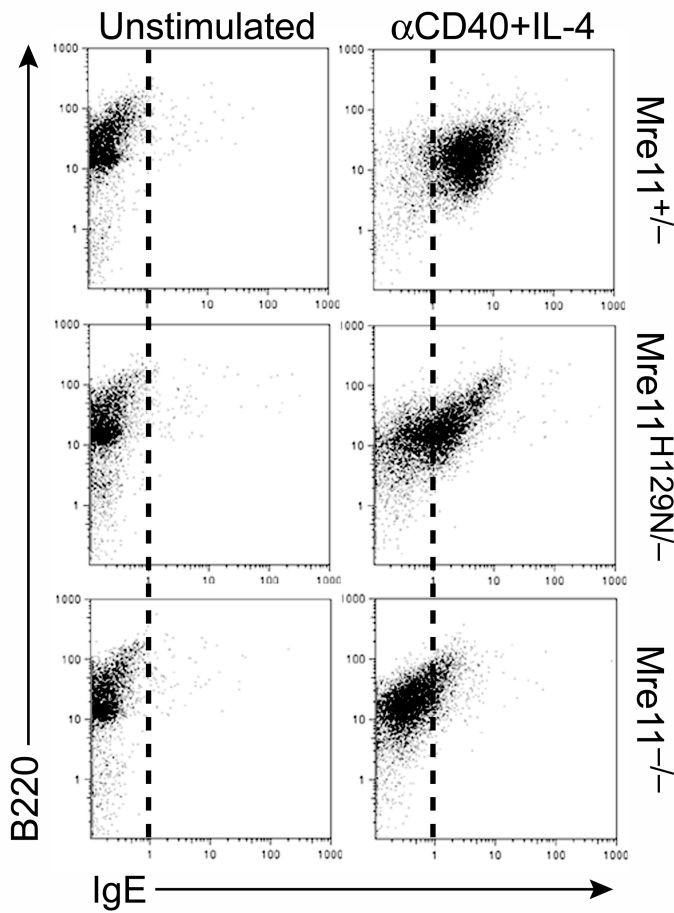
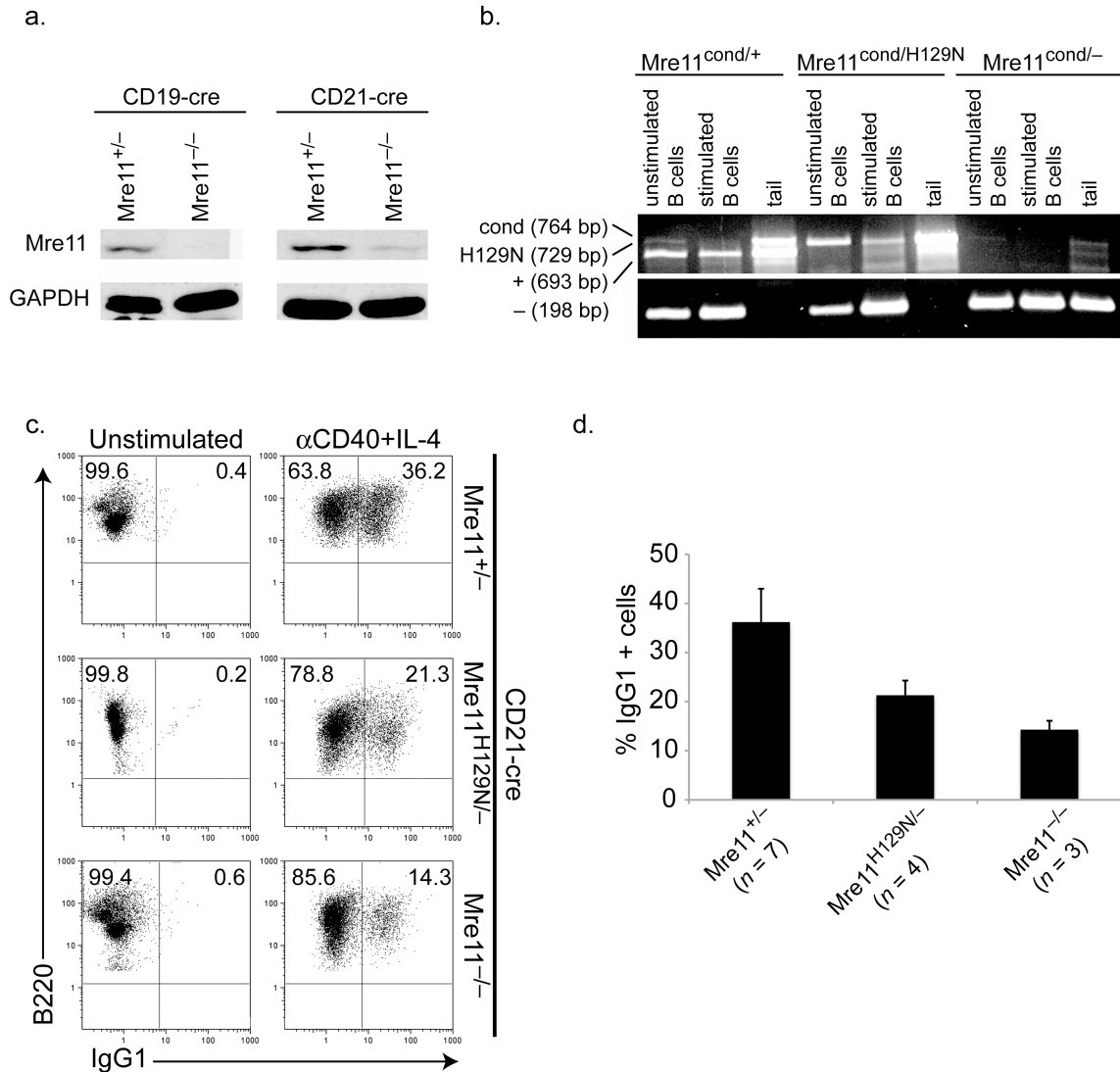


