

# Lawrence Berkeley National Laboratory

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### **Title**

Ergonomics in the Biosciences

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# **Ergonomics in the Biosciences**



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Lawrence Berkeley National Laboratory***



LOUIS STOKES LABORATORIES, NIH

"What the cathedral was to the 14th century and the office building was to the 20th century, the laboratory is to the 21<sup>st</sup> century."

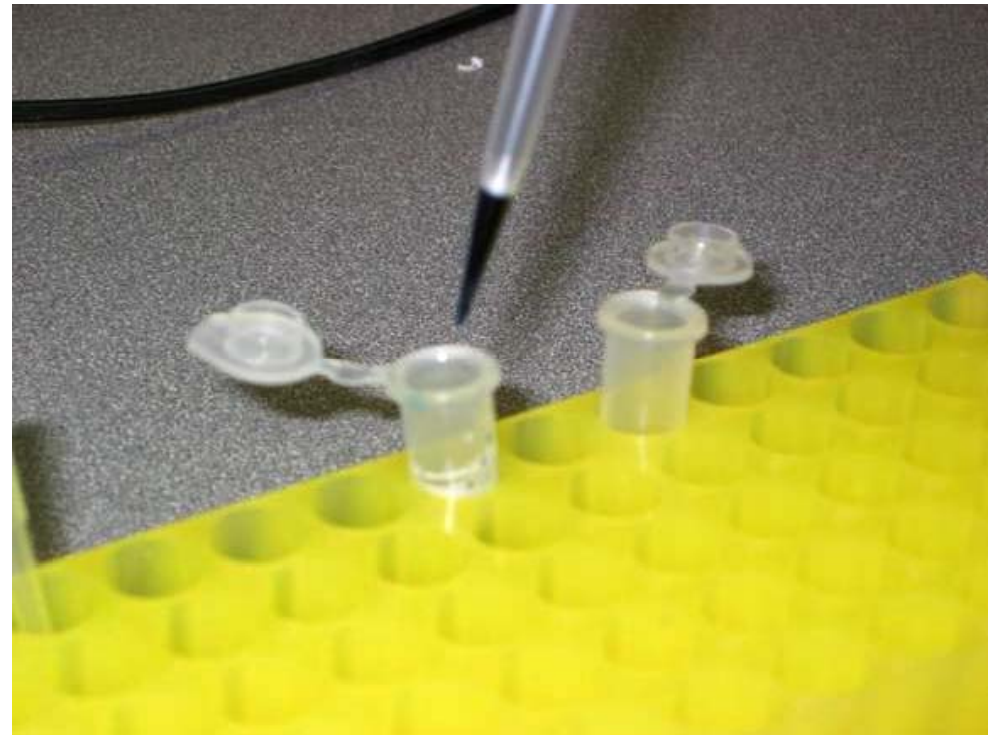
Don Prowler, LS&EM Conference, 2001

# Ergonomics Risk Factors



Many lab activities involve repetitive, forceful pinching in awkward postures

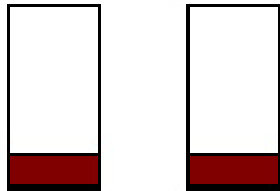
# High precision demand





# Static postures → Fatigue, Contact stress

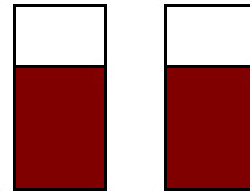
**Resting Muscles**



Blood Needed

Blood Flow

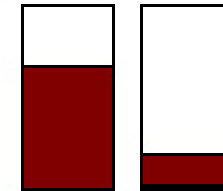
**Dynamic Work**



Blood Needed

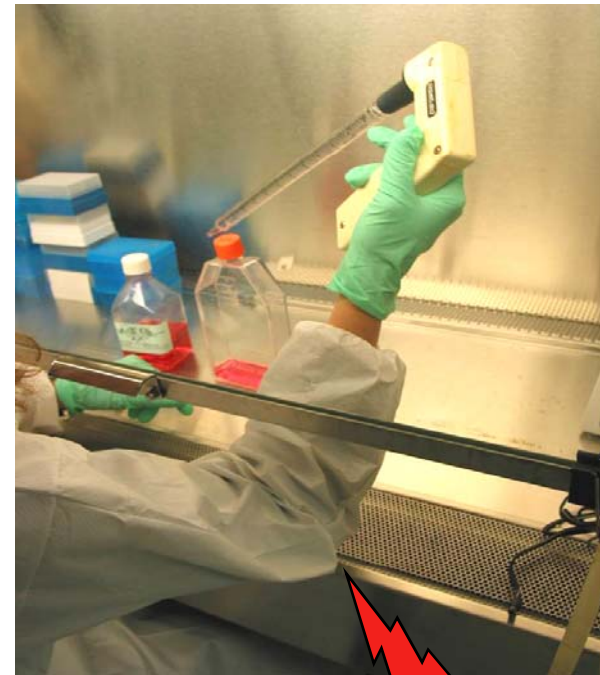
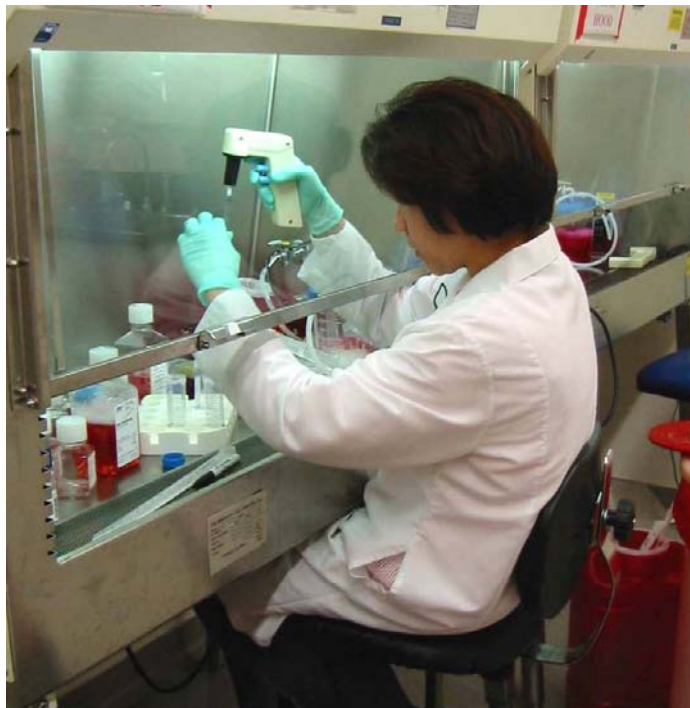
Blood Flow

