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Title

Ergonomics in DNA Sequencing: Standing Down to Ergonomics

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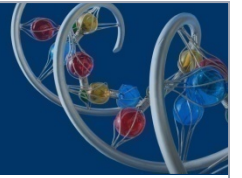
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Author

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Publication Date

2009-10-15

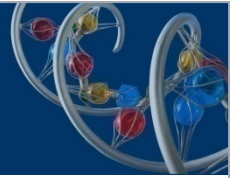


Ergonomics in DNA Sequencing

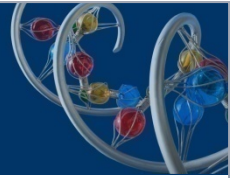
Standing Down to Ergonomics

Presented at the COEH 2009 Summer Institute
by Christine Naca
July 30, 2009





- **What We Do: Introduction**
- **How We Work: Ergonomics Challenges in Biotechnology**
- **Ergonomics Stand Down**
- **Questions**



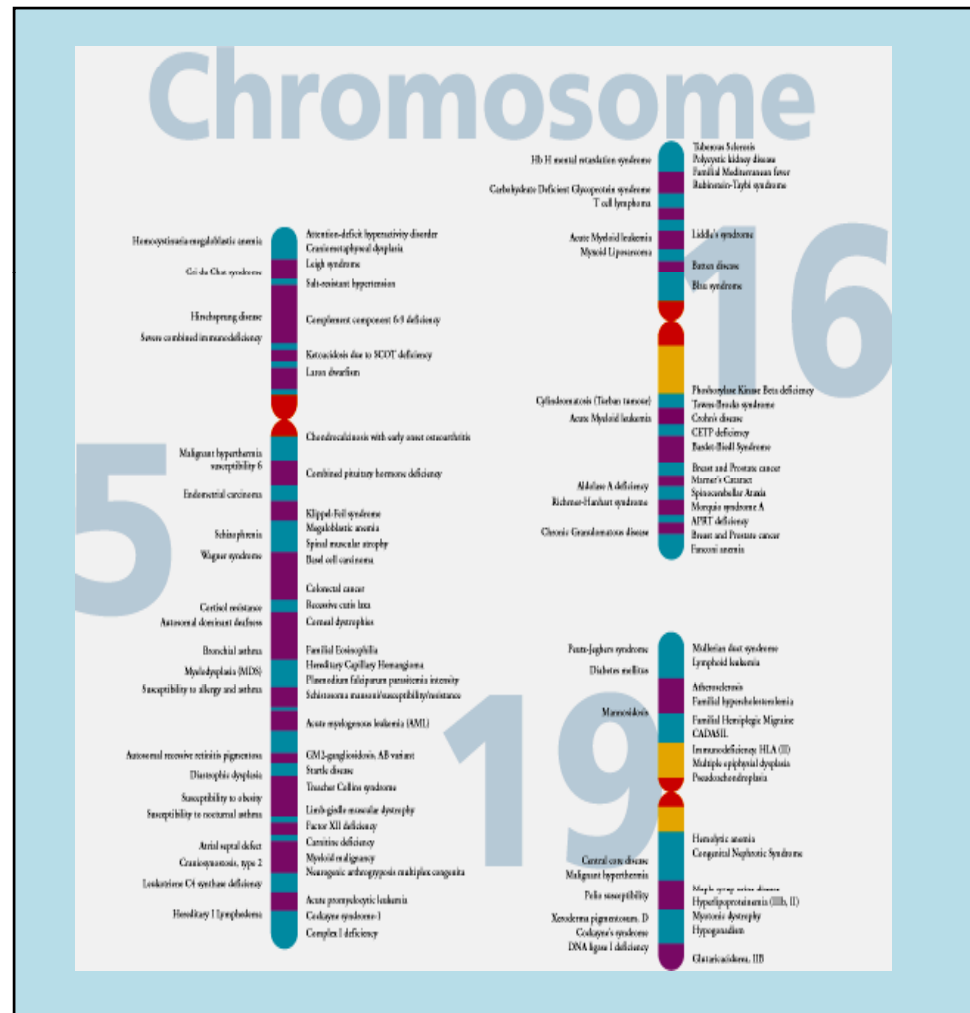
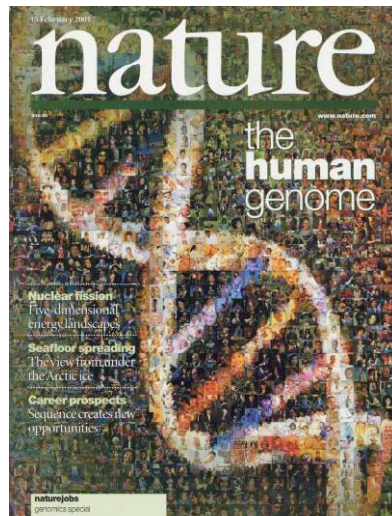
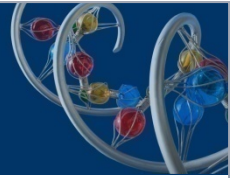
- Walnut Creek, CA-located PGF opened in 1999
- ~250 employees

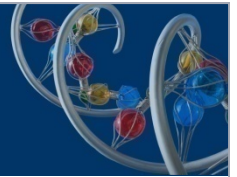


Mission:

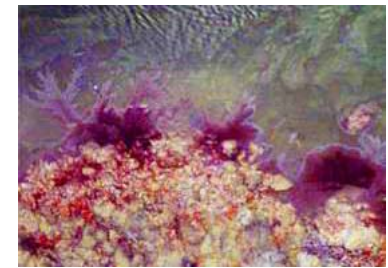
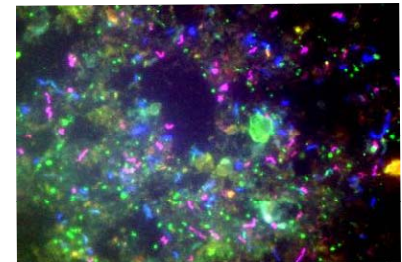
DOE JGI, Serving as a genomic user facility in support of the DOE missions:

bioenergy, carbon cycling, and bioremediation.

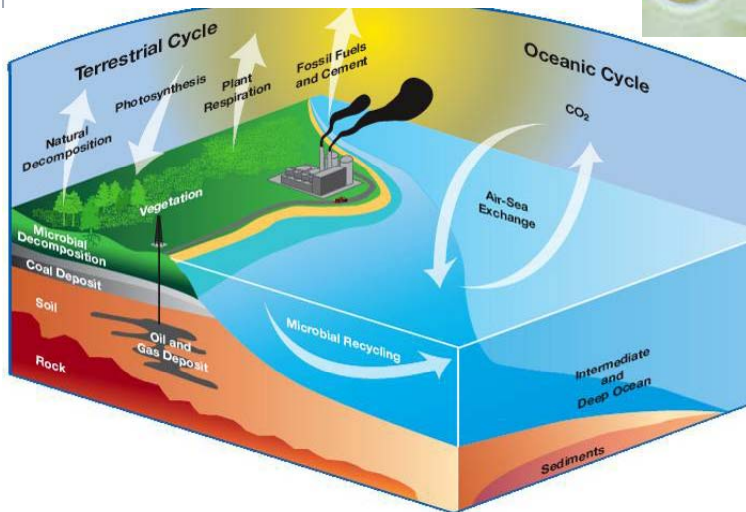




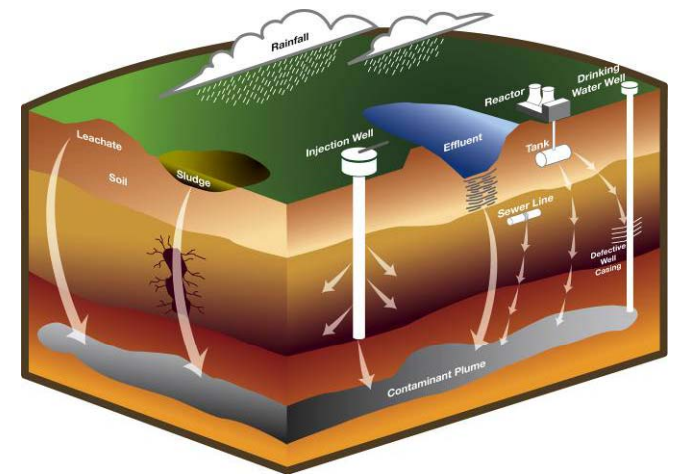
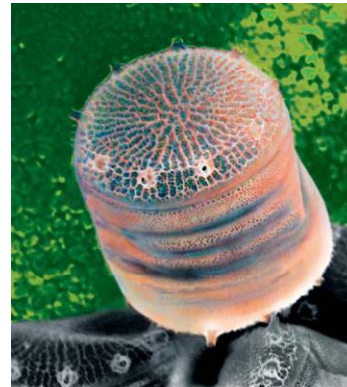
Bioenergy

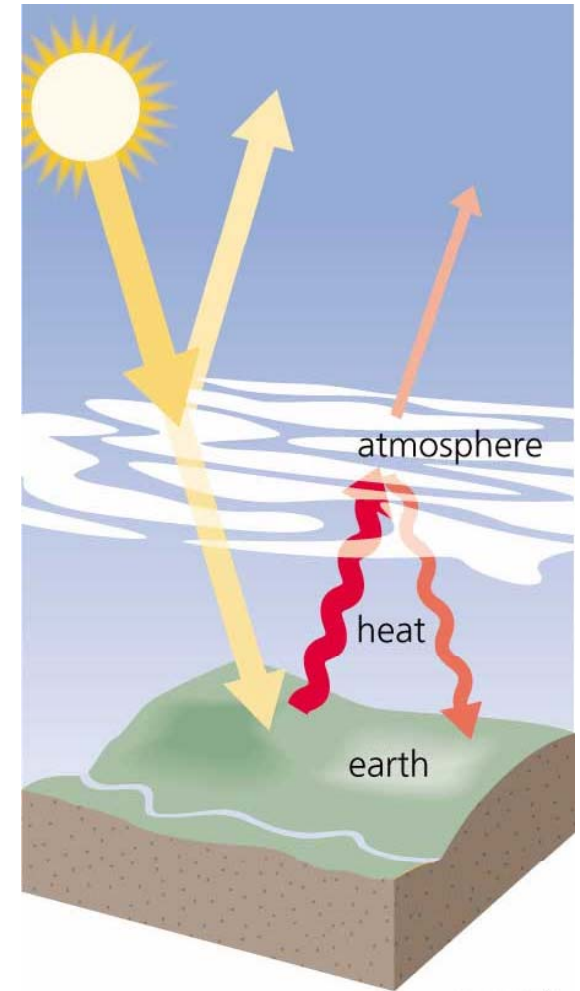
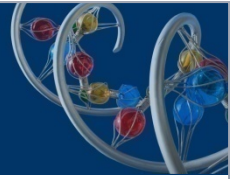


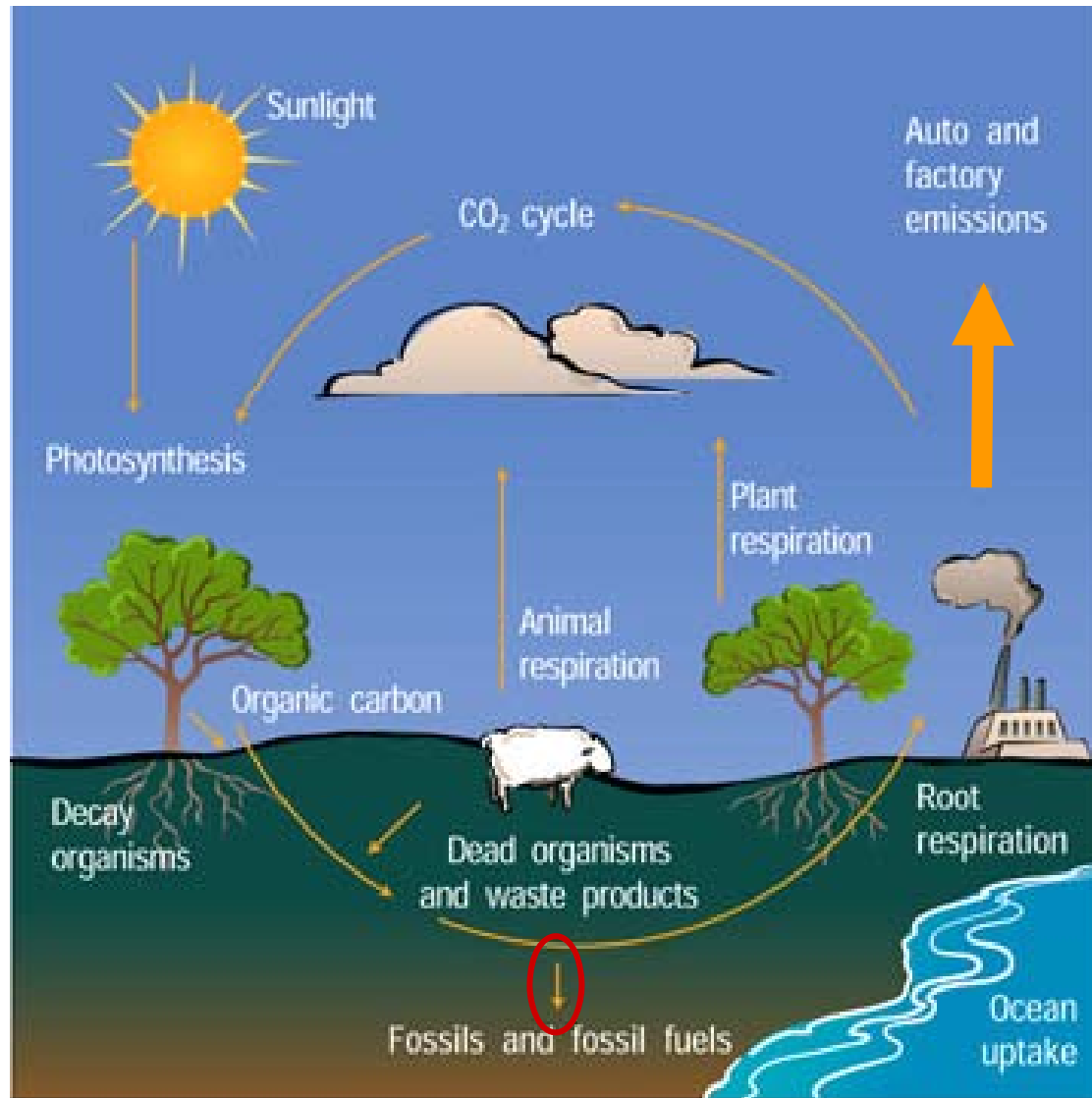
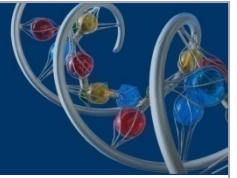
Carbon Cycling



