

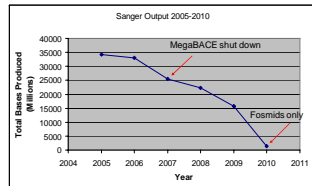
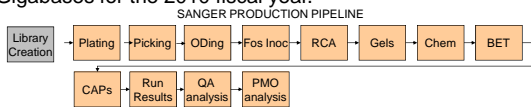
# DNA Production Sequencing at the Joint Genome Institute: A Multi-Process Operating System



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## SANGER SEQUENCING

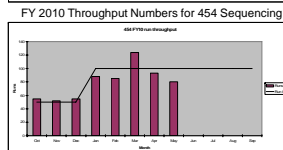
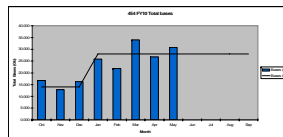
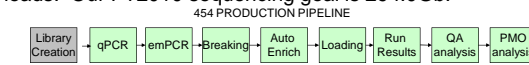
Sanger sequencing at the JGI began in 1999 with the Human Genome project. At our peak, we were running 36 MegaBACE instruments and 70 ABI instruments. Today we are running just 10 machines. Our sequence output had reached 34.3 Gigabases per year. We were standardly sequencing 3kb, 8kb, and 40kb libraries. Currently, we are sequencing mainly 40kb. As a result of our Sanger process being phased out, we are committed to sequencing just 3.92 Gigabases for the 2010 fiscal year.



Staffing: Currently we have 4 technicians scheduled to run Sanger daily.

## 454 SEQUENCING

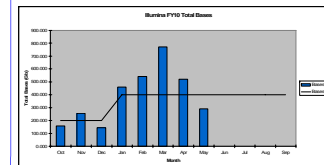
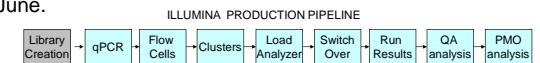
454 Sequencing began in 2007 with the purchase of 2 454 instruments. Testing and optimization of the instruments was conducted in our R&D group and finally released to production in July 2008. Currently we are operating 8 instruments. We are sequencing Standard, Paired End, cDNA and rapid libraries. Weekly our goal is to complete 25 loads. Our FY2010 sequencing goal is 294.0Gb.



Staffing: Currently we have 12 technicians scheduled to run 454 daily.

## ILLUMINA SEQUENCING

Illumina sequencing came to production in July of 2008 as well. Since that time, we have increased the number of instruments to 12 including 2 which are still in R&D. We are capable of doing 36, 72 and 114 cycle runs. We have validated 5 new cBOT instruments this current year and we have successfully completed our first 95G run which took a little over 16 days. Weekly our goal is to load 7-10 runs. Our FY 2010 sequencing goal is 4,200.0Gb. Also new this year will be the purchase of 2 HySeq instruments coming early June.



FY 2010 Throughput numbers for Illumina Sequencing

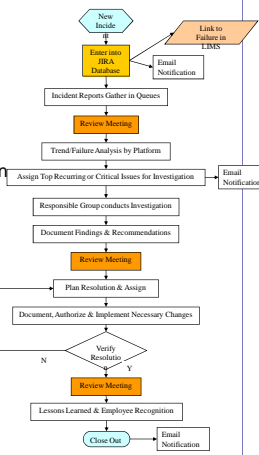


Platform	FY10 Goal	completed YTD	# Runs goal	#Runs completed
Illumina	4,200.0 Gb	3,255 Gb	210 runs	172 runs

Staffing: Currently we have 4 technicians scheduled to run Illumina daily. Two of these technicians also work weekends.

## QUALITY

One of the main areas of focus within the production department, continues to be that of quality. We are always looking for ways to improve the quality of the sequence coming through for our collaborators. We have recently implemented an extensive incident reporting (IR) system to track any deviation from the norm which may impact the sample in any way. The submissions are communicated directly to all groups within production and comments can be made related to the incident. Biweekly, we meet to discuss incidents that have been reported and to come up with solutions to prevent them from re-occurring. As a result of our IR trends, we have established employee led working groups to resolve sample mix-ups, update protocols, and create checklists and daily walkthroughs to ensure instruments are running and possible incidents are

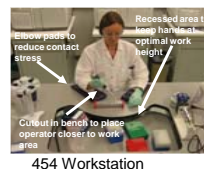


Another improvement we made was in the 454 enrichment process. We have begun double enriching all libraries. We have seen an improvement in the raw wells and bases as a result.