**Static Work**



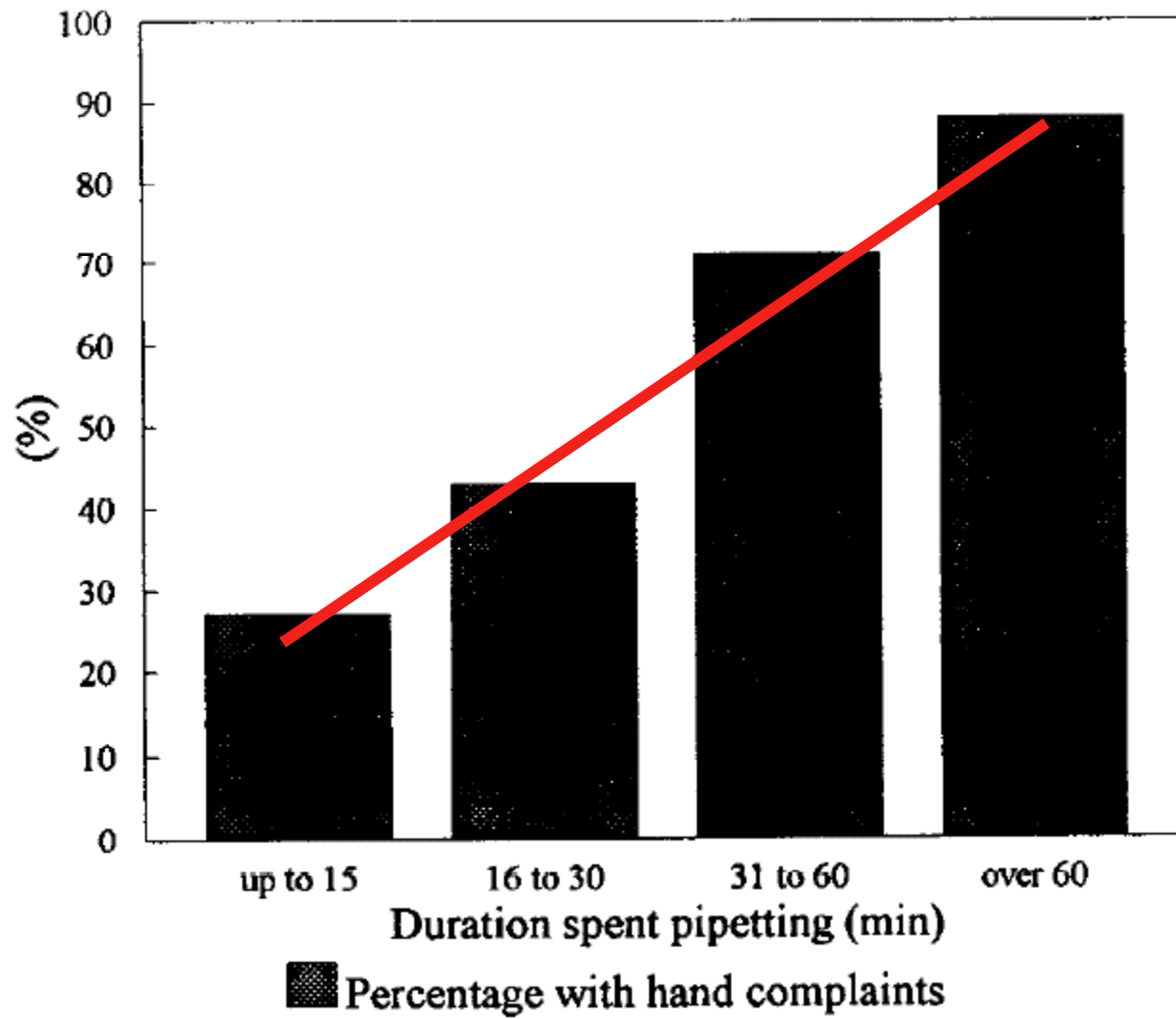
Blood Needed

Blood Flow



# Manual Pipetting

- Frequent use (>300 hrs/yr) associated with high risk of hand & shoulder problems
- Elevated rates MSDs (Bjorksten, 1994)
  - Hand problems (OR 5.0)
  - Shoulder problems (OR 2.4)
- Increased risk (David & Buckle, 1997)
  - pipetting > 1-1.5 hours per day



David & Buckle, Applied Ergonomics, 28:4, 1997



# Microscopy

- 85% of cytotechnologists with musculoskeletal symptoms: headache, neck pain/stiffness, back pain, upper-extremity discomfort.
- numbness, tingling, and/or pain in the fingers:  $>1/3$  Left,  $1/2$  Right

(Thompson, 2003)