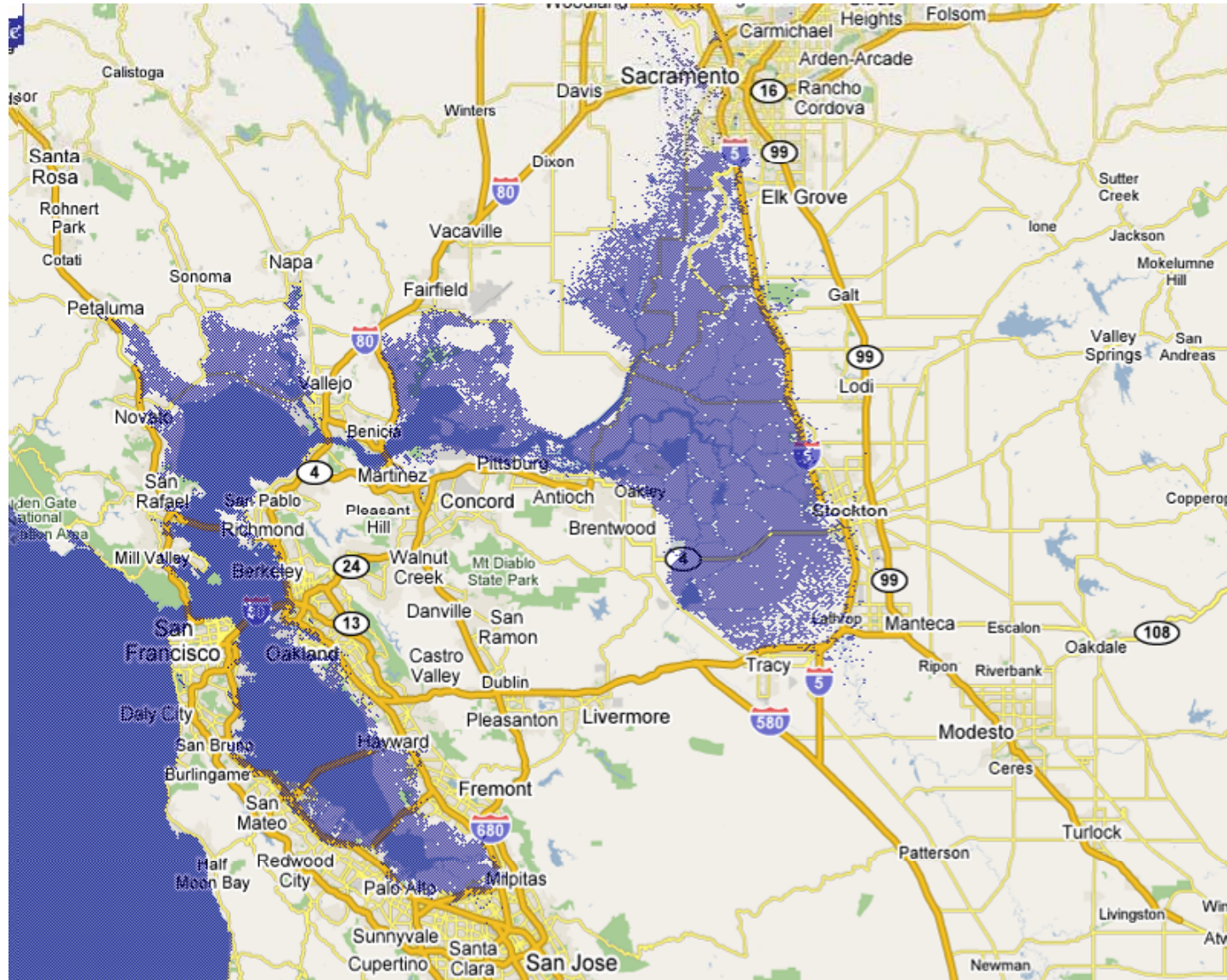
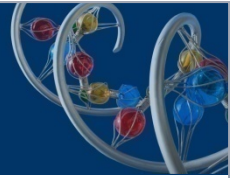
Biogeochemistry

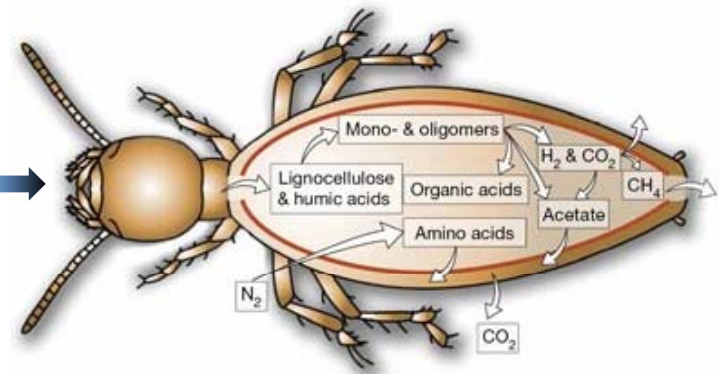
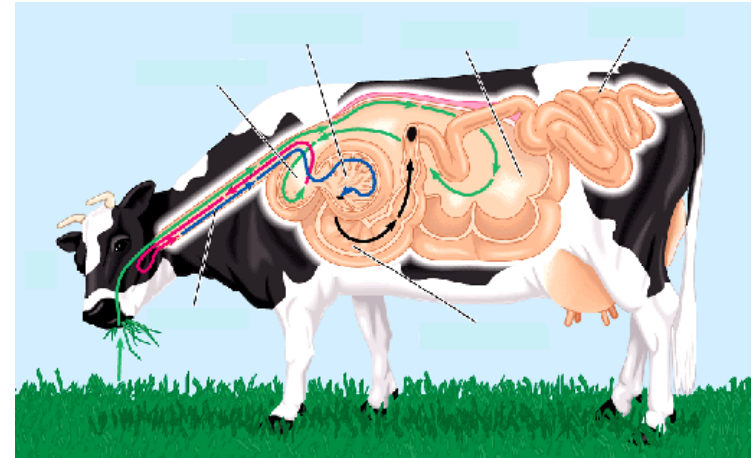
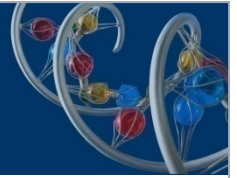




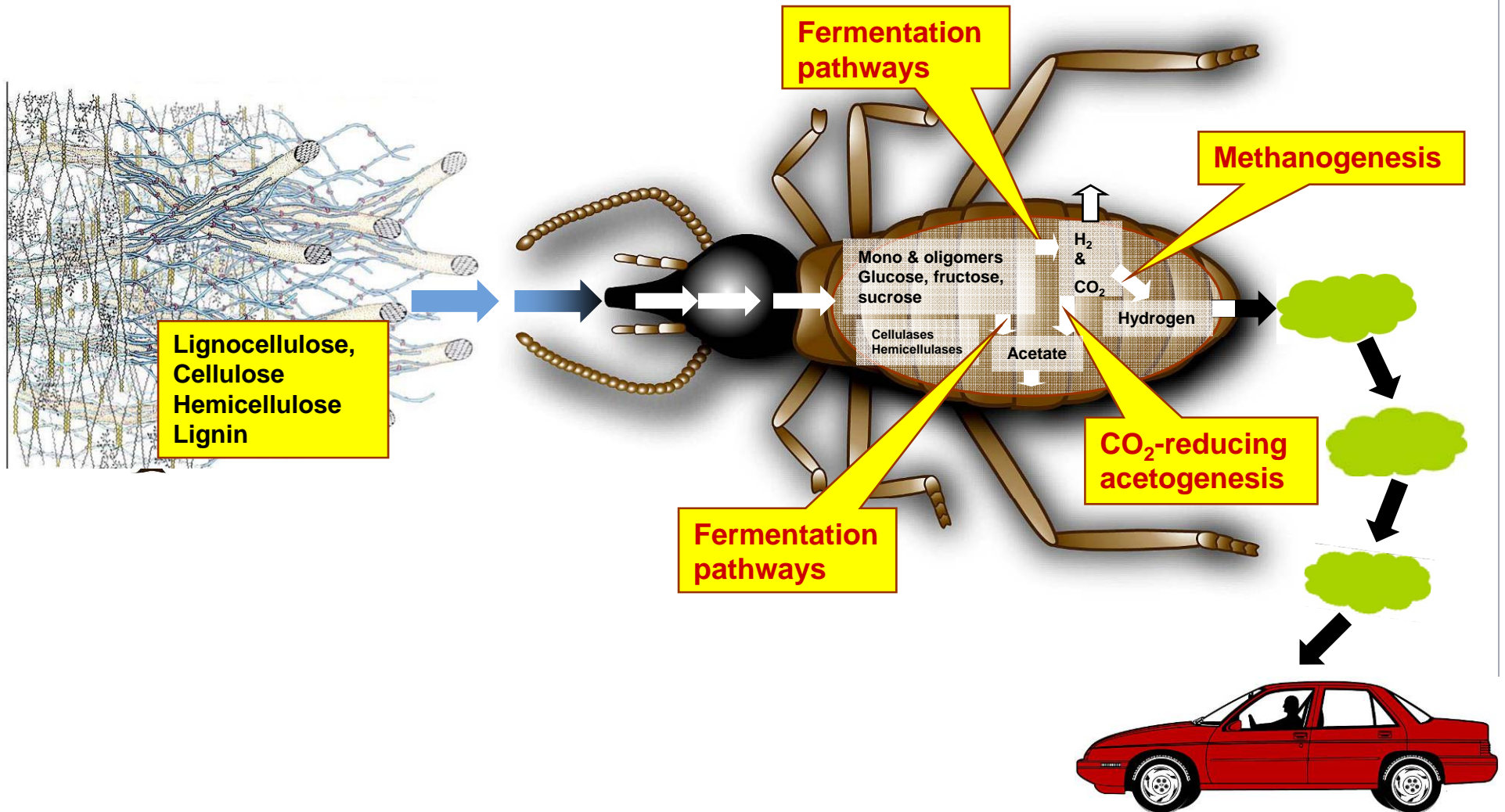
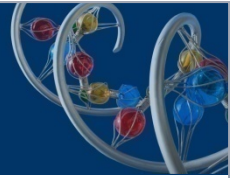


Sea Level Rise





Termites



Termites eat wood
bacteria in their stomach breaks it down for them which turns into energy



