Physics Invention Sequences Users' Guide: Electric Field

ELECTRIC FIELD INVENTION SEQUENCE

Includes: *family contribution index* (characterizing a location), electrical influence index (magnitude of the electric field)

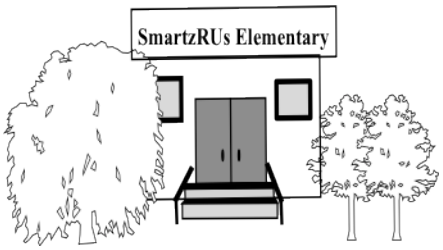
Teacher Notes: Electric field is a particularly abstract quantity. As a field descriptor, it characterizes a location rather than an object. It is a vector quantitiy, and it is a unit rate of another abstract quantity - electric charge. This sequence first introduces the concept of characterizing space, and then applies that concept to characterizing a location based on the net electrical force that a charged object would experience. The last activity can be omitted if time is an issue – it is a short, fun application that acclimates students to thinking about their newly invented electric influence index neither as net force nor charge but as the ratio of the two and therefore a different quantity.

Levels: This sequence is appropriate for college level and any advanced HS course that teaches electric field.

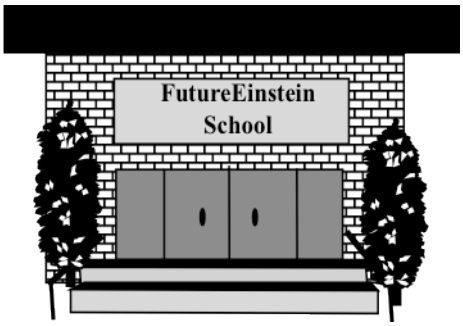
Family contribution index

Each school below holds a car-wash several times during a year to raise funds for new playground equipment. Your job is to find a "family contribution index" to compare the fundraising between schools. This index cannot be simply how much money is raised: although though bigger schools raise more, they also need more equipment.

Construct a family contribution index number for each school. Make sure that a bigger index means that the school is more effective at fundraising.



30 families contributed $600

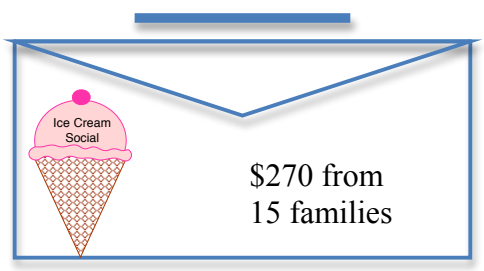


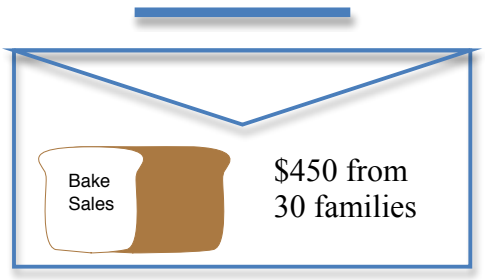
80 families contributed $1200

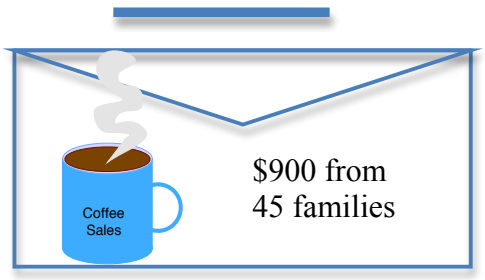
20 families contributed $360

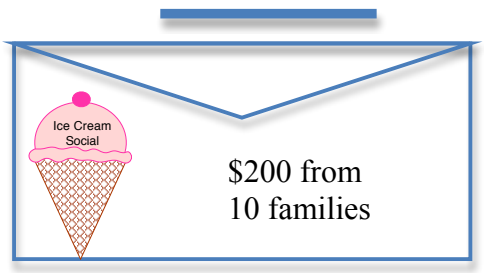
Name that school!

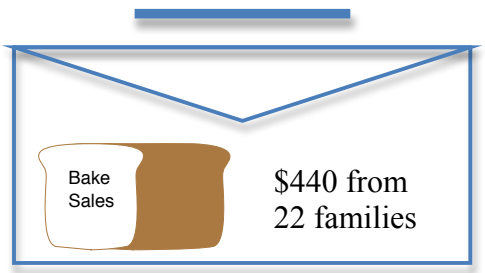
The superintendent of the school district has a big problem on his hands and he needs your help. Well meaning parents delivered the fundraising envelopes to his office for each school's fundraiser, but they didn't put their school's name on the envelope! Sort the envelopes for the various fundraisers. (You can write the school's initials above the envelope: SRU, FE, or LA.)

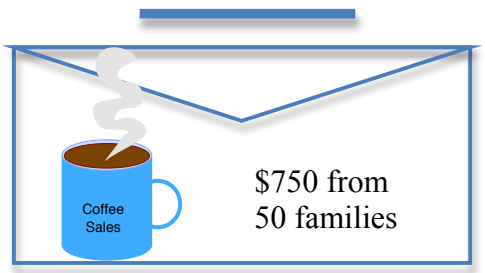












Follow-up questions: Predicting the future

1. Which makes the most sense as a way to describe this index, characterizing the rate at which a process occurs over time, or characterizing what's going on at a location in space?

Let's assume that the number of families at the school can change from year to year, but that the index doesn't change. Make the following predictions:

2. Future Einsteins have a goal for raising $1000 in coffee sales next year. How many families will have to participate in that fundraiser in order for them to meet their goal?