## Musculoskeletal Problems Reported by Microscope Users

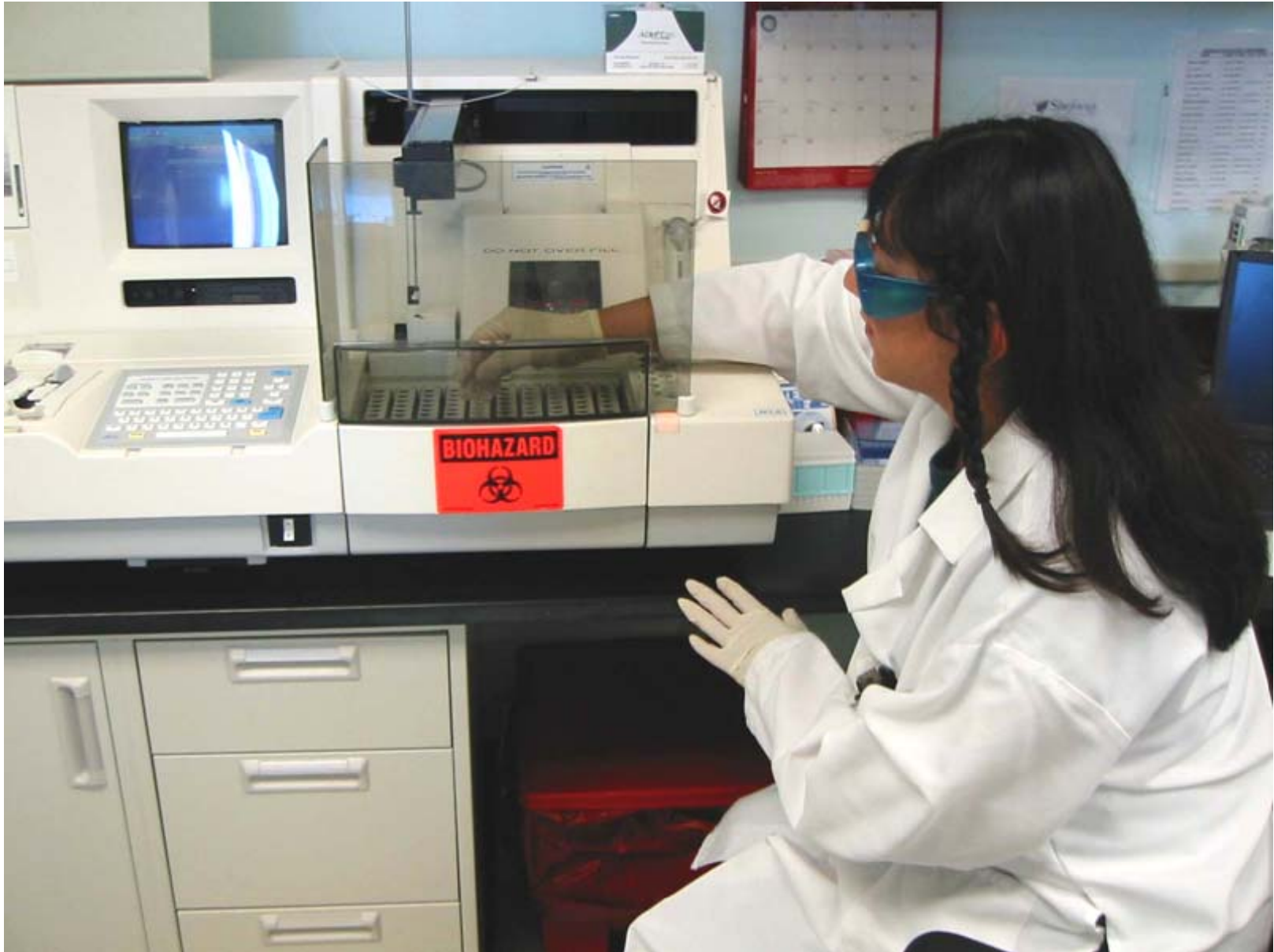
Anatomical Location	Employee Percentage
Neck	50-60
Shoulders	65-70
Back (Total)	70-80
Lower Back	65-70
Lower Arms	65-70
Wrists	40-60
Hands and Fingers	40-50
Legs and Feet	20-35

Workstation adjustability is a key factor in our ability to adapt work areas to the constantly changing people, task, and equipment in the lab environment.

“Biosafety cabinets and laboratory workbenches ...present ergonomic hazards which are mostly due to ***lack of adjustability & leg room.***”

CDC, Laboratory Ergonomics website, 9-24-07  
<http://www.cdc.gov/od/ohs/Ergonomics/labergo.htm>