Supplementary Figure 1. MRN deficiencies generated by CD19-Cre do not block early B cell development. Flow cytometric analyses of bone marrow using the indicated antibodies. Artemis deficiency was used as a control for early developmental block resulting from defective V(D)J recombination. Three mice of each genotype were analyzed. Numbers in the quadrants represent the averages \pm S.E.M. B220/IgM positive populations reflect B cells having supported successful V(D)J recombination at the heavy and light chain loci. B220/CD25 positive populations have supported heavy chain, but not light chain, recombination.



Supplementary Figure 2. Requirement of MRN for switching to IgE. Representative flow cytometric analysis of class switching from IgM to IgE in B cells cultured with IL-4 and anti-CD40 for four days. IgE positivity cannot be quantitated precisely due to IgE antibody binding to Fc receptors.



Supplementary Figure 3. Conversion of Mre11^{cond} to Mre11⁻ by CD21-Cre. (a) Western blot analyses comparing Mre11 protein levels in CD19-Cre and CD21-Cre containing mice. Enriched splenic B cells stimulated with IL-4 and anti-CD40 were used. More residual Mre11 protein was reproducibly observed in CD21-Cre relative to CD19-Cre Mre11^{-/-} B cell cultures. (b) PCR analyses confirming conversion of Mre11^{cond} to Mre11⁻ by CD21-Cre in B lymphocytes. Primers used are depicted in figure 1a. (c) Flow cytometric analyses of class switching from IgM to IgG1 in mice harboring CD21-

Cre, which begins expression in mature IgM⁺ B cells. Numbers in upper right quadrants represent the average percentage of IgG1⁺ cells from three to five mice of each genotype.

(d) Bar graph depicting direct comparisons of IgG1⁺ cell populations in (c) (average \pm S.D).