Fistulated Cows

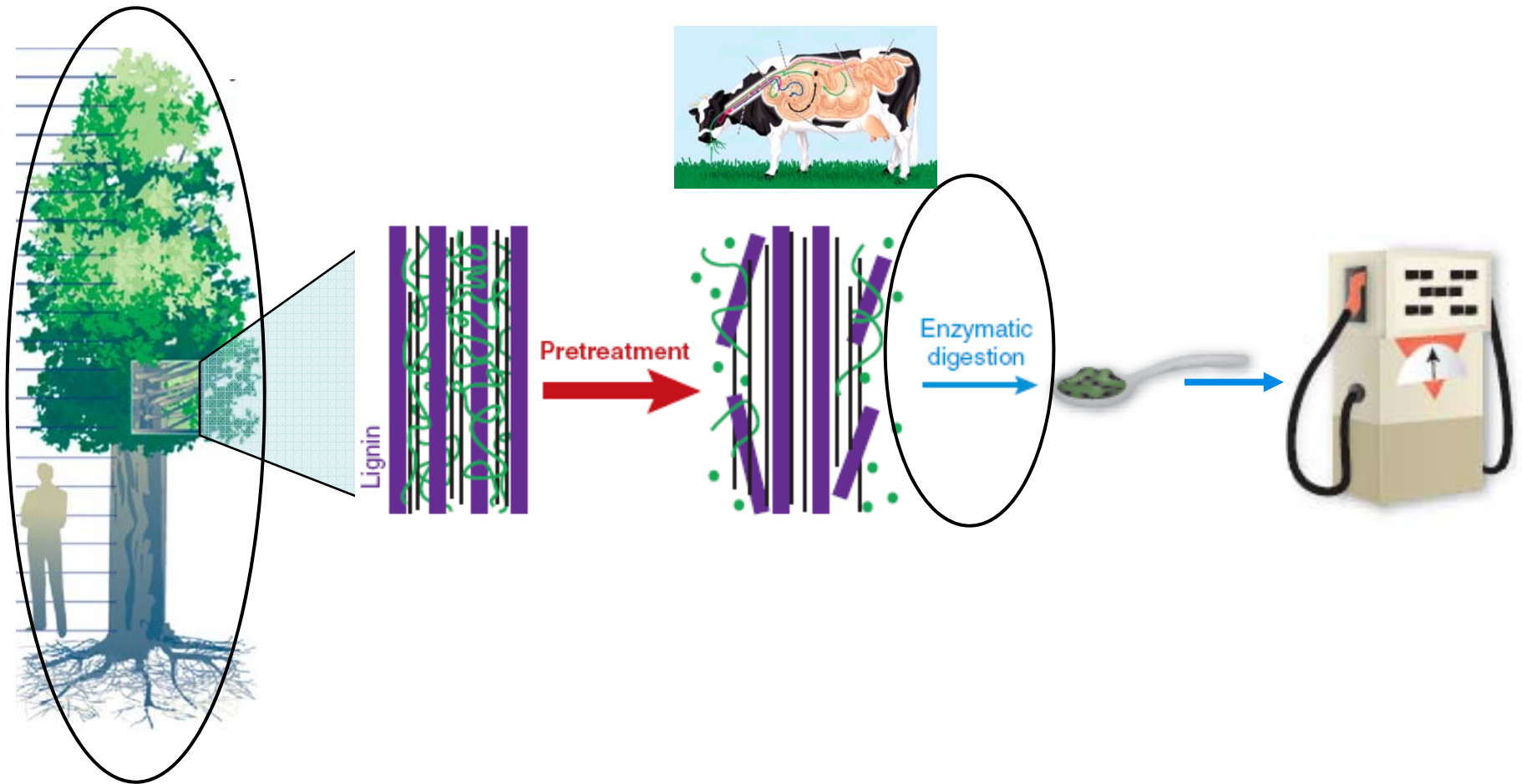
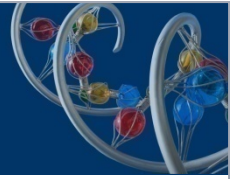


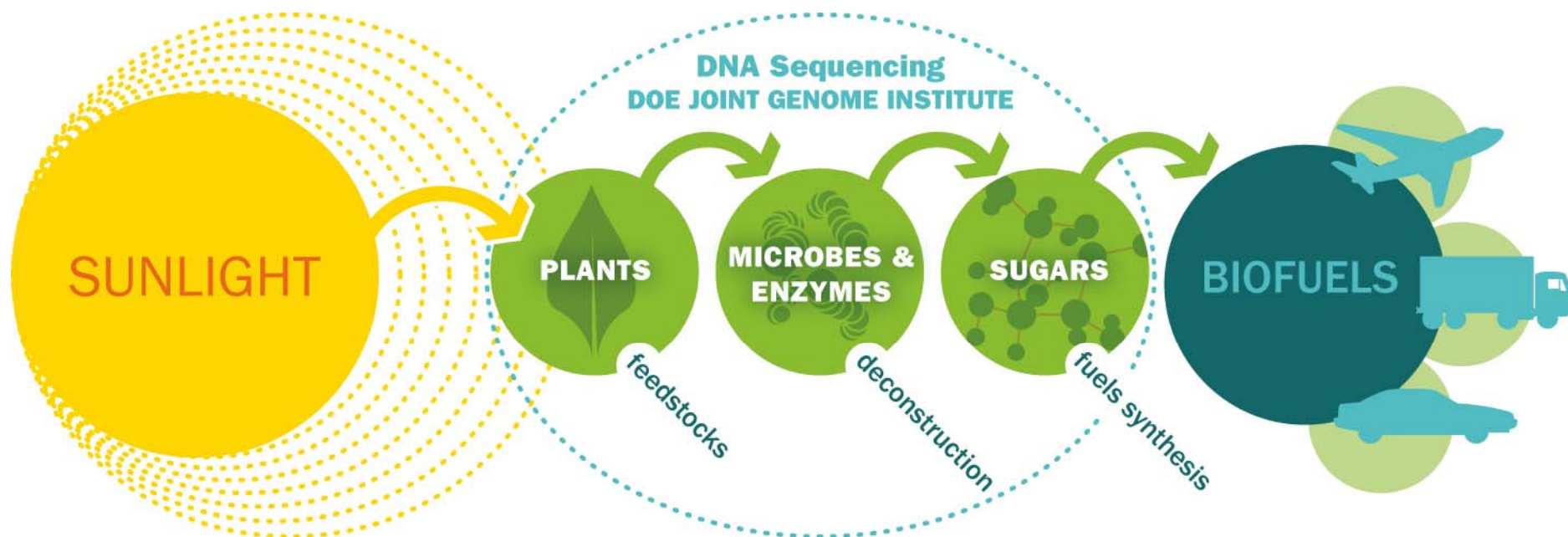
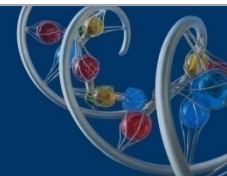
It is a Little Messy & Smelly!



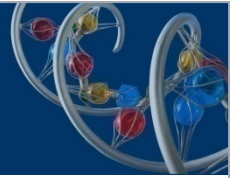
Converting Cellulose to Alcohol

The Future





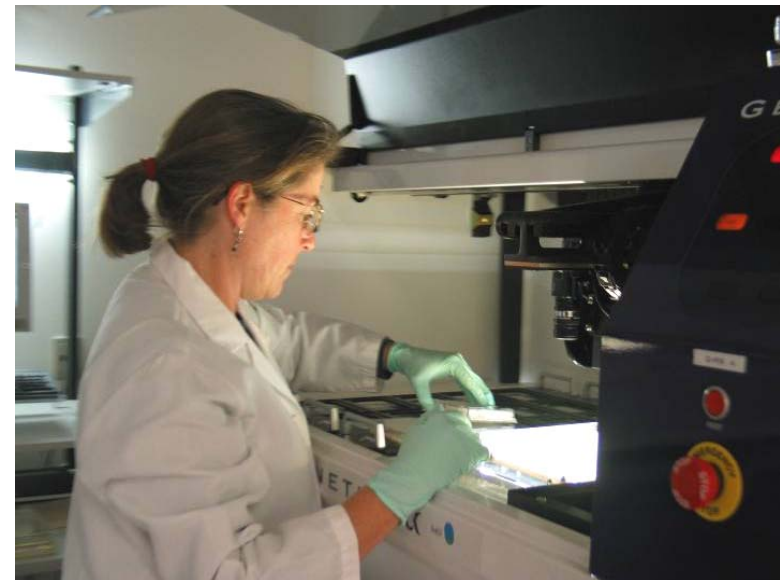
Genomic Strategies for Averting an Energy Crisis and Reducing Global Warming



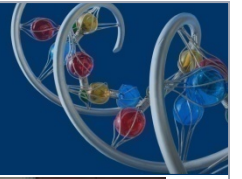
Office & Manufacturing Work Environments

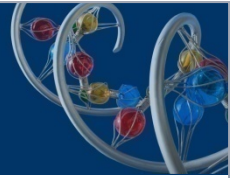


60% staff in computer-intensive office settings



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

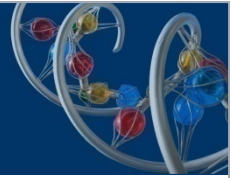




- **Ergo Working Group (EWG)**
- **139+ Ergo projects**
- **Ergonomists onsite 2x a week**
- **Early Intervention Program**
- **Pilot John Muir provider as a satellite health services for LBL employees**
- **October National Ergonomics Awareness Month**

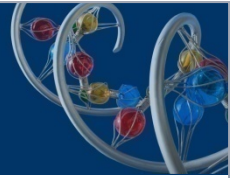
Ergo Project Status

Prior to Stand down



Classification	Category	Closed	In Progress	Grand Total
Administrative		48	8	56
Engineering	Custom	40	17	55
	Off the Shelf	51	16	65
Grand Total		139	41	180

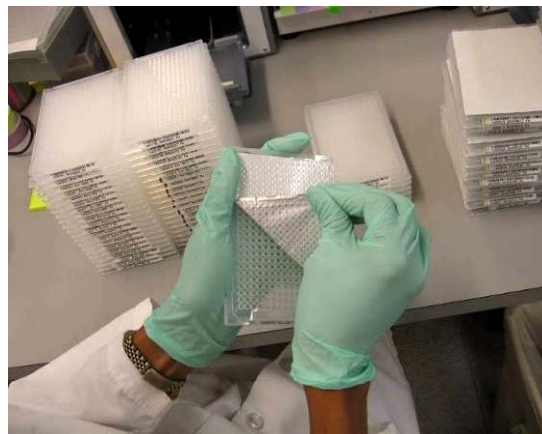
Ergo Projects by Classification



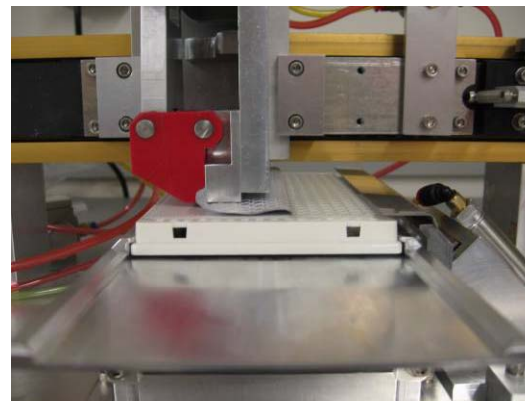
Thermal Cycler Loading

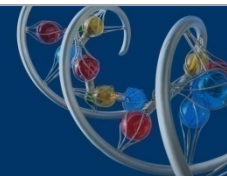


Peeling Seals



Freezer Rack Lifting





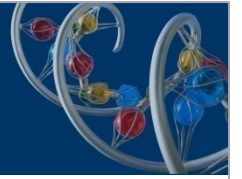
Height-Adjustable & Custom Designed Tables