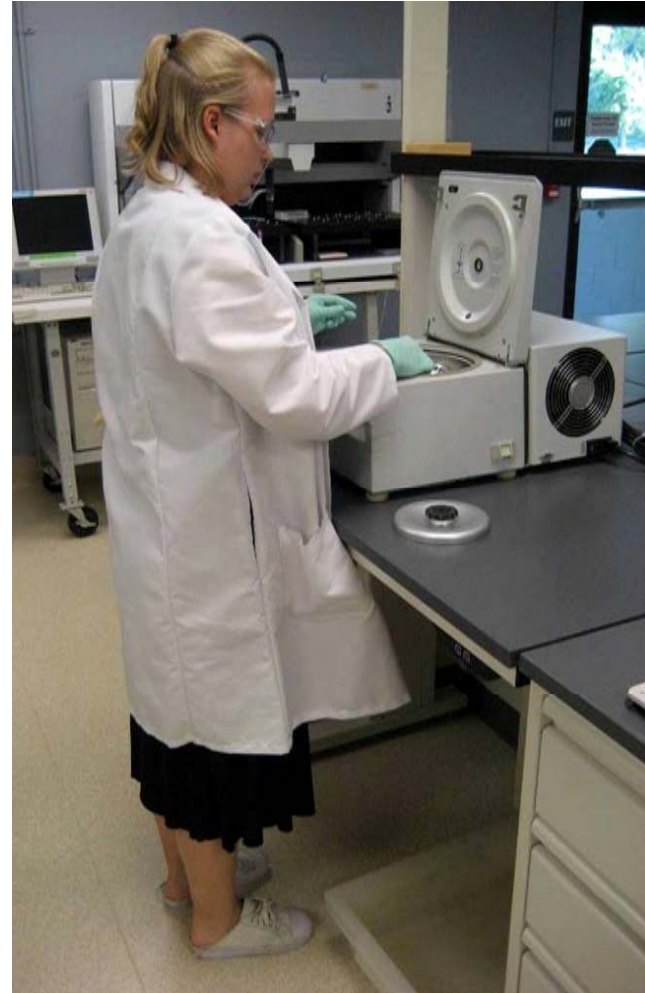


***Where should  
things go?***

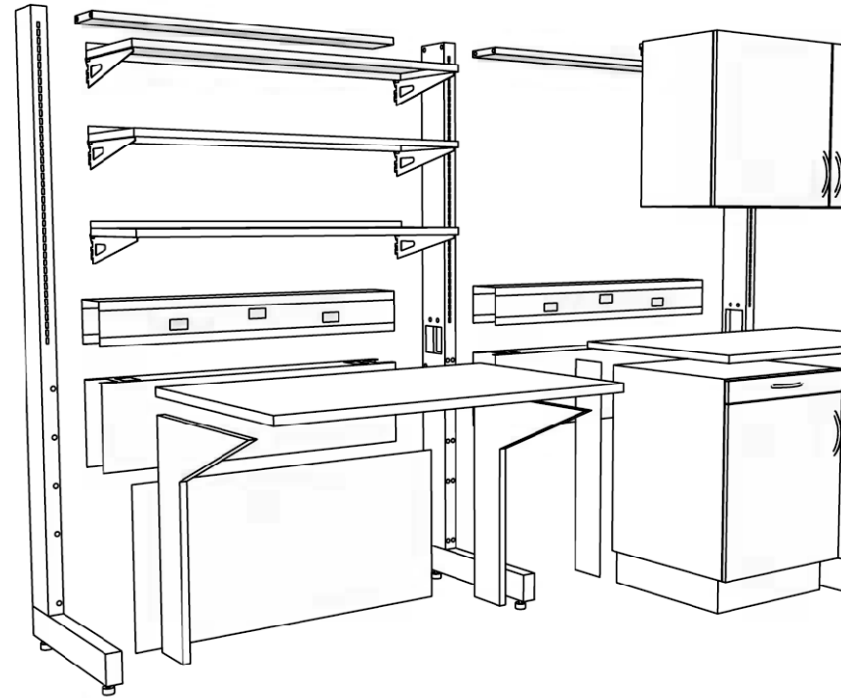




# Height adjustability adapts to changes in equipment and technology over time



# Modular lab furniture

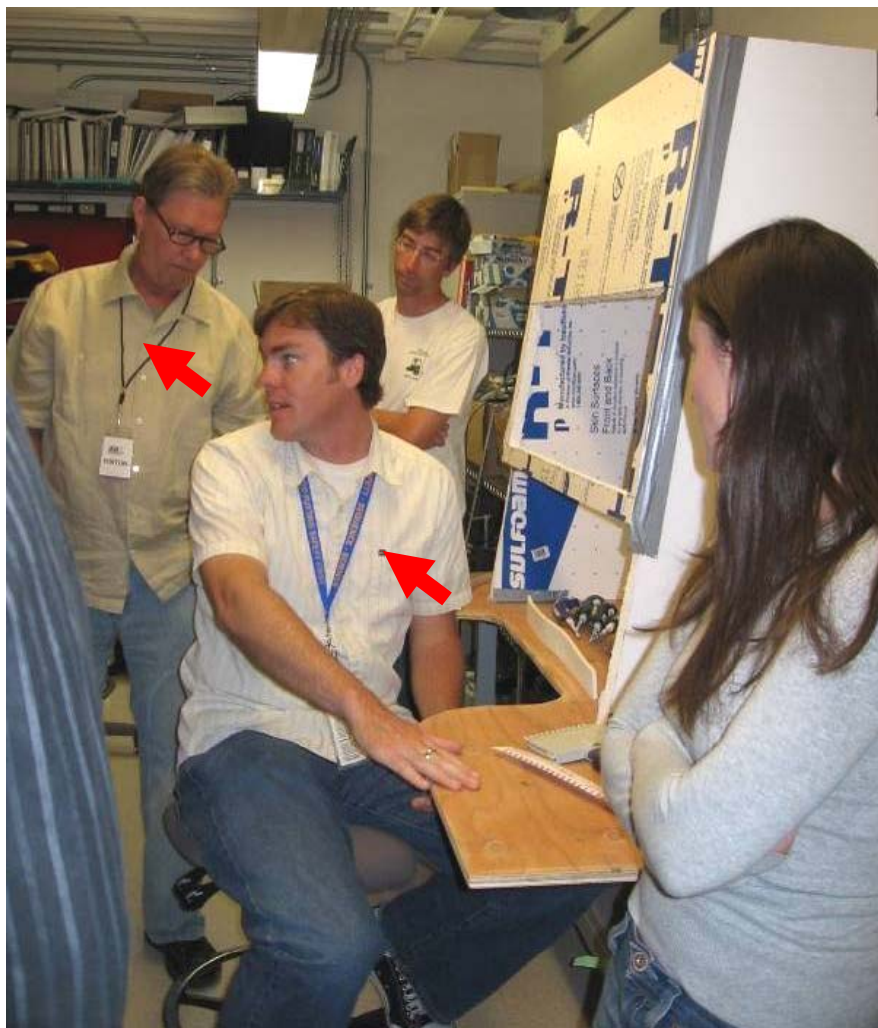


Bench top DNA Hood before ergo modification:  
Inadequate legroom & long reach distances →  
flexed back and awkward neck/shoulder posture





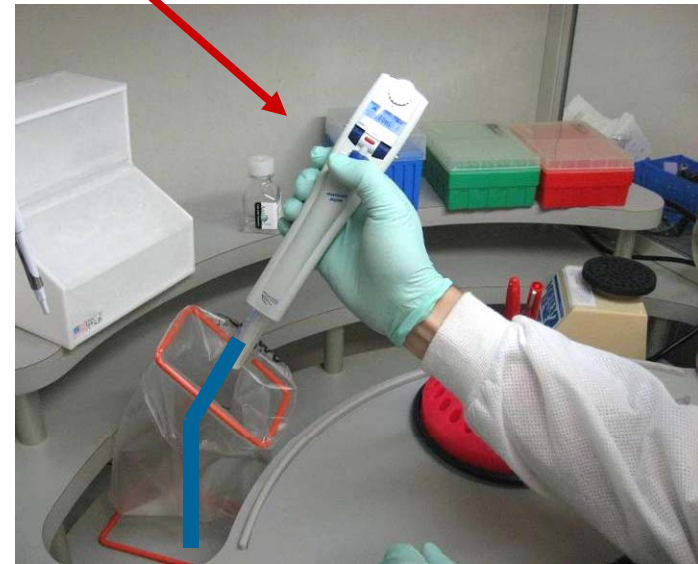
# Early mock-ups for 454 group input & collaboration w/ Ergo Team (June 07)



# Bench top DNA Hood design

Ergonomic features:

1. Recessed area & tilted receptacles reduce awkward wrist postures
2. Padding protects elbows & forearms
3. Programmable pipette (Eppendorf Xstream) improves hand position, reduces force & repetitive movement





[www.jha-techspace.com](http://www.jha-techspace.com)





SOMA Hybrid chair



# References

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# JGI Ergonomics Program



“A recipe for success to improve worker safety and health”