Figure S 4 Mre11+/-

Blunt

IgG1

TGCTCTTTTGTAGTACCGTTGTC | TGGGTCACTCACATTTAACTTT
TGCTCTTTTGTAGTACCGTTGTC | **GT** | TCCAGGGCAGCCAGGACAGGTG
GGTGACCCAGGCAGAGCAGC | TCCAGGGCAGCCAGGACAGGTG

TGCTCTGTGTGAACCTCCCTCTG | GCCCTGCTTATTGTTGAATGGG
TACTCTGTGTGAACCTCCCTCTG | **T** | CAGGACAGGTGGAAGTGTGGTGA
GGCAGAGTAGCTACAGGGAGC | CAGGACAGGTGGAAGTGTGGTGA

ACAGCTGTACAGAATTGAGAAA | GAATAGACACCTGCAGTTGAGG
ACAGCTGTACAGAATTGAGAAA | **T** | AAGTGTGGAGACCCAGGCAGAG
ACAGGTAAGCAGGGACAGGTGG | AAGTGTGGAGACCCAGGCAGAG

GAAGAAAAGATGTTTTAGTTT | TTATAGAAAACACTACTACATT
GAAGAAAAGATGTTTTAGTTT | AGGGCAGCCAGGACAGGTGGAA
GTGACCCAGGCAGAGCAGCTCC | AGGGCAGCCAGGACAGGTGGAA

CAGTAAGGAGGGACCCAGGCTA | AGAAGGCAATCTGGATTCTG
CAGTAAGGAGGGACCCAGGCTTA | TATAGGGCAGCCAGGACAGGTG
GTGGTGACCCAGGCAGAGCAGC | TATAGGGCAGCCAGGACAGGTG

GGTAGGCCTGGACTTTGGGTCT | CCCACCCAGACCTGGGAATGTA
GGTAGGCCTGGACTTTGGGTCT | **ATAG** | GGGTGCCAGGACAGGTACAAG
AATATCCAGGCAGAACAGGTCCA | GGGTGCCAGGACAGGTACAAG

AAGAAAAGATGTTTTAGTTT | TATAGAAAACACTACTACATT
AAGAAAAGATGTTTTAGTTT | GTGACCCAGGCAGAGCATCTAT
AGCCAGGACAGGTGGAATGTG | GTGACCCAGGCAGAGCATCTAT

IgE

AACTGGAATGAACCTCATTAA | CTAGGTTGAATAGAGCTAAACT
AACTGGAATGAACCTCATTAA | GGCCCGGCTAAGCTAAGTAAGG
TGGACTGAATTGGCTAAGATG | GGCCCGGCTAAGCTAAGTAAGG

CTGGACTTTGGGTCTCCACCC | AGACCTGGGAATGTATGGTTGT
CTGGACTTTGGGTCTCCACCC | GAGCTGGGCCAGGCTGGTATGA
CTGGTCCAAGTTGGGCTAAACA | GAGCTGGGCCAGGCTAGTATGA

AGGCAATCCTGGGATTCTGGAA | GAAAAGATGTTTTAGTTTTA
AGGCAATCCTGGGATTCTGGAA | **T** | TGGGTTAAACTAGGTTGCACTG
GTTAACCTGGGCTGGACCATAC | TGGGTTAAACTAGGTTGCACTG

ACAGCTGTACAGAATTGAGAAA | GAATAGACACCTGCAGTTGAGG
ACAGCTGTACAGAATTGAGAAA | **TC** | GCGGGCGGGGCTAGGCTGGGC
AGGCAAGGCTGAGCTAGGCTGGG | GCGGGCGGGGCTAGGCTGGGC

GGCCAGCAGGTGGCTGGACTA | ACTCTCCAGCCACAGTAATGAC
GGCCAGCAGGTGGCTGGACTA | TTTTGTATATCGGTTGAAATG
GGCAGGGCTGGACTGAGCTAGC | TTTTGTATATCGGTTGAAATG