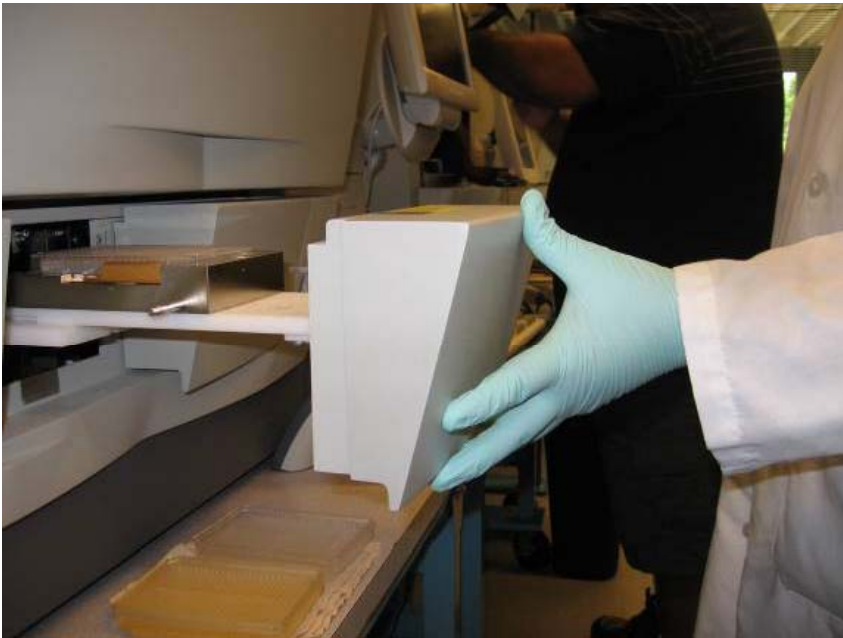
Before



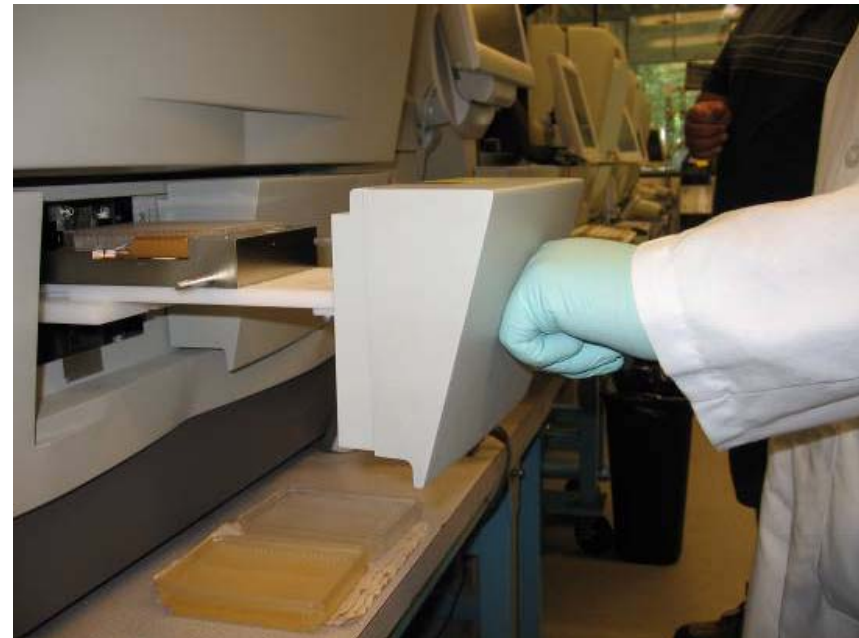
After



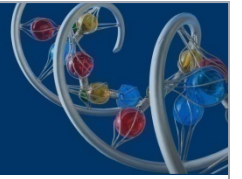
Best Practices and Training



Before



After



Anti-Fatigue Mats



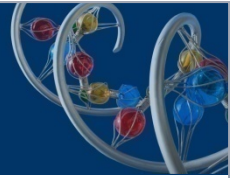
Before



After

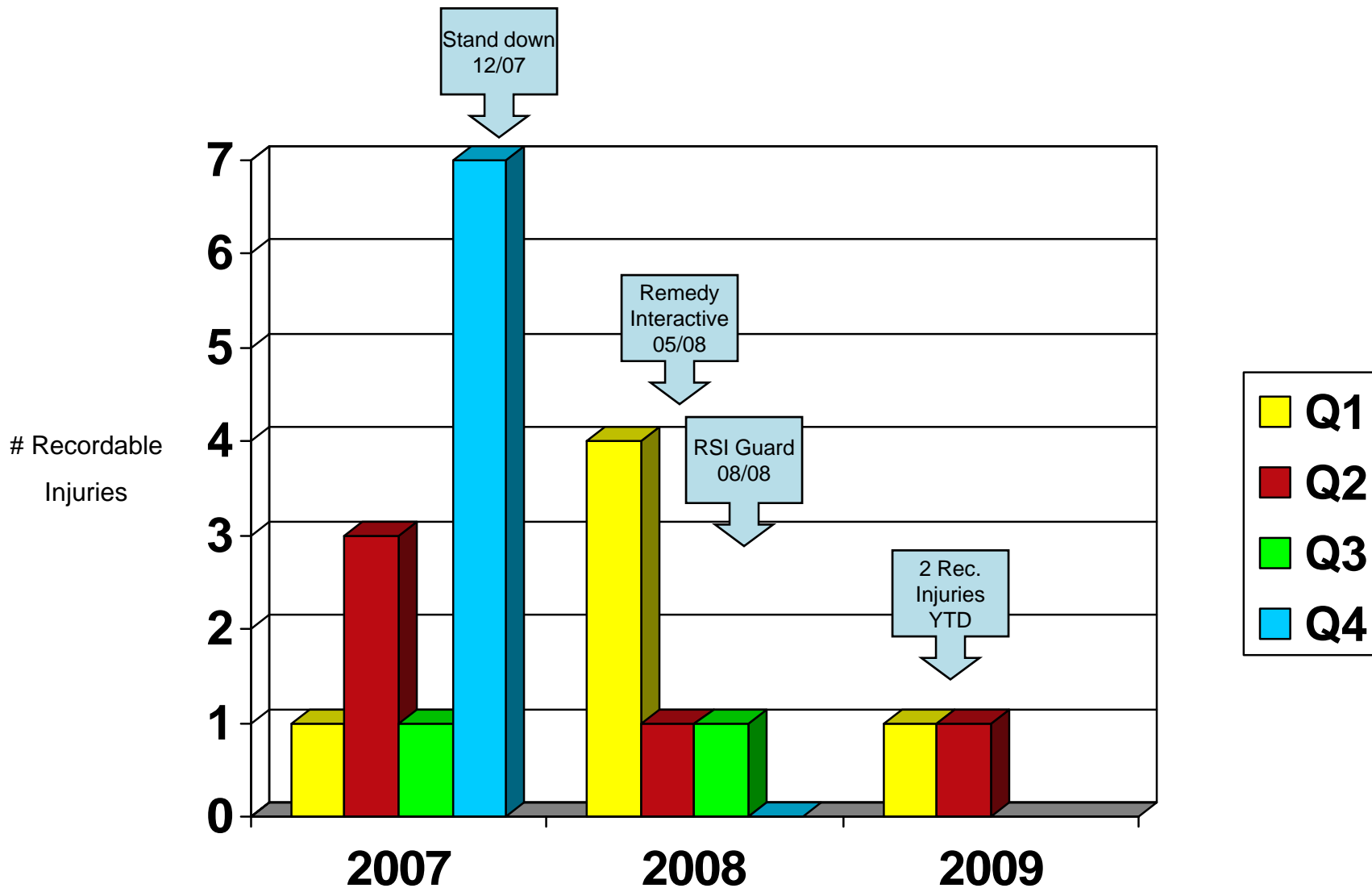
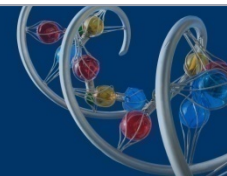
2007 Ergo Cup Winners

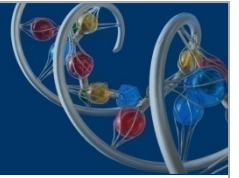
“Team Driven Workplace Solutions”



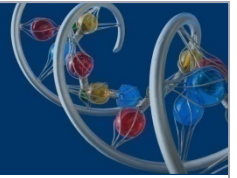
Recordable Injury History

By Calendar Year

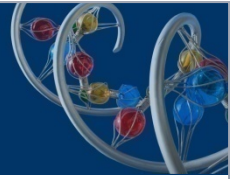




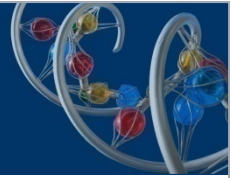
- 1) Job hazard analysis and evaluation of work process in RCA are less than adequate**
- 2) Formal management walk around program at the JGI is not adequately identifying or controlling ergonomic hazards**
- 3) Exposure of workers to ergonomic hazards in the RCA is excessive**
- 4) JGI processes for worker involvement in safety needs improvement**



- **Too many people in early intervention**
- **Communication with medical at partner labs needed improvement**
- **Partner lab Contract Transition (stress)**
- **Communication with employees was difficult (trust)**
- **Rotating staff for cross-training**
 - Morale
 - Repetitive stress
- **Aspects of the Production Org structure were not working**
- **Next generation sequencing technologies were being introduced (very manual processes/stress knowing one line will be shut down?)**



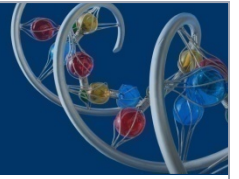
Ergonomics Stand Down



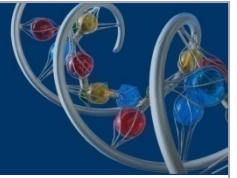
Goal: To provide an injury-free workplace, so that at the end of the day employees could go home without experiencing any discomfort.

How:

- **Understanding how our current morale problems are negatively impacting safety**
- **Improve communication and teamwork to create a safer work environment**
- **Involve EVERYONE in seeking the solutions**
- **Identify all hazards within the production process**
- **Implement necessary changes to ensure a safe work environment.**



- **Onsite consultant**
 - Macroergonomics & Human and Organizational Change
- **2 Ergonomists/Therapists**
- **IE (industrial engineer)**
- **JGI Safety Officer and EHS Division Safety Coordinator**
- **JGI Director, Operations, HR**



Week 3 Schedule

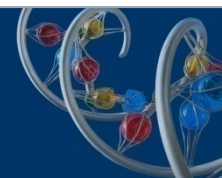
17	18	19	20	21
Kick-off				
Working Groups II	Working Groups II	Working Groups II	Working Groups II	Debrief
Lunch	Lunch	Lunch	Lunch	Eddy Lunch
Working Groups II	Working Groups II	Early Intervention Brainstorming	Safety Checklist/Walkabout Training	Debrief
Daily Summary	Daily Summary	Daily Summary	Debrief (Ira/Andy)	Actions for Shutdown Return
<i>Nurse Meeting</i>	<i>Nina Rosenberg</i>	<i>Andy Imada</i> <i>R. DeBusk</i>	<i>Andy Imada</i> <i>R. DeBusk</i>	<i>Andy Imada</i> <i>Eddy Rubin</i>

Daily Schedule: 8:30am – 5:00pm

Breaks: 11:00am – 11:15am; 3:00pm – 3:15pm

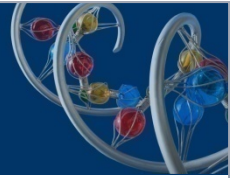
Lunch: 12:30 – 1:00pm (except for Fri: 12:00 – 1:00pm)

Micro-breaks are to be taken throughout the day

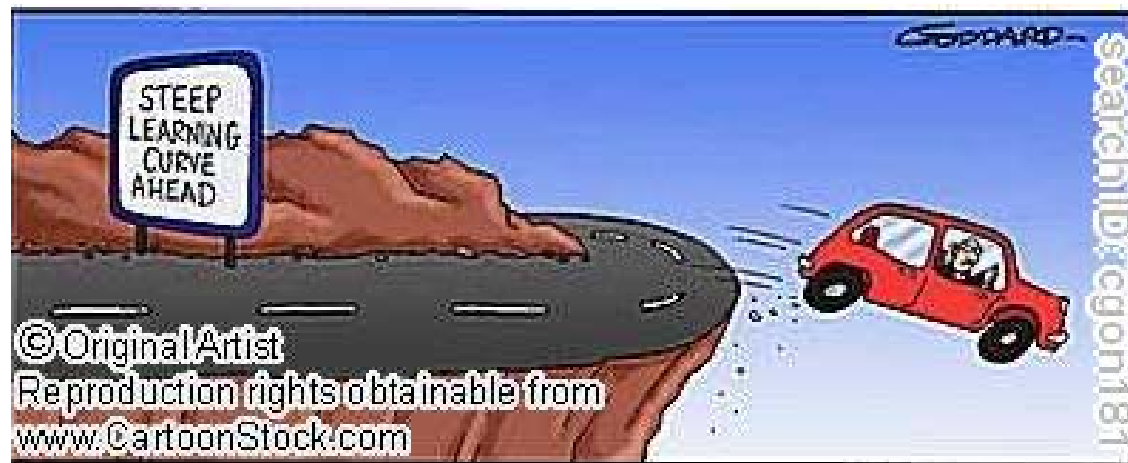


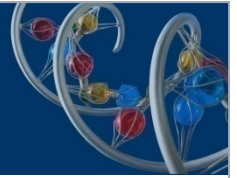
December Safety Stand Down
Week One Summary – End of the Day Assessments

12/04/2007 End of the Day Assessment	
+	Delta
Small groups participation	Change groups the second time
People opened up	Presenters, eliminate the duplication; agree on items during micro breaks
Re-bonding as a group	Rebekah did a lot of work for the snacks
People came up solutions; worked together; goal oriented people	Communicate changes
Agreement on both shifts	Micro breaks every 1-1.5 hours
Snacks	Highlight the passionate ideas
Exercise where A changes something about B	Have smaller sessions with working group follow ups
Operators and management took responsibility for what they weren't doing	Focus on how operators might change
Small group facilitators	Fewer groups in this room
Facilitator	Micro breaks coincide with lunch
	Stretch break every hour
	Felt rushed during break outs. Either more time or more focused
	Facilitators Summarize and validate flip charts
12/05/2007 End of the Day Assessment	
+	Delta
ID'd re-org. struggle with challenge	Disorganized, pick teams faster
Different people in different groups	Not enough time for breakout sessions
Check off similar info	Poor forecasting
Glimpse into others roles	Don't qualify availability
Managers mixed in	More micro breaks
Creativity	Lack of acknowledgement and positive feedback (during group discussion)
Enthusiastic	Sidebar conversations
Eddy's question session	Not sticking to schedule
Good participation	
New speakers	
Meeting new people	
More discussion, new speakers	
No resistors	
Morale increase	
Recognition by Sue	
pizza	

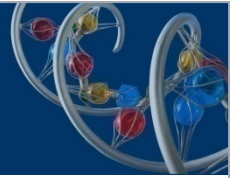


- Organizational design and change management
- Knowing where we are and accepting where we are going...



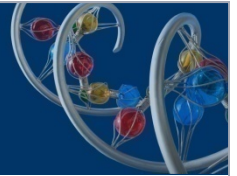


- **Ergo Risk Factors**
 - High Forces: manual process/peeling
 - High or Changes in repetition rates: Wellmate to hydra
 - Awkward postures
- **Training/Familiarity of Process**
- **Workflow Issues ie. large backlog vs catch up work**
- **Equipment Malfunctions**
- **Workload ie. # batches/person; throughput/shift (how much are you rushing)**
 - Process Area
 - Shift
- **Methods of Communication ie. mixed messages**



- 1) Step-by-step Protocol**
- 2) Workflow**
- 3) Risk Assessment**
- 4) Solutions: Administrative, Engineering**
- 5) Required Practices**
- 6) Throughput Model**

Use the chemistry area as an example...