Presented by  
Melanie Alexandre  
and  
Christine Naca

# Overview

- Description of the JGI
- Review of Production Tasks
- JGI Ergonomics Program



- Walnut Creek, CA-located PGF opened in 1999
- ~250 employees

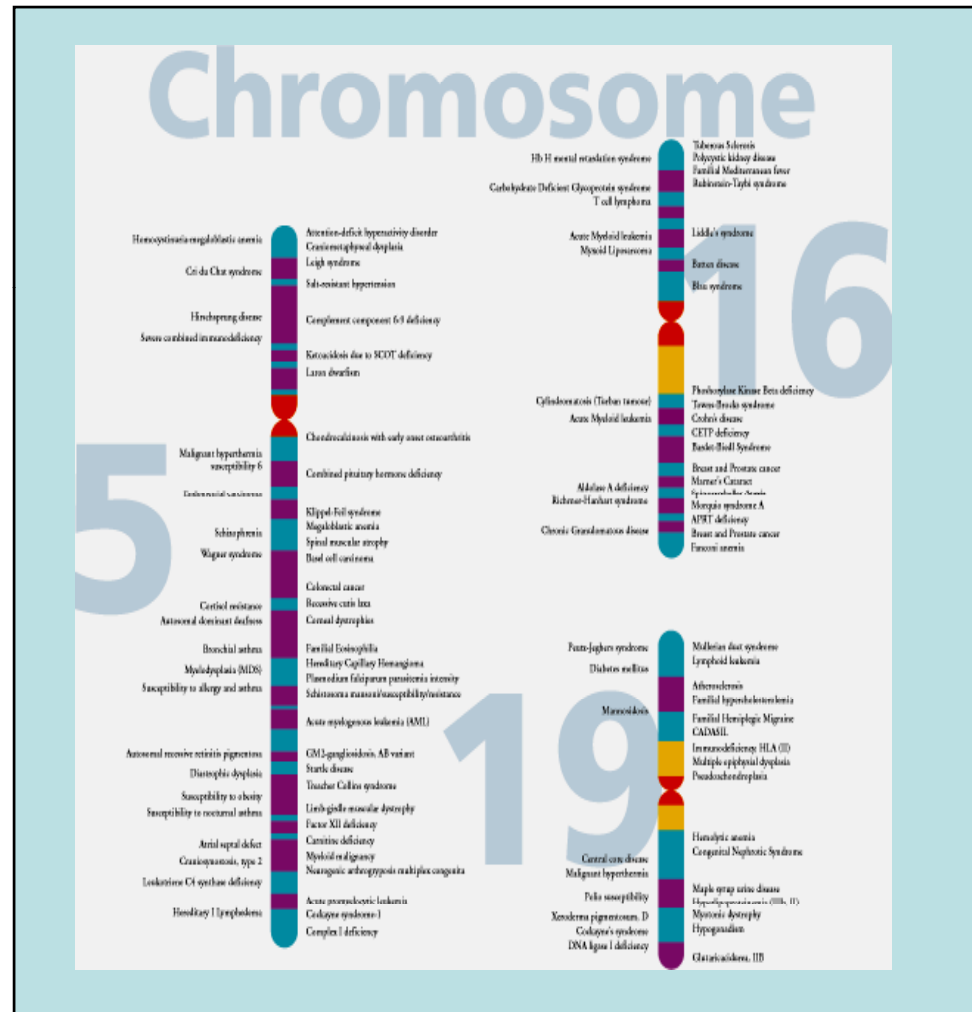
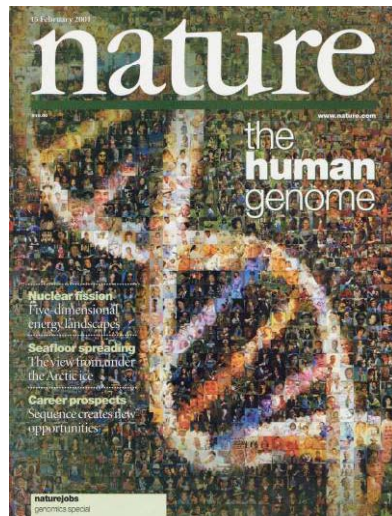


***Mission:***

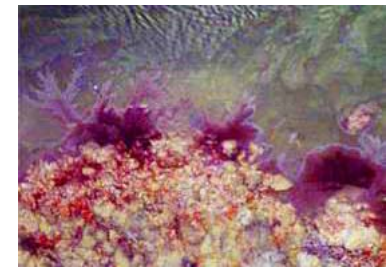
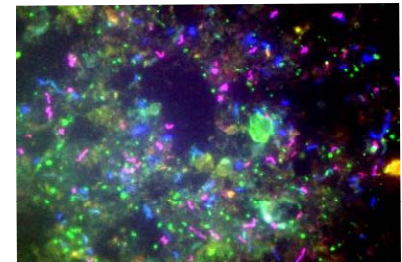
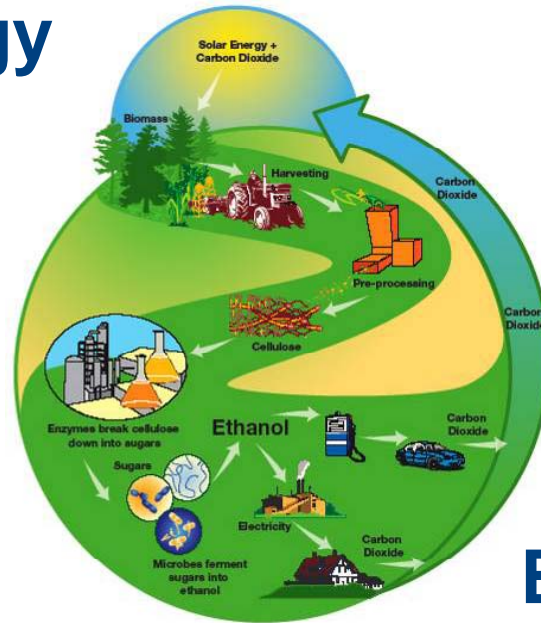
***DOE JGI, Serving as a genomic user facility in support of the DOE missions:***

