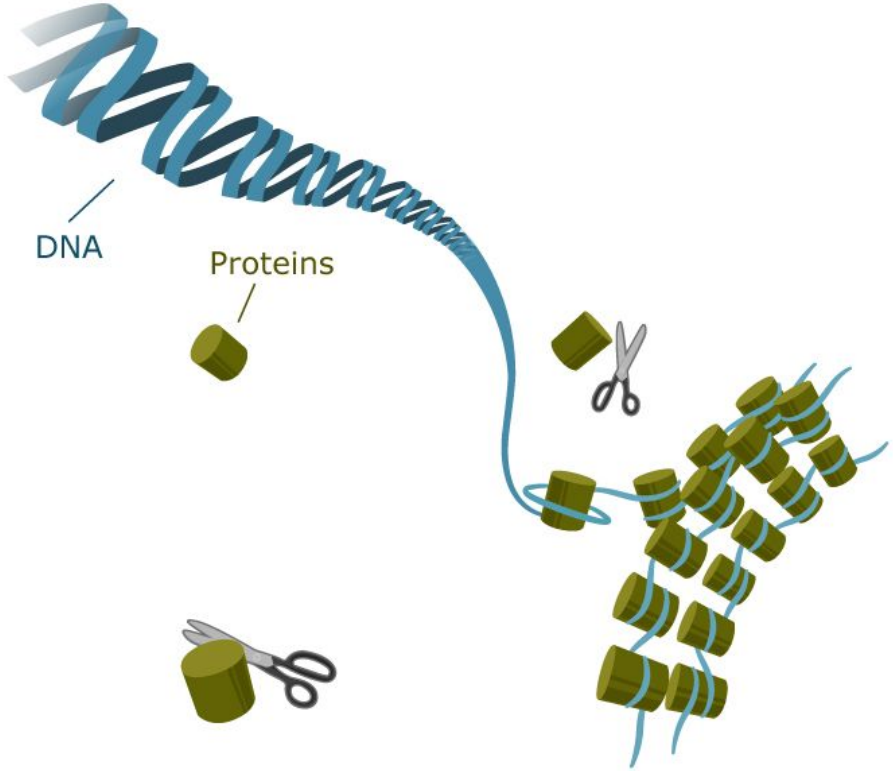
Step 3:
Strain out the solids and clumps with a strainer or filter paper.



Removing the Histone Proteins

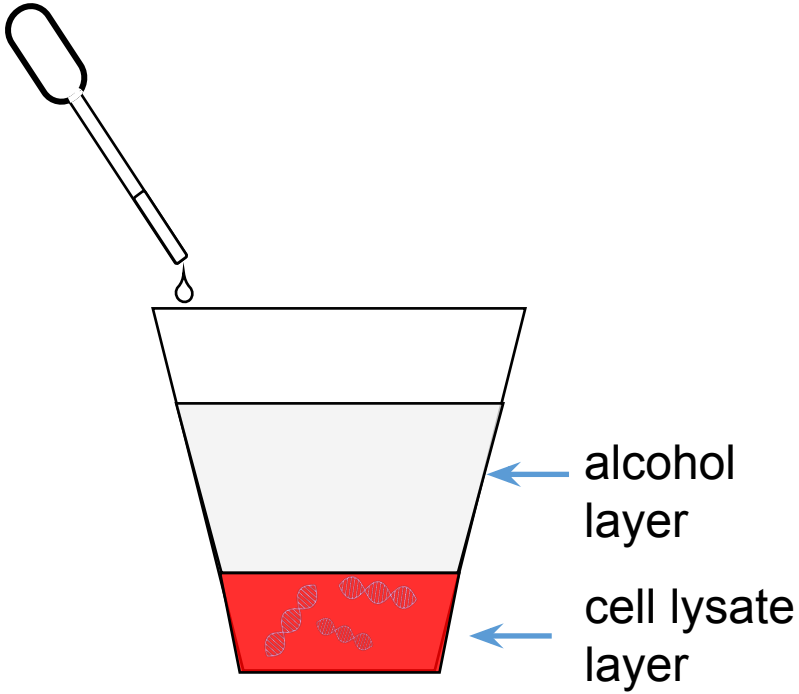
Step 4:
Add enzymes called proteases to cut away DNA-bound proteins (histones).





Precipitating and Collecting the DNA

Step 5:
Slowly add alcohol to precipitate the DNA from the liquids.



Step 6:
Wait a few minutes then wrap your precipitated DNA around the toothpick to observe.

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Extends K-5 concepts to include independent and dependent variables

Revise an experimental process (or design collaboratively/individually)

Predict how data could be affected with using different tools

How can we adjust the activity?

K-2

Make the steps easier - sort the cards by smash up the fruit, break into the cells, separate the DNA from everything else, get the DNA out.

3-5

Sort the steps with more complexity

Make predictions about changing the order of the steps

Evaluate the process

Compare my results to your results

6-8

Take the protocol and revise it to answer another question

Would using a different fruit result in more/less DNA

How long do you need to mash the fruit in order to maximize DNA

How does the concentration of the solutions affect the amount of DNA collected?

Small group work

In your group, look at the activity.

- **What could you do to focus on the Planning and Carrying out an Investigation SEP?**
- **What modifications would you make to match the abilities of each age group? (K-2, 3-5, 6-8)**

Resources

- Planning and Carrying out an Investigation - grade level expectations
- Graphic Organizers for SEPs/CCCs
- Sentence frames for SEPs
- Investigation Strategies
- Appendix F - Science and Engineering Practices

Thank you!!

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