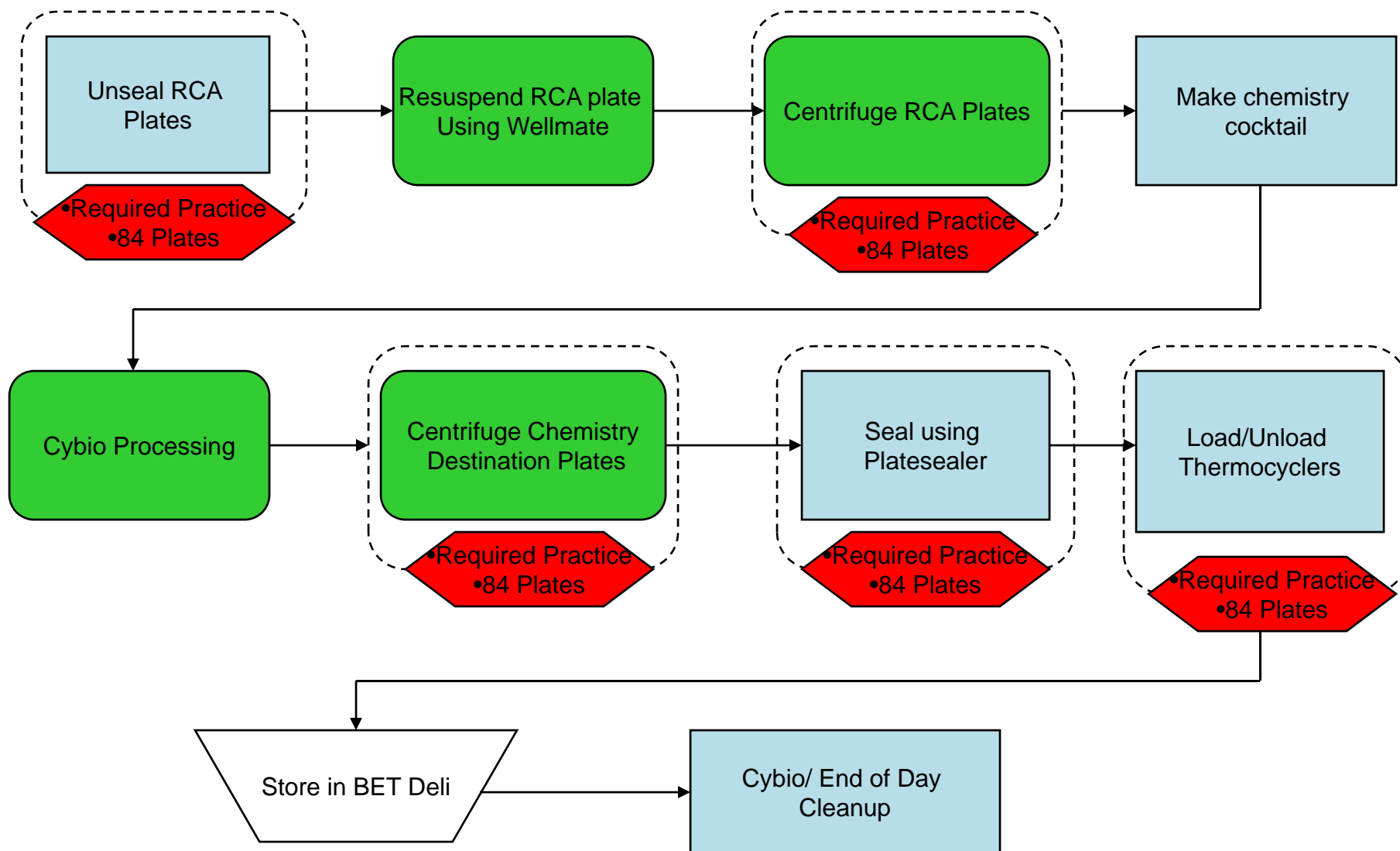
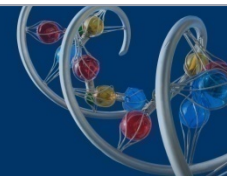


Sequencing Chemistry SOP: Quick Reference Guide

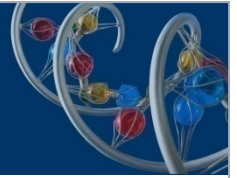
Version #/Date: 12/07/07
Author(s): Gerald Ilog, Catherine Adams, Matthew Zane
Reviewed/Revised by: Name(s)

Procedure

1. Check batches for primers and special instructions
2. Pull reagents
Note: Allow one hour to thaw
3. Unseal two batches of RCA plates using automated unsealer.
4. Add 5ul of Milli Q water to RCA batch 1 Biorad source plates. Take a calibration weight.
Note: Visually check that water is added to each well.
5. Setup Cybio Well Vario. Perfrom a tip QC, tighten tips, perform a tip wash, check dial settings, move tubing, and check lubricant levels.
6. Take a 5 minute Break
7. Unload batch 1 plates from Wellmate (16 plates at a time).
8. Load Batch 2 plates on Wellmate.
9. Spin down Batch 1 Biorad plates.

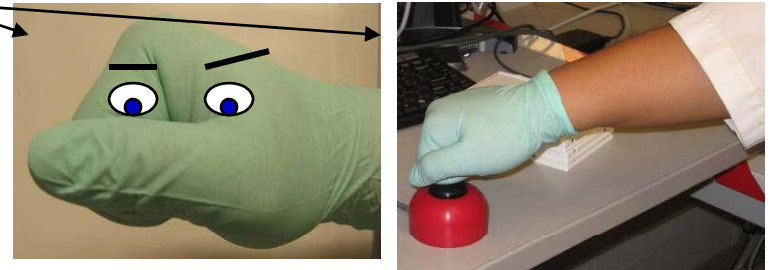


How to use the “It’s A Peeling” Button



Hazard 1A

Use a “smiley face” grip, and use the flat part of the second joint of the fingers to press the button lightly



Use a fist to press the button lightly

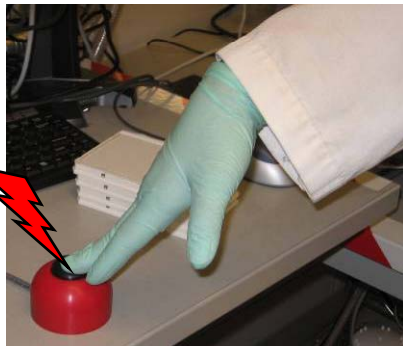
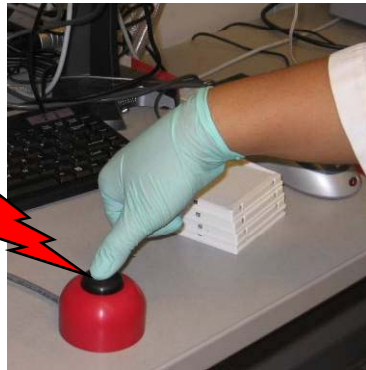


Do not use finger tips or thumb



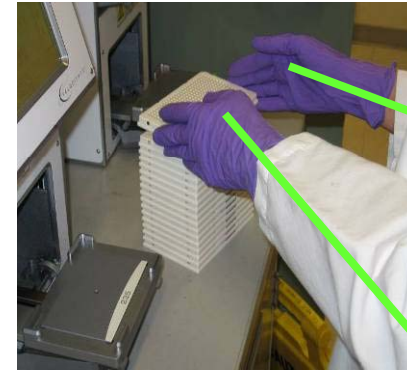
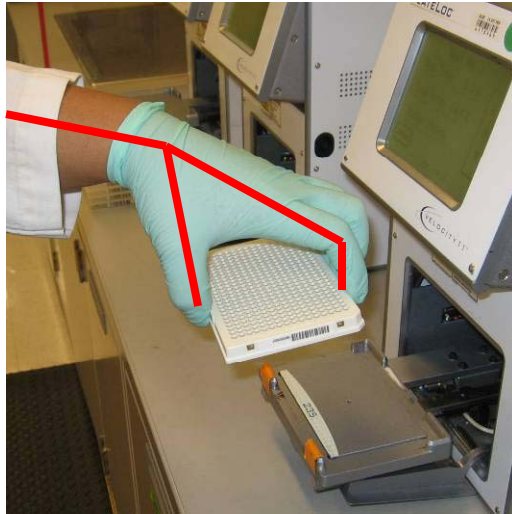
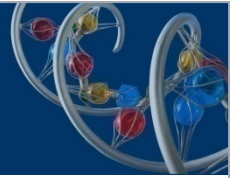
Use the palm of your hand to press the button lightly, do not use finger tips or thumb

After

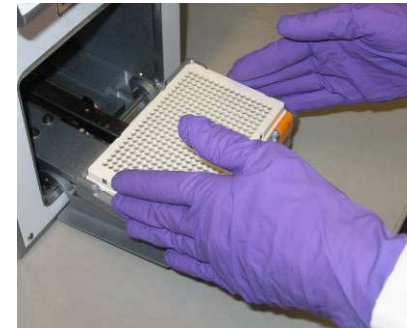


Before

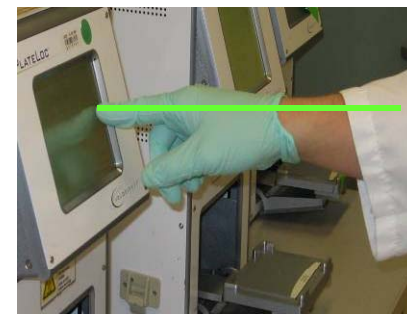
Sealing Plates



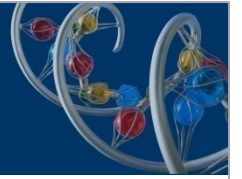
**Avoid using a “claw grip.”
Use two hands to load and
unload plate onto sealer.
Press the start button
*lightly***



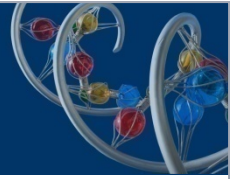
Before



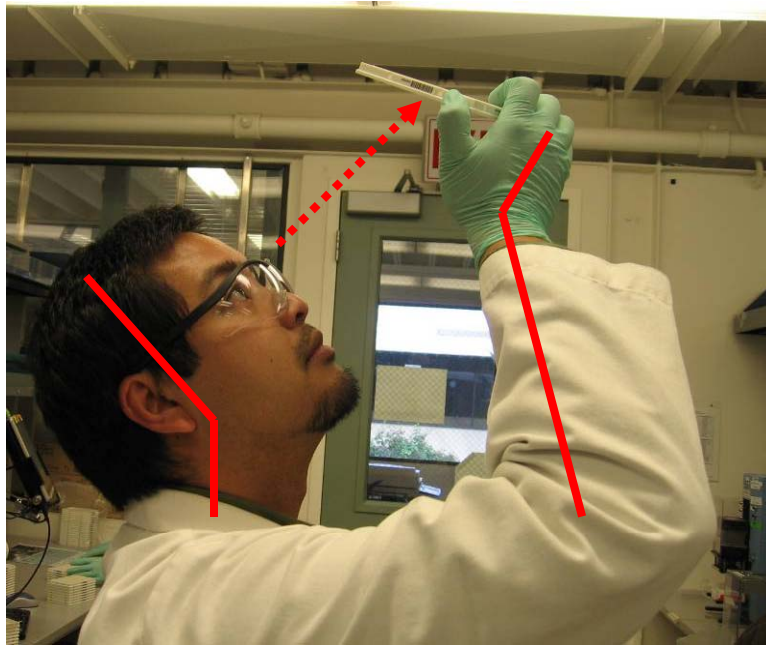
After



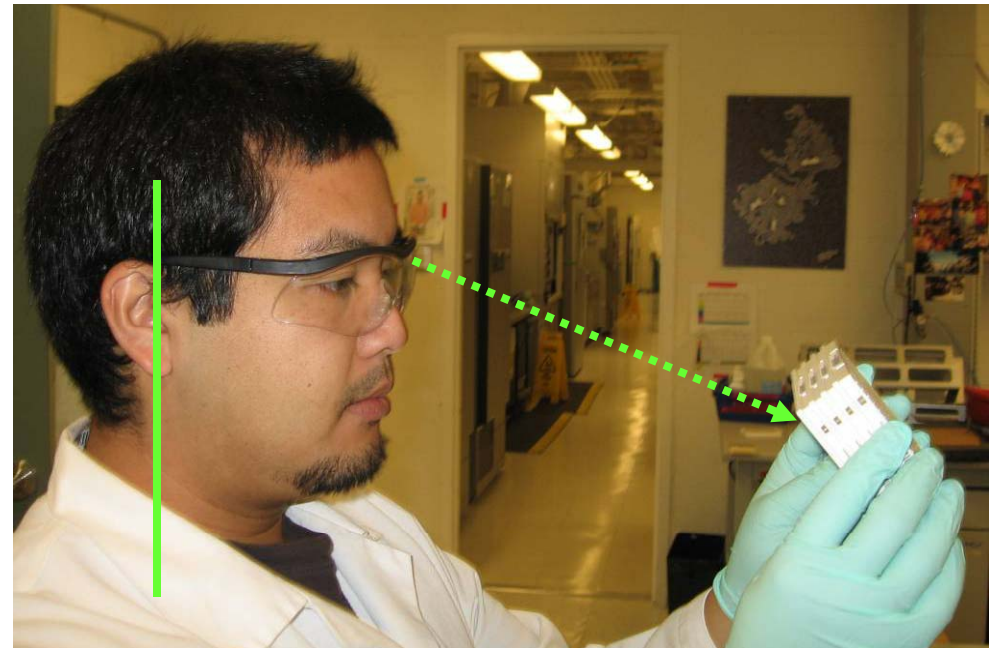
- **Example Slides**



Perform a visual check of every 4th plate after Centrifugation. Use two hands to hold plate, do not raise above eye level.