***bioenergy, carbon cycling, and bioremediation.***

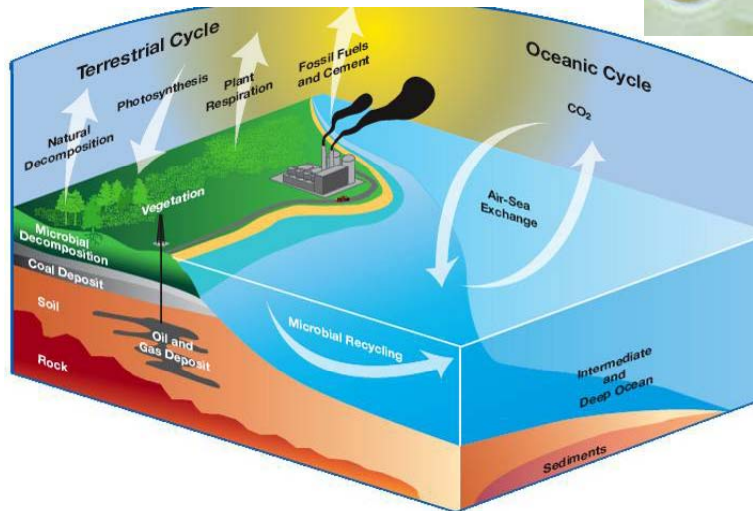




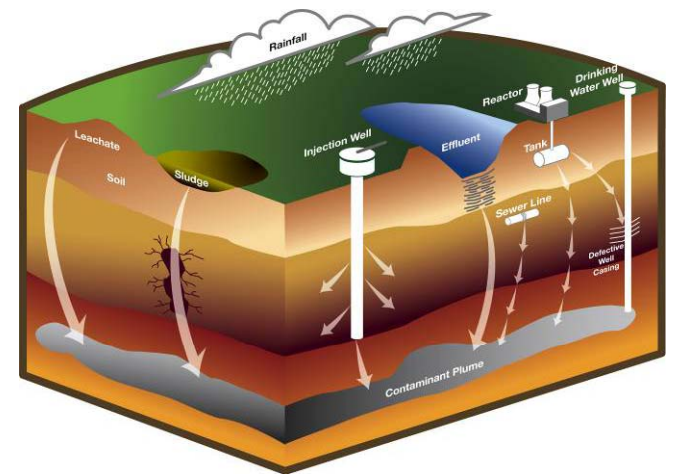
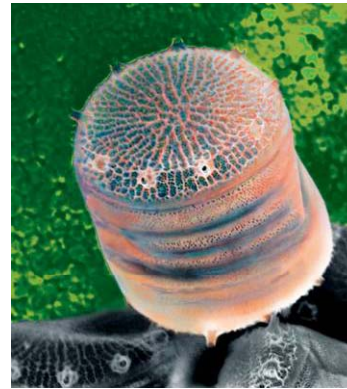
# Bioenergy