3. Learnalot Academy's number of families will go down by 10% next year. How much can they count on raising at their next ice cream social?

4. SmartzRUs will have a 20% increase in their population, how much can they plan on raising at next year's car washes?

Electrical influence index

Your task is to devise an *Electrical Influence Index*. Imagine that a charged particle (called the "probe particle") is placed at some location in space, and experiences an electrical force from a collection of other charges that are arranged in some unknown way in the general vicinity. Come up with one number to stand for the electrical influence at each of the three locations.

- Make sure the index describes the location, not the probe charge.
- Different locations may have different index values, or they may be the same.

LOCATION 1

Net charge of 2 units experiences a force of 50 N

LOCATION 2

Net charge of 3 units experiences a force of 60 N

LOCATION 3

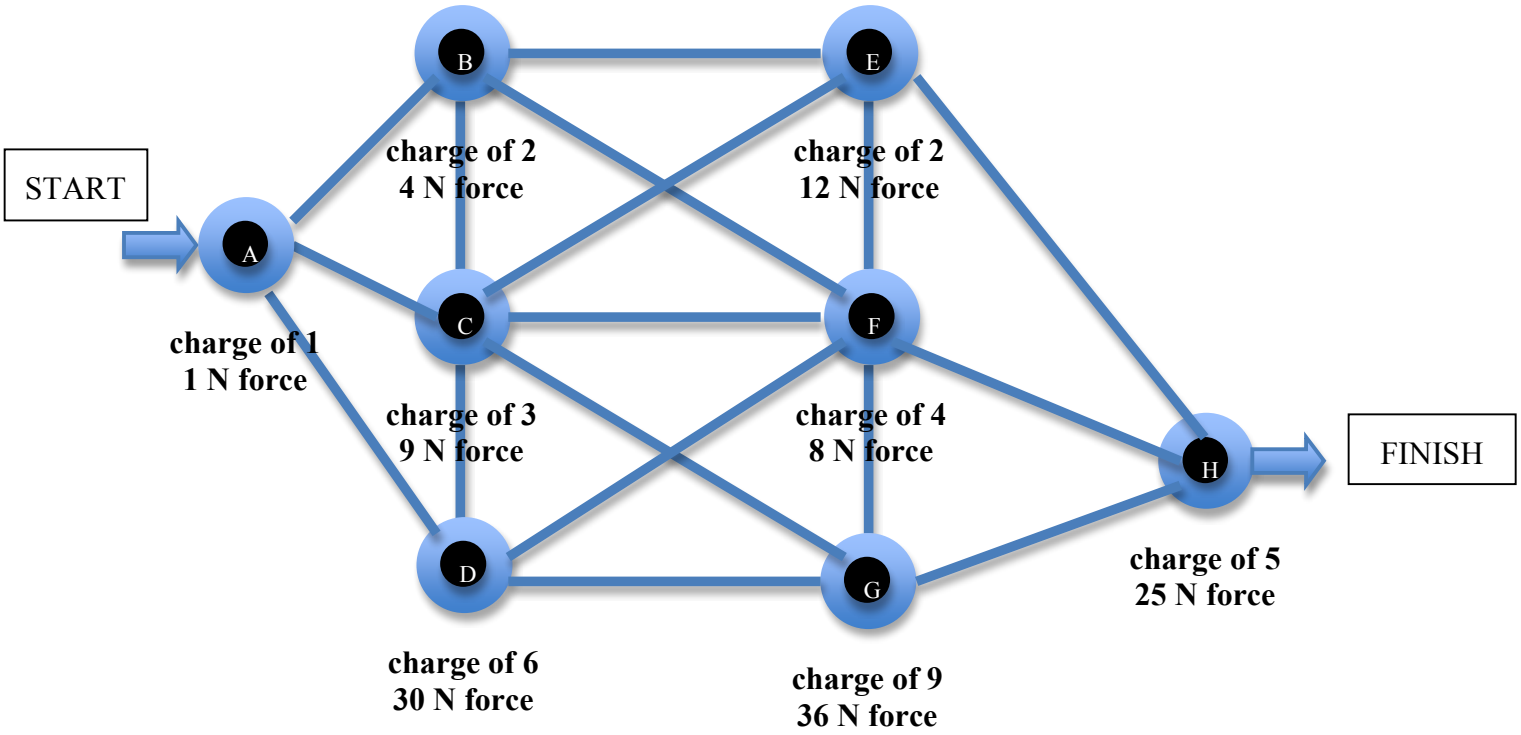
Net charge of 4 units experiences a force of 80 N

	Location 1	Location 2	Location 3
Electrical Influence Index			

Provide an *interpretation* of the electrical influence index. In everyday terms, what does its value tell you about the location?

Follow up: Seeing in the dark

Big Tough Fun-Plex is a new indoor sports facility that just opened up with paintball, laser tag, etc. Their new attraction is a competitive game called Dark Charge that is a completely darkened human maze. Each team has a hand-held instrument that has a mildly charged probe and measures how much electrical force the probe feels. To make the game interesting, the charge of the probe changes at each check-point. The check-points increase in *Electrical Influence Index* as you get closer to the exit. Which of the following paths should you follow if you want to win this game?



III Summer Job Interview

You're such a master at Dark Charge, that the Big Tough Fun-Plex wants to interview for a job calibrating their maze. As a test, they want you to complete the table below

Check-point	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Net Charge	5 units			3 units	3 units			
Force		12 N	12 N			16 N	2 N	5 N