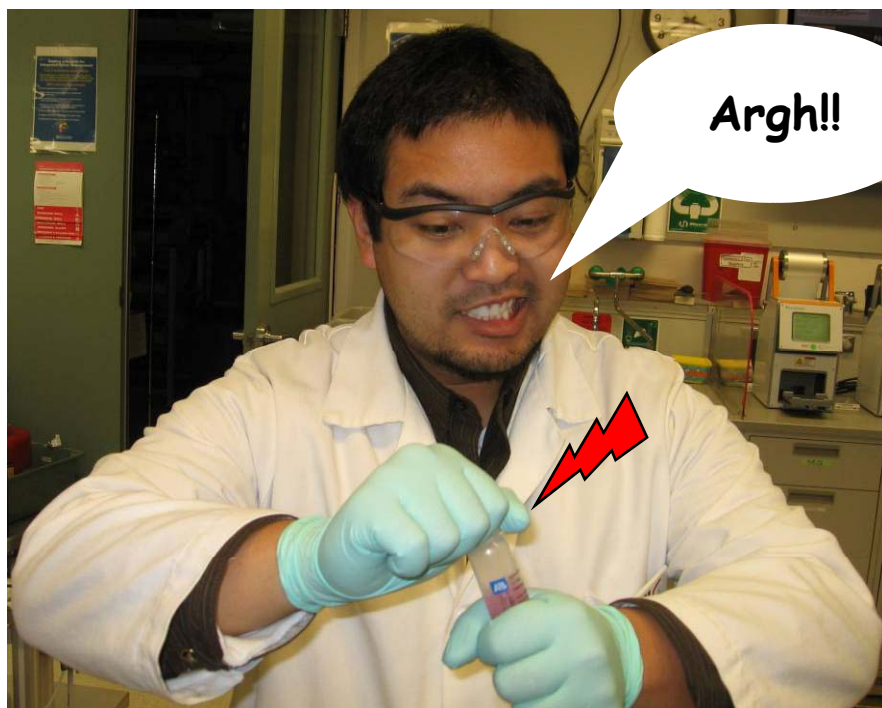
Before



After



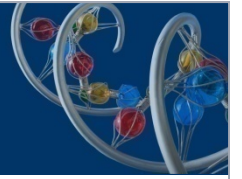
**Use a pair of slip joint pliers to remove the cap.
Do not try to open reagent bottles with your hands.**



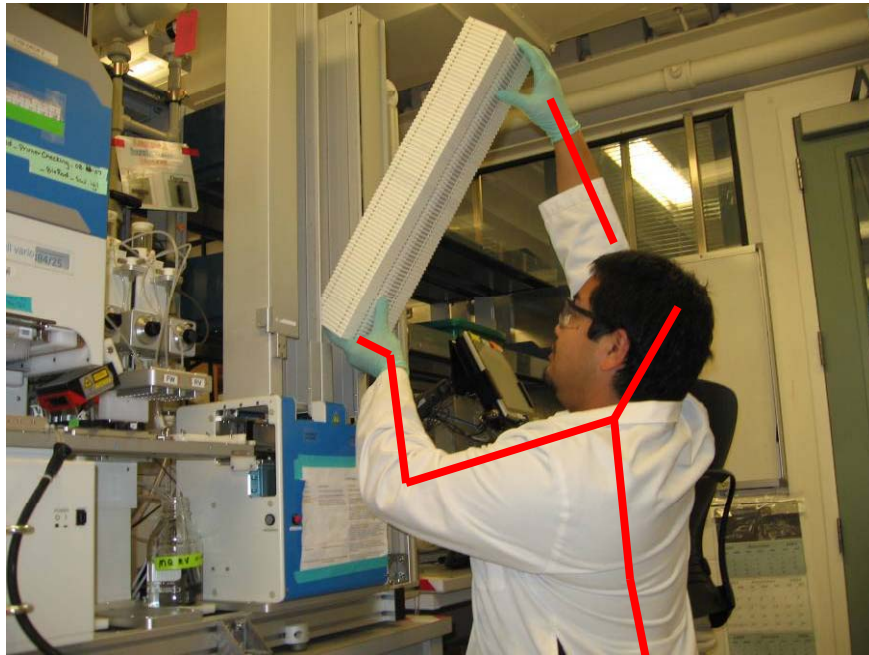
Before



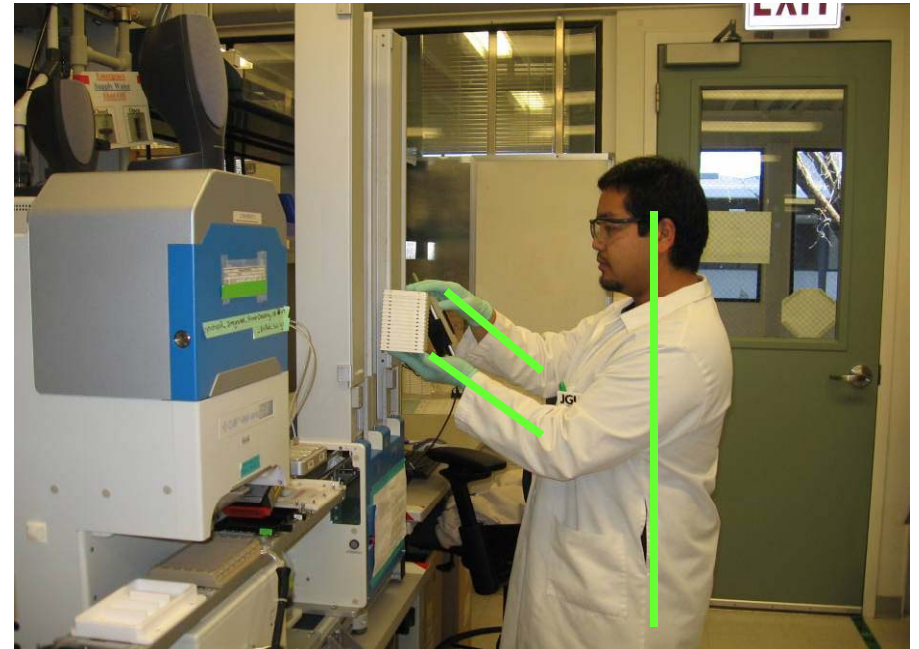
After



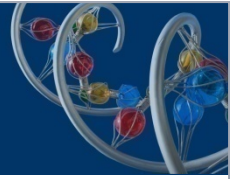
Adjust the table to a height that is good for you. Avoid raising your elbow above shoulder level and utilizing awkward hand postures. Load no more than 16 plates at a time.



Before



After



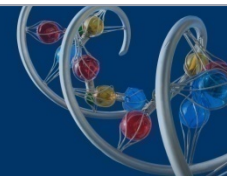
Before

Use a stool when loading reagents to avoid hunching over

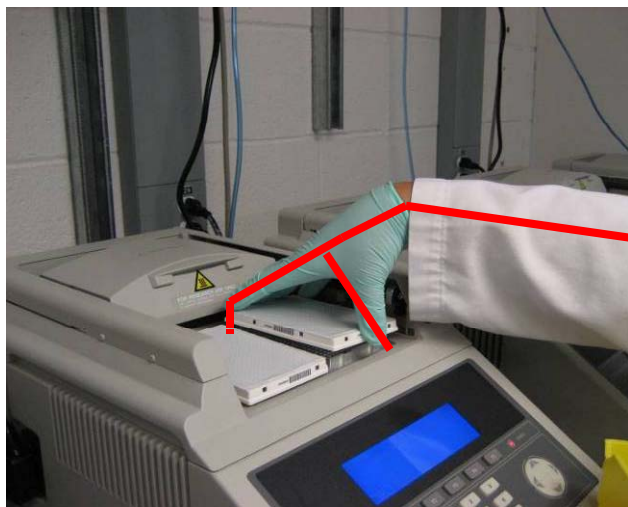


After

How to load Thermocyclers



Load with both hands in a neutral position, avoiding a claw-like grip as seen below in options A and B



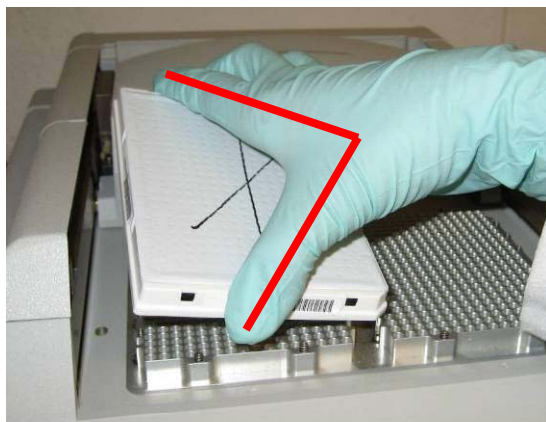
A



B

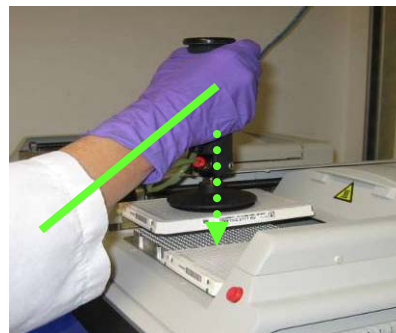


Load using the unloading tool, or drop the plate in place using a neutral position as seen below in options C and D

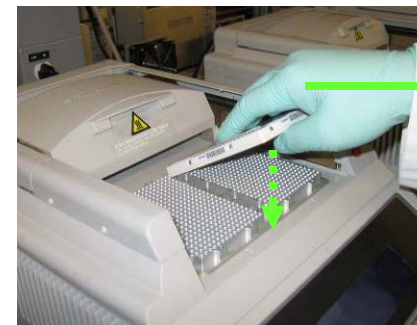


Before

C



D

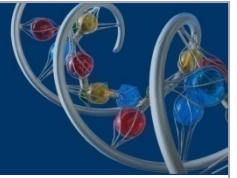


After



6) Operator Feedback: Safe Level of Plate Processing by Area

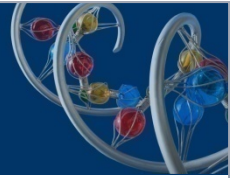
Plating (Bioassays per FTE)	Picking (Plates per FTE)	OD (Plates per FTE)	Fos Inoc (Plates per FTE)	Rca (Plates per FTE)	Gels (Gel per FTE)	CHEM (Plates per FTE)	BET (Plates per FTE)	Caps (Loaded Plates per FTE)	Caps (Debased Plates per FTE)	Caps (Machines Running 36cm)
40	104	104	40	104	0.8	208	208	208	208	34
38	100	100	40	100	0.8	200	200	200	200	32
46	120	120	40	120	1.0	240	240	240	240	39
31	80	80	80	80	0.6	160	160	160	160	26
16	42	42	42	42	0.3	84	84	84	84	14
16	42	42	42	42	1.0	84	84	84	84	14
32	84	84	84	84	0.7	168	168	168	168	27
15	40	40	40	40	0.3	80	80	80	80	13
12	30	30	30	30	0.2	60	60	60	60	10
15	40	40	40	40	0.3	80	80	80	80	13



- **Organizational Structure changes**
- **Throughput model**
- **Partner labs commitment from medical**
- **Streamlined return to work program**
- **Early Intervention Program**
- **Full Time Ergonomics Support (3 ergonomists)**
 - Monitoring program
- **Onsite Nurse on Tues, Thurs PM**
- **Process Change Notification**
- **Observation Program**
- **Structured process for rotation on the production floor**
- **Ergo points**



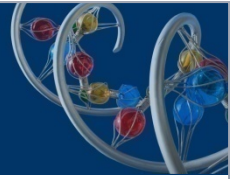
Role	Responsibilities
Production Coordinator	<ul style="list-style-type: none"> • Managing and coordinating all aspects of the sanger line from Plating through ABI • Responsible for change management on the line • Throughput, scheduling, staffing • Supervising the Technical and Administrative supervisors
Technical Lead	<ul style="list-style-type: none"> • Single point of contact on designated shift to make all technical decisions • Shift meetings • Anything associated with processing samples • Interact with Supervisors on staffing problems, schedule changes • Interact with Production coordinator on technical aspects of the process • Coordinating technical training
Administrative Supervisor	<ul style="list-style-type: none"> • Hire, performance management, time keeping, staff development (1x1s) • Anything w/ HR • Interact with Technical leads on time keeping, staffing problems and schedule changes • Interact with production coordinator on staffing needs • Administrative training



- **20% overall reduction in throughput**

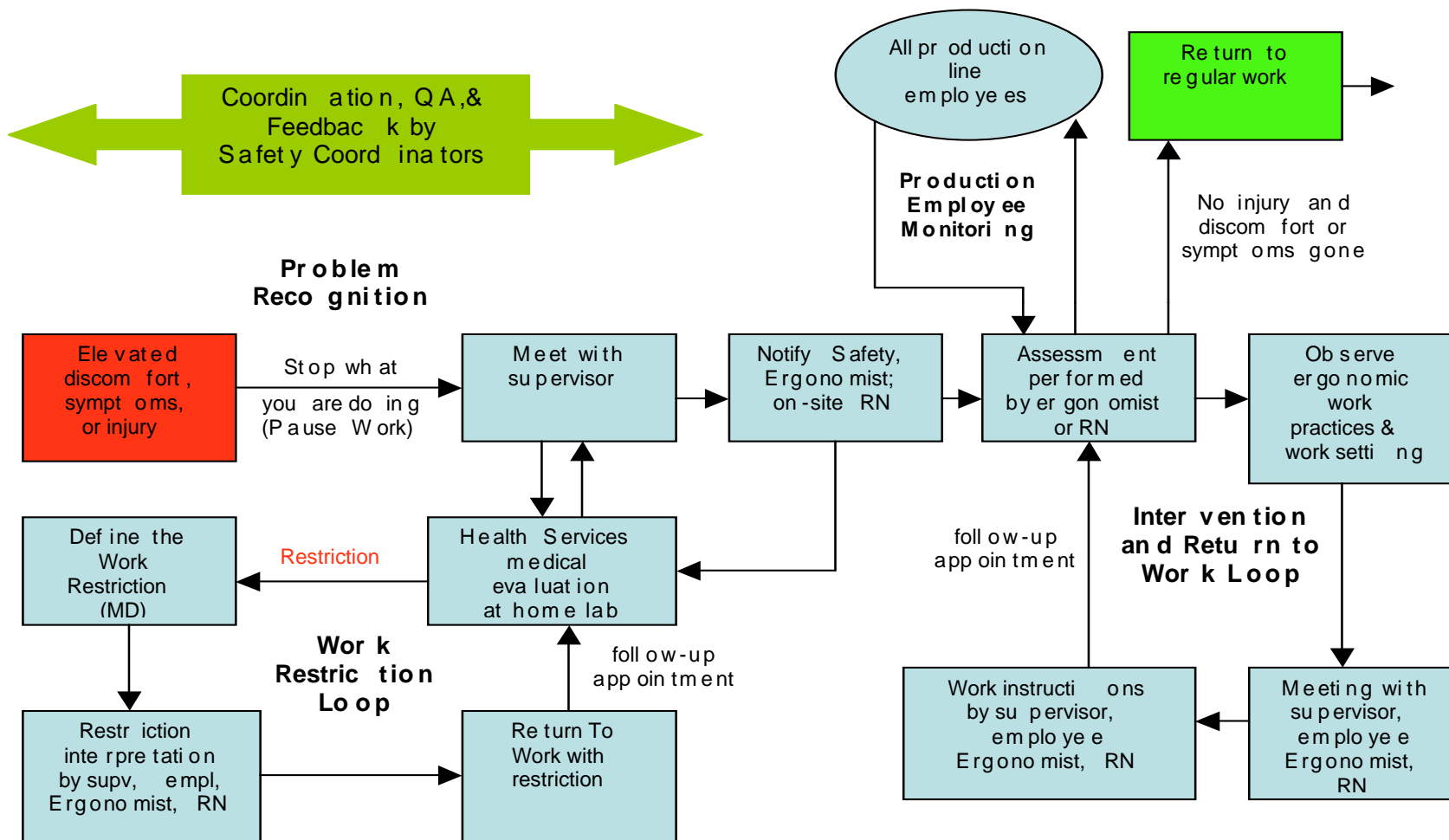
FY2008 Production Numbers:

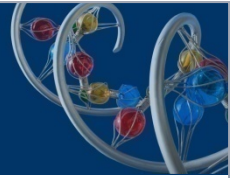
	Q1	Q2	Q3	Q4	Total
Sanger	4.030	3.397	6.142	6.142	19.711
454	3.164	6.603	7.398	7.398	24.563
					44.274



- **HR**
 - Case review meeting
 - Employee accommodations
- **Medical**
 - Partner labs support for onsite Nurse
 - Partner labs support for Early Intervention
 - Partner labs now incorporate JGI ergonomist paperwork

JGI Early Intervention Process Chart: Monitoring, Observations





- **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 sensitive for low force high repetition tasks like at JGI**

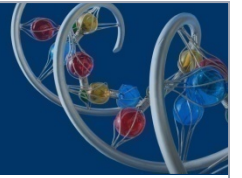


GOAL: Reduce ergonomic risk caused by the combination of tasks assigned



'Ergo Points'

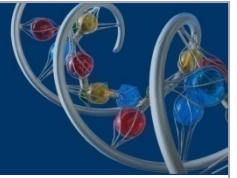




Weight Watchers

Food	Weight Watchers Points
Medium Fries	10
Cheeseburger	7
Big Mac	14
Corn on Cob	3
DAILY TOTAL	34

Ergo Points



Task	Ergo Points
Handling bio-assay trays	20
Loading/Unloading Stackers (Top Loading)	16
Loading/Unloading Stackers (Front Loading)	5
Unsealing Heat Seals	18
DAILY TOTAL	59

Moore-Garg Strain Index

Job / Task: **RCA: Peeling Foil Seals**

Date: **7/27/2006**

Analyst: **Christine Naca, Ira Janowitz**

SI Score Interpretation
 < 3 Safe
 3-5 Uncertain
 5-7 Some Risk
 > 7 Hazardous

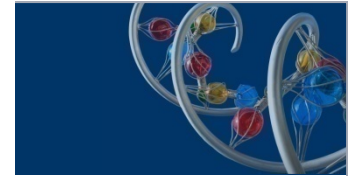
Product of all multipliers

SI = **10.1**

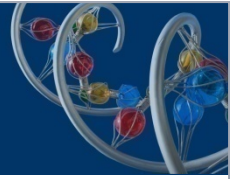
Variable	Rating Criterion	Observation	Variable Multiplier	Enter Multiplier	%Max, MVC
Intensity of Exertion (BS is Borg Scale)	Light	Light: Barely noticeable or relaxed effort (BS: 0-2)	1		<25%
	Somewhat Hard	Somewhat Hard: Noticeable or definite effort (BS: 3)	3		25-35%
	Hard	Hard: Obvious effort; Unchanged facial expression (BS: 4-5)	6		35-55%
	Very Hard	Very Hard: Substantial effort; Changes expression (BS: 6-7)	9	6	55-75%
	Near Maximal	Near Maximal: Uses shoulder or trunk for force (BS: 8-10)	13		>75%
Duration of Exertion (% of Cycle)	< 10%		0.5		
	10-29%		1.0		
	30-49%		1.5		
	50-79%		2.0	1.5	
Efforts Per Minute	> 80%		3.0		
	< 4		0.5		
	4 - 8		1.0		
	9 - 14		1.5		
Hand/Wrist Posture	15 - 19		2.0	1.0	
	> 20		3.0		
	Very Good	Perfectly Neutral	1.0		
	Good	Near Neutral	1.0		
Speed of Work	Fair	Non-Neutral	1.5		
	Bad	Marked Deviation	2.0	3.0	
	Very Bad	Near Extreme	3.0		
	Very Slow	Extremely relaxed pace	1.0		
Duration of Task Per Day (hours)	Slow	Taking one's own time	1.0		
	Fair	Normal speed of motion	1.0		
	Fast	Rushed, but able to keep up	1.5	1.5	
	Very Fast	Rushed and barely/unable to keep up	2.0		
Duration of Task Per Day (hours)	<1		0.25		
	1 - 2		0.50		
	2 - 4		0.75		
	4 - 8		1.00		
	> 8		1.50	0.25	

Note: This worksheet was adapted and interpreted by the USF investigators. No warranty is offered.

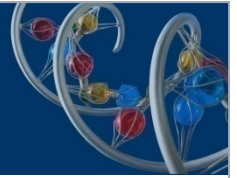
Reference: J. Steven Moore & Arun Garg, Thomas E. Bernard and Robert B. Walton
 The Strain Index: A Proposed Method to Analyze Jobs For Risk of Distal Upper Extremity Disorders; Am. Ind. Hyg. Assoc. J. 56:443-458 (1995)
 University of South Florida College of Public Health
 Tampa FL 33612-3805 (813) 974-6629
 tbernard@hsc.usf.edu and rwalton@hsc.usf.edu
 v2.2 1/11/01 © 2001 Thomas E. Bernard
 Partial support from UAW-Ford NJCHS
 Ford Motor Company
 US Air Force
 For updates, see Stone Wheels at www.hsc.usf.edu/~tbernard
 No Warranty: Expressed or Implied.



Strain Index assumes conducting same task all day long.

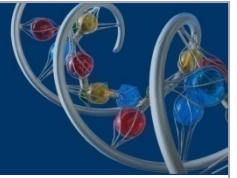


- **Task-specific to JGI production jobs**
- **First 20 tasks based on synthesis of Strain Index, expert opinion, and anonymous employee discomfort ratings to 'calibrate' data.**
- **Statistical tests for agreement**
- **Apply to other production tasks**



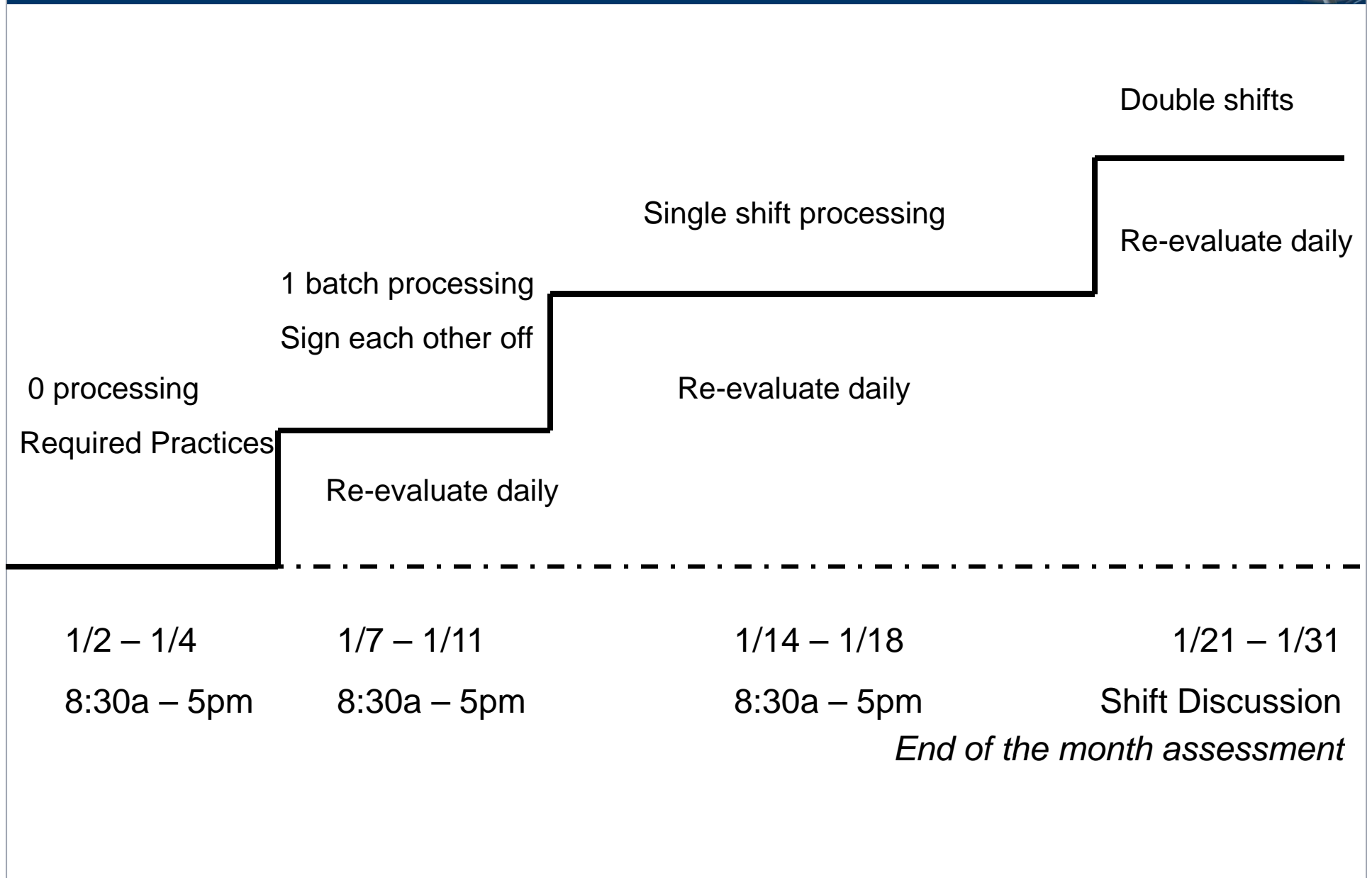
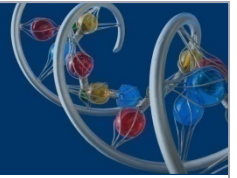
- Supervisors use it as a ‘sandbox’ to test out various combinations and quantities of tasks
- Used to validate new processes and/or process changes i.e. new technologies

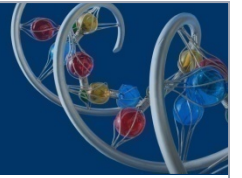
Ergo Points continues to provide guidelines to identify ergonomic risk exposure



- Area fully documented, required practices in place**
- Hazard solutions need to be reasonable and meet operator expectations**
- You must feel safe with the throughput levels and the work pace**
- Operators fully trained to work in the area**
- Clear expectations for operators and supervisors**
- Process Change Notification in place**
- Communication Model in place**
- Early intervention in place**
- Return to work procedures in place**
- Employee/Supervisor checklist in place (Check and Balance)**
- Leadership in place**

Plan: Ramping Back Up





- **Back to processing 4 batches/day, which is an overall 20% reduction of processing plates**
- **Administrative/Engineering modifications to the line**
- **Incorporating next generation technologies into production**

Vying to retain the Ergo Cup 2008

- The JGI Production Department competed with two new innovations.
- Kept Up Employee Morale



“Base Off”

Before

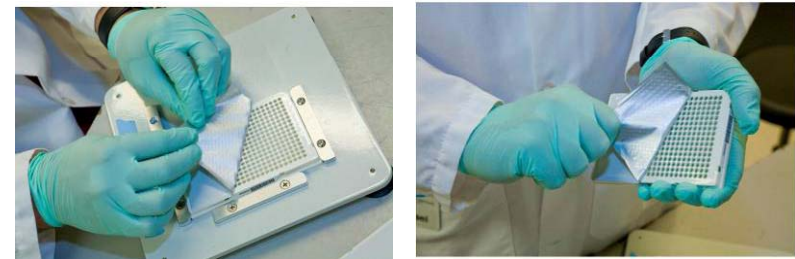


After



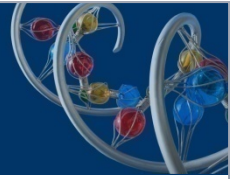
“It's A Peeling”

Before



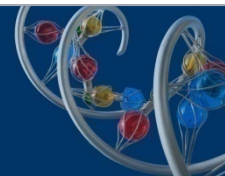
After

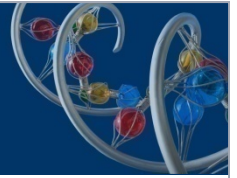




- **No ‘silver bullet’**
- **Ergonomics is a team effort**
- **Required an organizational solution**
 - Change in culture (productivity vs safety)
 - Staff ownership
 - Accountability
 - Support from Medical, HR, Safety, LLNL and LBL
- **Takes time and patience to change**
- **Change is difficult!!**

Commitment To Zero Injuries





Engineering designs and solutions

Early intervention

Targets employees
with discomfort
Includes bi-weekly
review meeting

Proactive Ergonomics Risk Assessments/Evaluations

Labs and offices
Monitoring
Walk-about
Comfort surveys



Ergonomics Working Group

Promotion
Awareness
Communication

Training/education

Risk targeted courses
Stretch break programs
Potty training
Website resources

Relaxation/ Rejuvenation Room

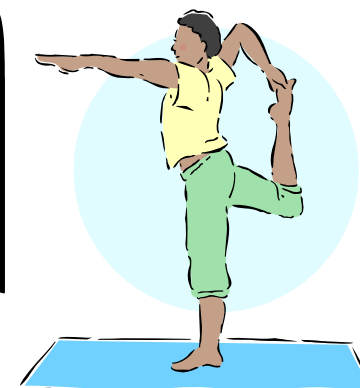
Ergonomics Demo Room

Work tool and practices

Ergo Points
Required Practices



Relaxation & Rejuvenation Room



Room 350 in Building 310 is your place to stretch, ice down, and take pilates classes. 350 is reserved exclusively for stretching, so stop by anytime during work hours to stretch or ice.