# Carbon Cycling



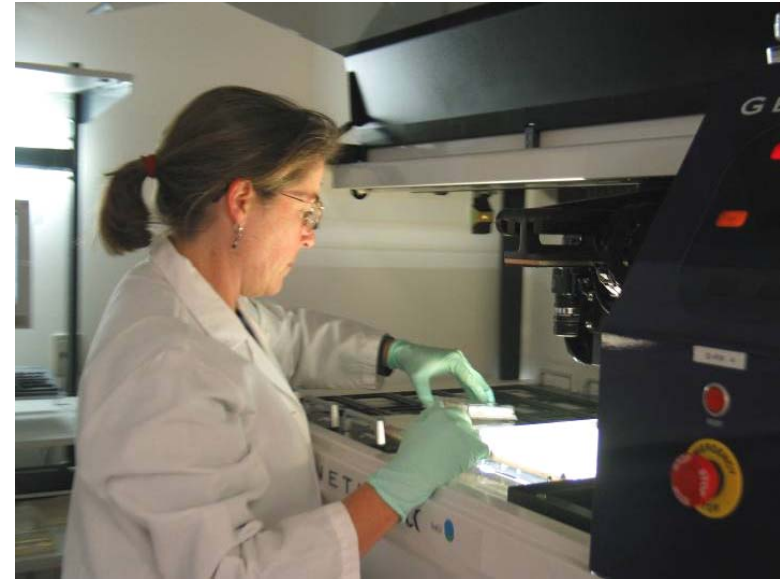
# Biogeochemistry



# Office & Manufacturing Work Environments



**60% staff in computer-  
intensive office settings**



**40% staff in hand-  
intensive  
production tasks  
(2 shifts)**



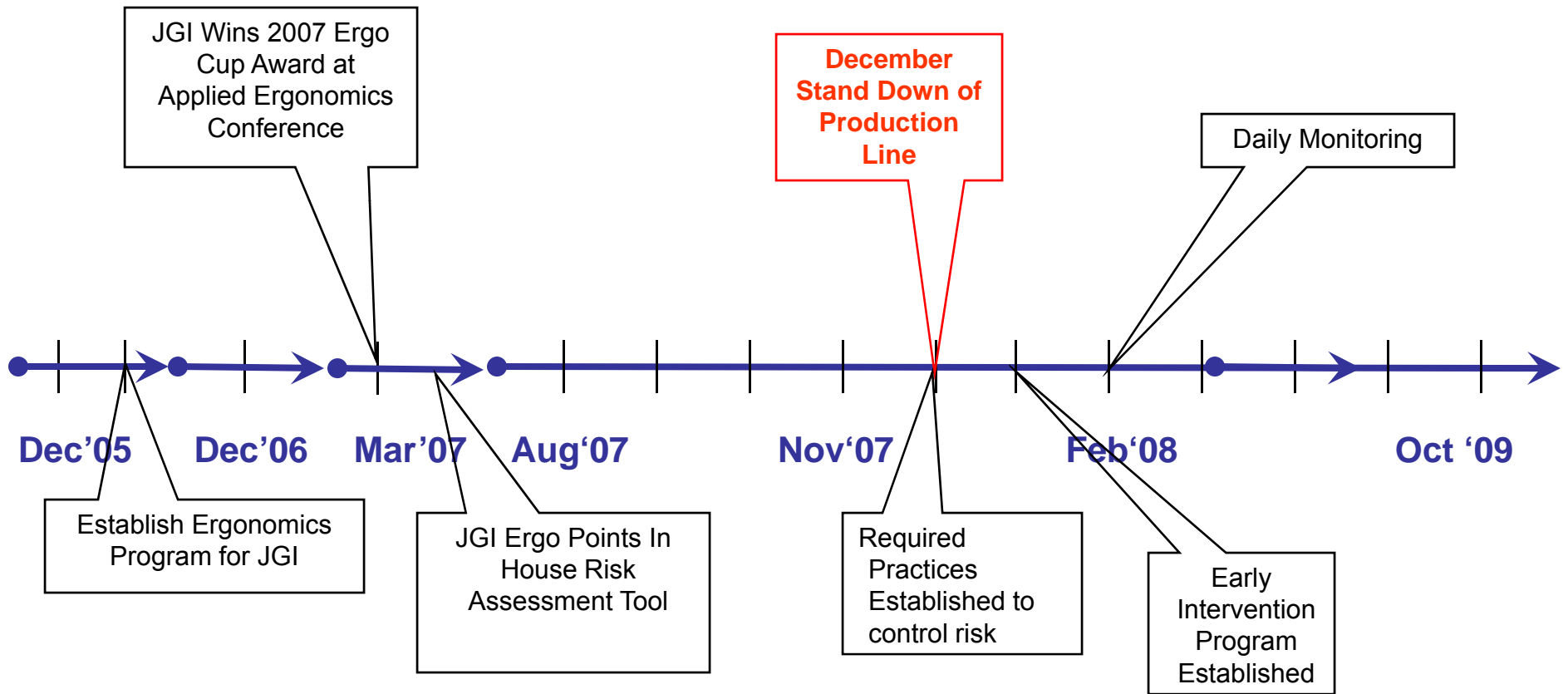
# Root Causes of Ergonomic Injuries

- Equipment/instruments designed for small batches/small lab use now being used for high throughput operation
- Culture:
  - Understanding Efficiency vs. Speed
- High force finger-intensive tasks



We are striving to determine how much is too much

# History of Ergonomics at JGI (Dec 2005-Current)



## Engineering designs and solutions

### Early intervention

Targets employees  
with discomfort  
Includes bi-weekly  
review meeting

### Proactive Efforts

Labs and offices  
Monitoring  
Walk-about  
Comfort surveys



### Safety Culture Working Group

Promotion  
Awareness  
Communication

### Training/education

Risk targeted classes  
Stretch break programs  
Potty training  
Website resources

