CONTENTS

Abbreviations denotine triphosphate Cell factories for protein production graduction against the protein production against the protein production graduction against the protein production against the protein protein protein production against the protein prote	XV
I An introduction to mammalian synthetic biology	1
Professor Jamie A. Davies	
What is a mammal?	2
Why do mammalian synthetic biology?	6
How is mammalian synthetic biology done?	8
What is easy, and what is hard?	11
2 Special features of mammalian systems	15
Professor Jamie A. Davies	
Mammalian genes	16
Mammalian cells	22
Mammalian cells in culture	26
In vivo issues	29
The problems versus the power	30
3 Technologies for mammalian synthetic biology	33
Dr Leonard J. Nelson and Professor Alistair Elfick	
We can read DNA very well	34
M/o can road DNIA warv wall	34
We can read DNA very well	
We can read DNA very well We can edit DNA pretty well	37
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR /Cas9 revolution	37
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution	37 37 37
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts	37 37 37 39
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too	37 37 37 39
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too But our capacity to author DNA remains modest	37 37 39 39 41
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too But our capacity to author DNA remains modest The next challenge is getting the modified DNA into mammalian cells	37 37 39 39 41
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too But our capacity to author DNA remains modest The next challenge is getting the modified DNA into mammalian cells Getting the DNA to stay in the cell can be difficult too	37 37 39 39 41
We can read DNA very well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too But our capacity to author DNA remains modest The next challenge is getting the modified DNA into mammalian cells Getting the DNA to stay in the cell can be difficult too Mammalian cellular repair machinery	37 37 39 39 41
We can read DNA very well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too But our capacity to author DNA remains modest The next challenge is getting the modified DNA into mammalian cells Getting the DNA to stay in the cell can be difficult too Mammalian cellular repair machinery Finally, we need to know our modified DNA is functional	37 37 39 39 41
We can read DNA very well We can edit DNA pretty well Rewriting approaches—genome editing tools CRISPR/Cas9 revolution Assembly of DNA parts We can write DNA quite well too But our capacity to author DNA remains modest The next challenge is getting the modified DNA into mammalian cells Getting the DNA to stay in the cell can be difficult too Mammalian cellular repair machinery Finally, we need to know our modified DNA is functional	37 37 39 39 41

Jamie Billington, Anna Mastela, and Professor Susan J. Rosser

	Teaching mammalian cells to make new, useful things	66
	Jamie Billington, Anna Mastela, and Professor Susan J. Rosser	
	Therapeutic proteins: the next generation of drugs	67
	Cell factories for protein production	69
	Mammalian cell lines	72
	Using synthetic biology to improve cells for bioproduction	75
	Producing therapeutic proteins in the body	76
	Going agricultural: synthetic biology in farm animals	79
6	Synthetic biology, stem cells, and regenerative medicine	84
	Professor Steven M. Pollard	
	What are stem cells?	85
	Stem cell differentiation	89
	Transcription factor 'master regulators' and reprogramming	89
	Synthetic transcription factors	92
	Mammalian cells in culture based ahead	95
7	The ethics of synthetic biology	0.7
		97
	David Obree	7/
		98
	David Obree	
	David Obree Ethics overview	98
	David Obree Ethics overview From analysis to synthesis	98
	David Obree Ethics overview From analysis to synthesis The appeal to nature	98 99 100
	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty	98 99 100 101
	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty Human enhancement	98 100 101 103
	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty Human enhancement The environment	98 100 101 103 105
	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty Human enhancement The environment Responsibility and safety	98 100 101 103 105 106
37 34	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty Human enhancement The environment Responsibility and safety Justice and fairness Conclusion	98 100 101 103 105 106 107
	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty Human enhancement The environment Responsibility and safety Justice and fairness Conclusion Alignment and alignmen	98 100 101 103 105 106 107 108
	Ethics overview From analysis to synthesis The appeal to nature Potential benefits, potential harms, and uncertainty Human enhancement The environment Responsibility and safety Justice and fairness Conclusion Japan Ballaman and AMQ benibom and guide at agreement and safety Justice and fairness Conclusion Japan Ballaman and AMQ benibom and guide at agreement and safety Justice and fairness Conclusion Japan Ballaman and AMQ benibom and guide at agreement and safety Justice and fairness Conclusion	98 100 101 103 105 106 107

Building to test ideas