GATTACGCCGAACTGGAGAGG | TCCTCTTTAACTTATTGAGTT
GATTACGCCGAACTGGAGAGG | **CAAG** | TTGACCTGGCATGAGCTTAACT
AGCAGGACTGGCTGGCTGGGA | TTGACCTGGCATGAGCTTAACT

Microhomology

IgG1

TTGAGTACCGTTGTCTGGGTCACTCACATTTAACTTTCTTGT
TTGAGTACCGTTGTCTGGGT**CA**AGACAGGTGGAAGTGTGGGG
CACAGTAGCTATAGGGGAGCCAGACAGGTGGAAGTGTGGGG

GCCAGAGGCAGCCACAGCTGTGGCTGTCTCTTAAAGCTTGTGA
GCCAGAGGCAGCCACACT**GTG**ACTCAGGCAGAGCAGCTCC
AGCCAGGACAGGTGGAAGTGTGGTGTACCACAGGCAGAGCAGCTCC

GCCAGACTCATAAAGCTTGTCTGAGCAAAATTAAGGGAACAAGGT
GCCAGACTCATAAAGCTTGTCT**G**CAGCCAGGACAGGTGGGAGTG
ACCCAGGCAGAGCAGCTTCAGGGCAGCCAGGACAGGTGGGAGTG

CTCTACTTCAGTTATACATGTGGGTTGAATTTGAATCTATTCT
CTCTACTTCAGTTATACAT**GTG**TGGGGATCCAGGTAAGGCT
AAGGGAGCCAGAACAGGTGGGAGTGTGGGGATCCAGGTAAGGCT

GCCGCTAAGCTAAACTAGGCTGCCTAACCCAGATGAGCCAAAC
GCCGCTAAGCTAAACTAGGCT**GTG**ACACAGGCAGAGCAGCTCAT
GCTAGGACAGGTGGAAGTGTGGTGACCCAGGCAGAGTAGCTCTT

GAATAGAGACCTGCAGTTGAGGCAGCAGGTGCGGCTGGACTAAC
GAATAGAGACCTGCAGTTG**AGG**AGAAATGGAAGATGCAGA
GCAGAGTAGCTATAGGGCAGCCAGGAGAAATGGAAGATGCAGA

GGTATGGATACGCAGAAGGAAGGCCACAGCTGTACAGAATTGAG
GGTATGGATACGCAGAAGGA**AG**CAGGTATAGGGAGCCAGGAC
GGAAAGTGTGGTGACCCAGGCAGAGCAGCTATAGGGAGCCAGGAC

TGAGTACCGTTGTCTGGGTCACTCACATTTAACTTTCTTGA
TGAGTACCGTTGTCTGGGT**CA**AGGTGGGAGTGTGGTGACCC
GAGCAGCTGCAGGGCAGCCAGGACAGGTGGGAGTGTGGTGACCC

GGTGAAGTGTGAGAGGACAGGGCTGGGGTATGGATACGCAGAAG
GGTGAAGTGTGAGAGAGCAGGG**GG**TGACCCAGGCAGAGCATCTA
CAGCCAGGACAGGTGGAAGTGTGGTGACCCAGGCAGAGCATCTA

TTAGTTGAGGTACTGATCTCTCTACTTCAGTTATACATGTG
TTAGTTGAGGTACTGAT**GGT**TTGCAGCTACAGGTAAGC
CAGGAGGAAAGTGGGGATCCAGGTGTGCAGCTACAGGTAAGC

GGTAGGCCTGGACTTTGGGTCTCCACCCAGACCTGGGAATGTA
GGTAGGCCTGGACTTTGGGT**CT**ATAGGGGAGCCGGACAGGT
TGTGGTGACCCAGGCAGAGCAGCTATAGGGGAGCCAGGACAGGT