Come try the

- foam mats
- foam rollers
- massage tools
- hot and cold packs



Pilates classes in 350

with Wendy Schackwitz

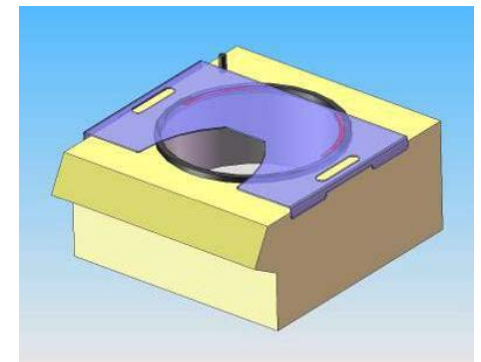
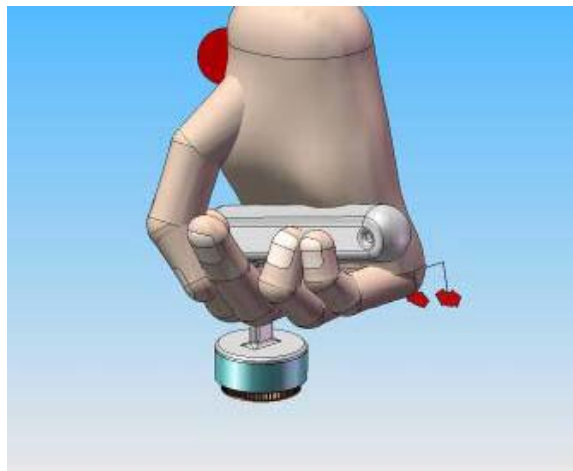
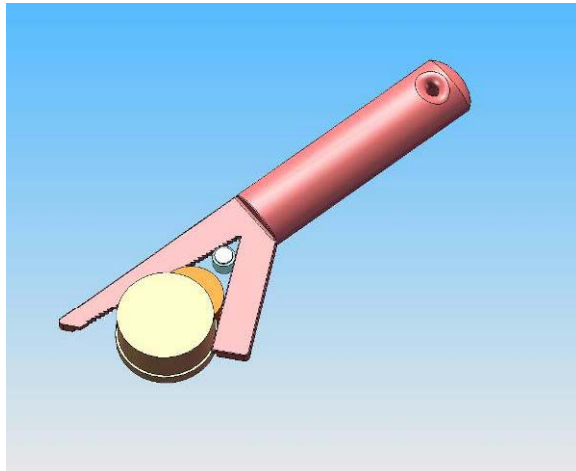
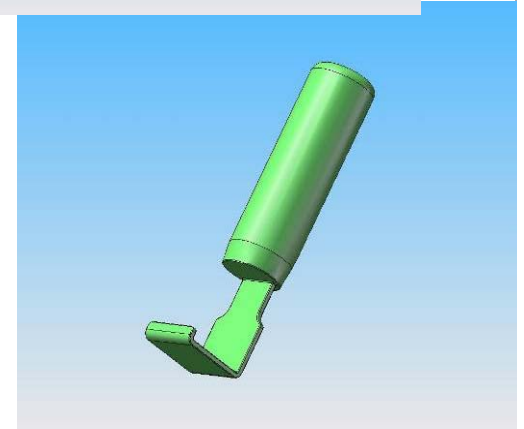
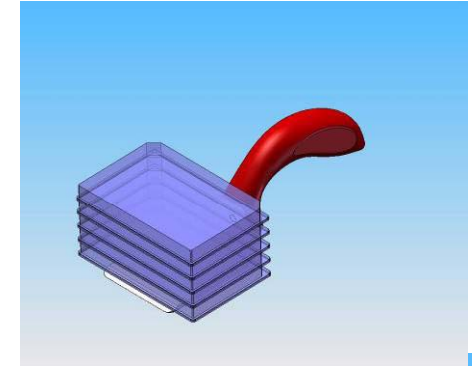
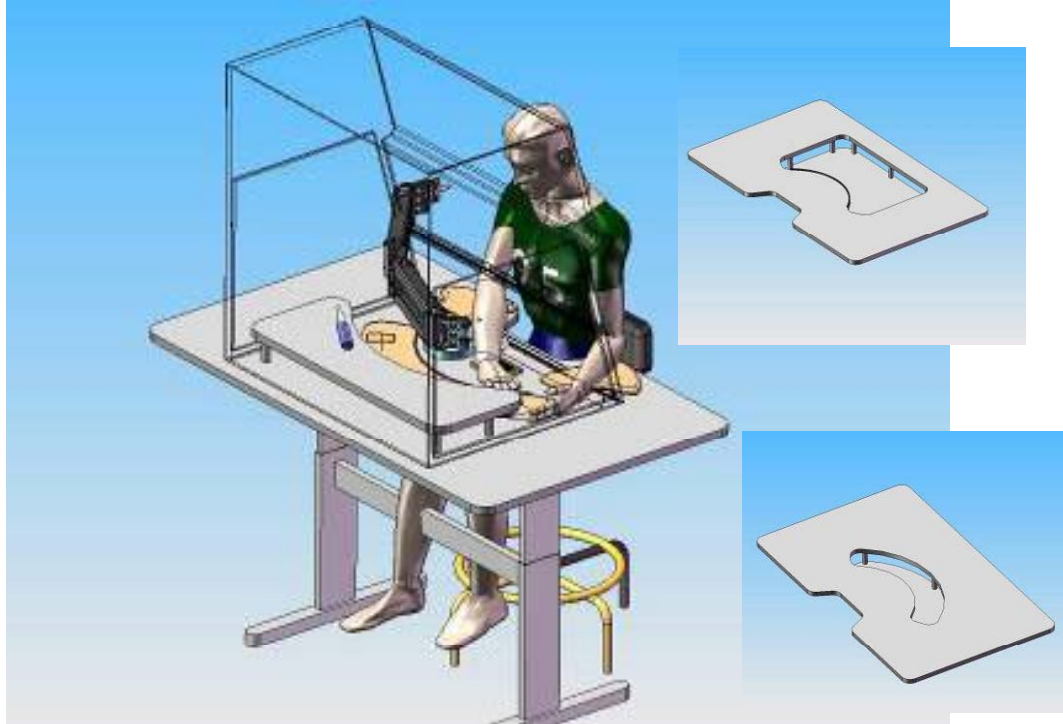
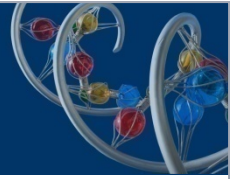
Mon 12:00 - 12:30

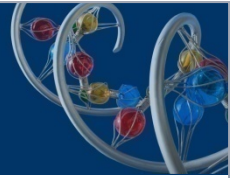
Wed 4:30 - 5:30

Fri 12:00 - 12:30

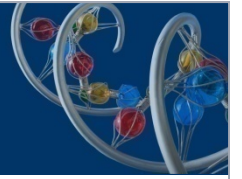


Employee Driven Designs





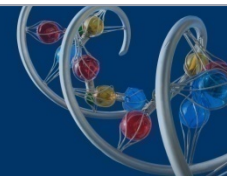
Recommitment to Zero Injuries and Safety



Acknowledgements:

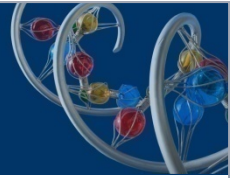
Susan Lucas, Melanie Alexandre, Ira Janowitz, Andy Imada, Stephen Franaszek, Debra Rosett, Simon Roberts, Dr. David Rempel

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.



‘Ergo Points’

More Detail

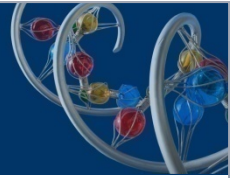


- **Part I: Generate a Detailed Task List to indicate tasks performed in specific production areas.**
 - Group tasks that are conducted together by a single operator (multi-tasking impacts the risk).

- **Part II: Collect a discomfort rating for each task (subjective metric)**

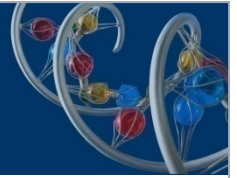
Discomfort Description	Discomfort Rating Scale
No	0
Mild	1
Moderate	2
Severe	3
Extremely severe	4

- **Data was compared to the Moore Garg Strain Index (SI) of individual tasks**
 - SI was used to cross reference subjective impressions of the production workers
 - SI assumes conducting a single task all day.



- **Part III: From the Detailed Task List, use the discomfort rating to generate a converted Ergo Points value.**
 - Ergonomic risk is a function of posture, repetition, force in the position of use, and duration.
 - The discomfort ratings assume these variables.
 - There is a non-linear relationship between the discomfort values and ergonomic risk, therefore a non-linear scale must be used to generate ergonomic risk values.

Discomfort Description	Discomfort Rating Scale	Ergo Points Scale
No	0	3
Mild	1	10
Moderate	2	20
Severe	3	50
Extremely severe	4	100

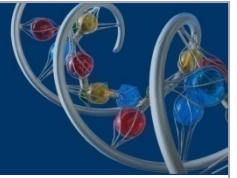


- **Part IV: Determine the Process Cycle Time for each task**

The Total Ergo Points values are calculated from the %Time/Workday for each task in a 7.5 hour workday.

$$\text{Total Ergo Points} = \sum \text{Ergo Points}_{(\text{Task 1-N})} \times \text{Time}_{(\text{Task 1-N})}$$

- **Part V: Collect 4 weeks of data**
- **Part VI: Conduct Statistical Analysis – in partner with UCSF**



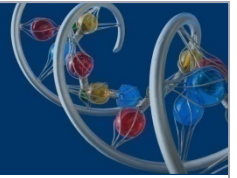
The findings of the Ergo Points Study suggest the following estimation of risk:

Ergo Points < 18 **Low Risk**

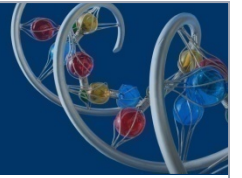
$18 \leq$ Ergo Points \leq 30
Moderate Risk

Ergo Points > 30 **High Risk**

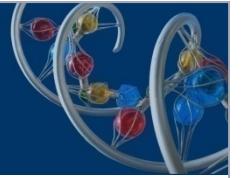
- Staff who are experiencing significant fatigue or discomfort should report this to their supervisor and should be scheduled to a task with a **lower Ergo Points rating**.
- Generally, schedulers should target scheduling of the staff in the **Moderate Risk** zone or lower.
- The Ergo Points ratings can be used to prioritize interventions. Tasks with Ergo Points ratings greater than 30 should receive a **high prioritization for redesign**.



- **November 2005 – STEER (System to Evaluate Ergonomic Risks) forms by EORM consulting firm**
 - Outcome: Could not quantify overall risk for multiple tasks conducted over the course of a workday
- **April 2006 – Moore Garg Strain Index**
 - Outcome: Assumes conducting only one task in a workday
- **June 2006 – HAL (Hand Activity Level), NIOSH Lifting Equations, Fatigue, Liberty Mutual Manual Material Handling Tables, Static & Dynamic Work Analysis, Rohmert Curves (muscle endurance and recovery), Rodgers Muscle Fatigue Assessment**
 - Outcome: Was not sensitive to high repetition multiple tasks with low hand force
- **November 2006 – Ergo Points formulation (formerly known as Ergo Watchers)**
- **July 2007 – Ergo Points methodology used as guidelines for assessing risk (excel spreadsheets)**
- **March 2008 – Ergo Points software tool deployed (Kecia)**
- **June 2008 – Auburn Engineers eTools**
 - Outcome: Was not sensitive to high repetition multiple tasks with low hand force



- **Align Ergo Points and Comfort Surveys**
- **Transfer Local Client to Web Based Forms**
- **Advanced Reports**
- **Cross Platform Risk Assessments**
- **Combine Risk Assessment with Resource Allocation and Staffing Models for planning**



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.