## SAFETY/ERGONOMICS

Safety and Ergonomics are always at the forefront of our work in the production line. With an integrated staff that moves between platforms, we must ensure that they have the proper safety training and the proper technical training. While Sanger is highly automated, many of the processing steps in 454 and Illumina remain manual, requiring extensive pipetting and hand intensive steps. Employee led efforts have resulted in best practices and required practices within each process step. These practices provide options to the staff in terms of tools to use and neutral postures for performing the work in the safest way. A group of our technicians presented their Employee led program, "Empowering Employees in Ergonomics", at this year's Applied Ergonomic Conference in San Antonio, TX and won the 2010 Ergo Cup!



454 Workstation



Tube & Bottle Openers



2010 Ergo Cup Team



Illumina Cluster Formation; Reagent Preparation



Pipet options



Bottle adaptors installed on the Illumina Analyzer

## STAFFING:

In the past we have had dedicated technicians for each of the 3 platforms. Currently, we have moved to an integrated staffing model. We have 20 technicians: 10 on each shift. Many of them have been trained on multiple platforms. This allows greater flexibility when staff are out or if there are fluctuations in throughput on a platform. We can easily shift resources across platforms based on our weekly needs. There is a lot of planning that needs to go into scheduling the staff in this manner and the schedule can change daily depending on staff availability and failures.

	M 24	T 25	W 26	Th 27	F 28
AM Tech #1	qPCR	qPCR	qPCR	qPCR	
AM Tech #2	break (3)	Load attec AM 454 Run Report	autoenrich robot 1 break (1)	autoenrich robot 2	Load bruin
AM Tech #3	BET (1)	Load tiger	Load tiger train AM 454 Run Report	BET (2)	BET (1)
AM Tech #4	autoenrich robot 1 AM 454 Run Report	autoenrich robot 2	empPCR (2)	break (3)	autoenrich robot 1
AM Tech #5	empPCR (2)	break (2)	Load G58	Load tiger	empPCR (2)
AM Tech #6	Load G58	RCA (1)	Load slug	empPCR (2) AM 454 Run Report	RCA (1)
AM Tech #7	ODing (1) Fosmids (2)	ODing (1) Fosmids (1)	Plating (40) ODing (1) Fosmids (1)	Plating (40) ODing (1) Fosmids (1)	
AM Tech #8	Load penguin	empPCR (2)	Load aggie	empPCR (2)	Load slug
AM Tech #9	RCA (0.5) break (1)	RCA (1)	RCA (1)	RCA (1)	Load aggie AM 454 Run Report
AM Tech #10	Load bruin	Load G58	empPCR (2)	Load G58	empPCR (2)
PM Tech #1	Load slug PM 454 Run Report	Load	autoenrich robot 2	Load aggie PM 454 Run Report	autoenrich robot 2
PM Tech #2					
PM Tech #3	empPCR (2)	break (2)	empPCR (2)	break (2)	empPCR (2)
PM Tech #4	autoenrich robot 2	empPCR (2) PM 454 Run Report	break (3)	autoenrich robot 1	Load gator
PM Tech #5	Load aggie	break (2)	Load gator PM 454 Run Report	Load penguin	break (3)
PM Tech #6	break (3)	ABI Tank Change (Bu/Po)	ABI Tank Change (Bu/Po)	ABI Maintenance (train Emer) break (1)	ABI Tank Change (Bu/Po) (1)
PM Tech #7	ABI Tank Change (Bu/Po) empPCR (1)	Picking (1 batch)	Picking (1 batch)	Picking (1.5 batches)	Picking (1.5 batches)
PM Tech #8	Load gator	Load penguin	Chem (2)	Chem (1)	Chem (1) PM 454 Run Report
PM Tech #9	Illumina	ABI maintenance	Illumina	ABI maintenance	Illumina
PM Tech #10	empPCR (2)	Illumina	Illumina	break (2)	Illumina