### Relaxation/Rejuvenation Room

### Ergonomics Demo Room

### Work tool and practices

Ergo Points  
Required Practices

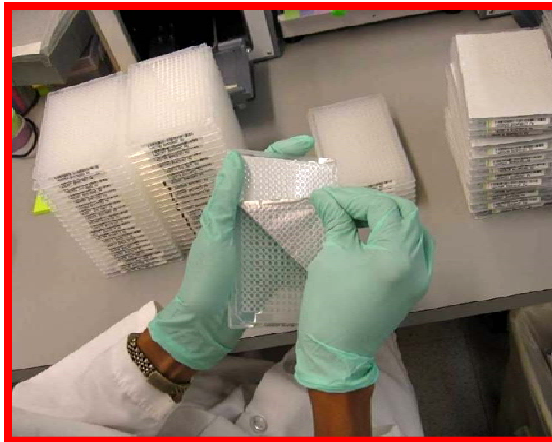


# Top 3 High Risk Factor Tasks (Then-2007)

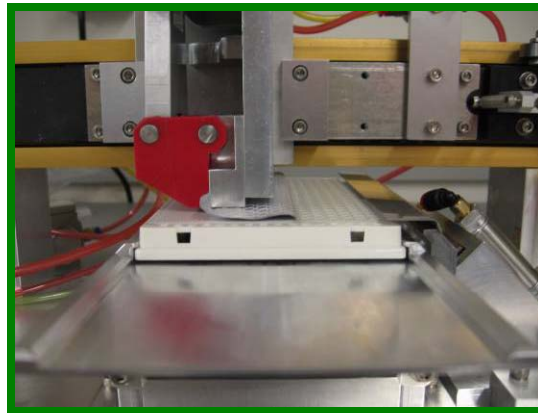
**Thermal Cycler Loading**



**Peeling Seals**



**Freezer Rack Lifting**

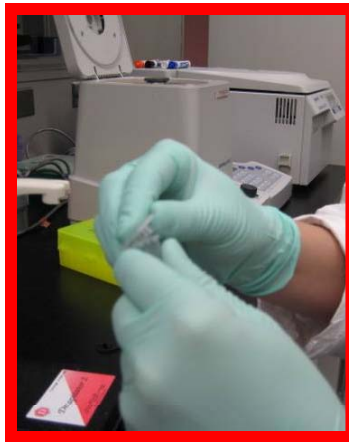


# Top 3 High Risk Factor Tasks (Now-2007)

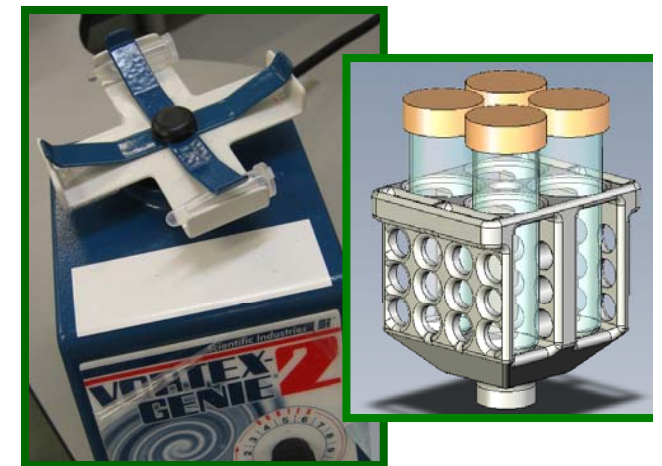
## Pipetting



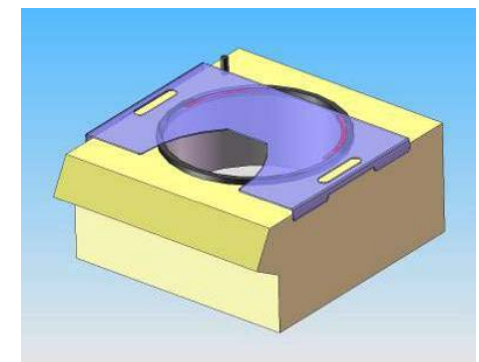
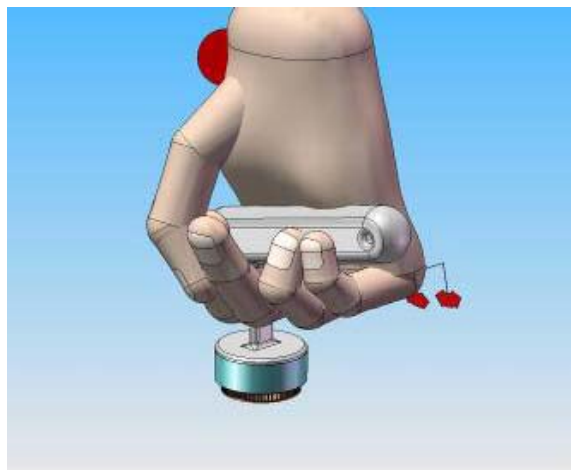
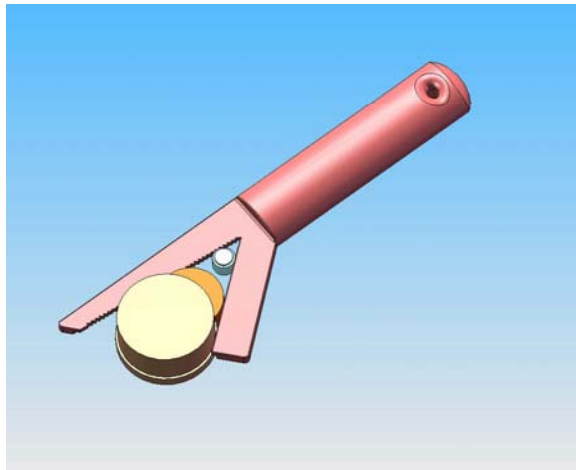
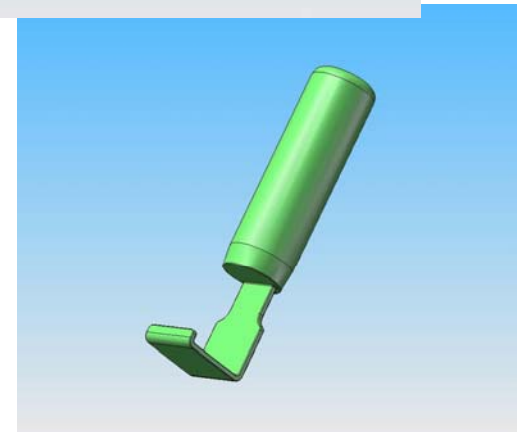
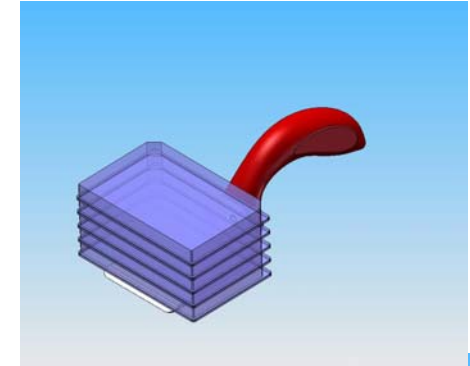
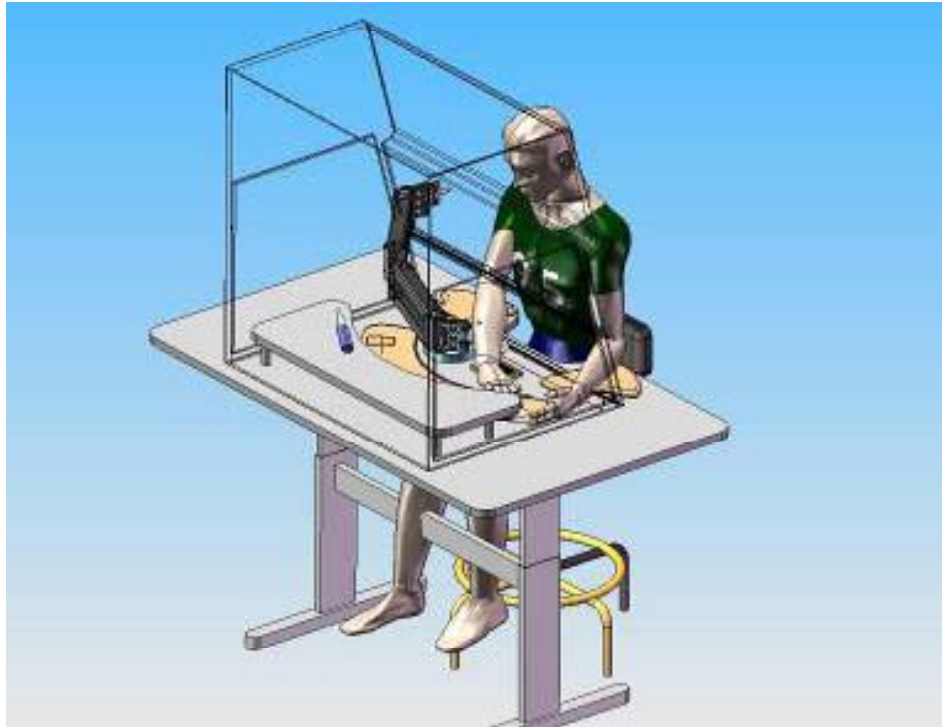
## Capping/uncapping



## Vortexing



# Employee Driven Designs



# 454 & Illumina Pipetting



Viaflo



Eppendorf Xstream



Vistalab Ovation



# Best Practices



Don't use thumbs to open tubes.



Use uncapping tool to open ALL tubes, .2mL, 1.5mL, 2.0mL



# Ergo Points

- Supervisors want to know....  
“HOW MUCH IS TOO MUCH?”
- Guidelines for schedulers
  - What tasks can be scheduled together
  - How many tasks can be conducted in one day
- No ergonomics risk tool exists for low force high repetition tasks



**GOAL: Reduce ergonomic risk caused by the combination of tasks assigned**

# 'Ergo Points'







# Tour of Ergo Projects

This work was performed under the auspices of the US Department of Energy's Office of Science, Biological and Environmental Research Program, and by the University of California, Lawrence Berkeley National Laboratory under contract No. DE-AC02-05CH11231, Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344, and Los Alamos National Laboratory under contract No. DE-AC02-06NA25396.