CAGAAGGAAGGCCACAGCTGTACAGAATTGAGAAGAATAGAGA
CAGAAGGAAGGCCA**CAGCTGTA**AGGGAGCCAGAAACA
AAGTGTGGAGACCCAGGCAGAGCAGCTATAAGGGAGCCAGAAACA

GTAAGCCAGAGGCAGCCACAGCTGTGGCTGTCTCTTAAAGCT
GTAAGCCAGAGGCAGCCAC**AGC**AAGGACAGGGAAACTATAG
CCAGGCAGAGCAGTACCTTAGGAGCCAGGACAGGGAAGCTATAG

IgE

GAACCTCATTAACTAGGTTGAATAGAGCTAAACTCTACTGCCT
GAACCTCATTAA**CTAAGTTGA**ATTGAGTTGGCT
TGGCTGAGCTGAGTCAAGATGCTGAGTTGATTGAGTTGGCT

CTAGGTTGAATAGAGCTAACTCTACTGCCTACTGGACTGTT
CTAGGTTGAATAGAGCTA**AACT**GAGCAGGACTGGCCTGGC
TAAGCTAAGTAAGGCTGCCCTGA**AACT**GAGCAGGACTGGCCTGGC

GAATTTAAATTGGAAGCTAATTTAGAATCAGTAAGGAGGGACCC
GAATTTAAATTGGAAGCTAAT**T**GAACTGGCCTGGTCTGGGCTG
GCTAGGCTGAGCTAGGCTGACCT**G**AAGTGGCCTGGTCTGGGCTG

TGGGGTATGGATACGCAGAAGGAAGGCCACAGCTGTACAGAATT
TGGGGTATGGATACGCAGAA**GG**TCAGCAGGCCTAAGCAGGC
TGAGCTGGGATGGGCTGAGATGG**GG**TTACAGCAGGCCTAAGCAGGC

GTTTAATATAGAAGGAATTA**A**ATTGGAAGCTAATTTAGAATCA
ATTTAATATAGAAGGAATTA**AG**CTACACTGAACTAGGCAAGG
TTGAGTTGGCTAAGCTAAGCTG**AG**CTACACTGAACTAGGCAAGG

GGATACGCAGAAGGAAGGCCA**C**AGCTGTACAGAATTGAGAAGA
GGATACGCAGAAGGAAGGCCA**C**GGGGCGGGCTAGGCTGGGCA
GGCAAGGCTGAGCTAGGCTGGGCAGGGCGGGCTAGGCTGGGCA

ATTAAGGGAACAAGGTTGAGAGCCCTAGTAAGCGAGGCTCAAA
ATTAAGGGAACAAGGTTGAGAG**G**CTGGGCGGGCGGGGCTAGG
TTAGCTAGGCAAGGCTGAGCTA**G**GCTGGGCGGGCGGGGCTAGG

Figure S5 Mre11 H129N/-

Blunt

IgG1

AGCTGTGGCTGCTGCTCTTAAA | GCTTGTAAACTGTTTCTGCTTA
AGCTGTGGCTGCTGCTCTTAAA | CCAGGACAGGTGGAAAGTGTGG
AGGCAGAGCAGCTCCAGGGCAG | CCAGGACAGGTGGAAAGTGTGG

AAGCTTGTAAACTGTTTCTGCT | TAAGAGGGACTGAGTCTTCAGT
AAGCTTGTAAACTGTTTCTGCT | AGCCAGGAGAGGTAGAATTGTG
CCAGGAAGAGTAGCTACAGGGG | AGCCAGGAGAGGTAGAATTGTG

GACCTGGGAATGTATGGTTGTG | GCTTCTGCCACCCATCCACCTG
GACCTGGGAATGTATGGTTGTG | AGGGAGCCAGGACAGGTGGAA
GTGACCCAGGCAGAGCAGCTAT | AGGGAGCCAGGACAGGTGGAA

TGAGTGCTTCTAAATGCGCTA | AACTGAGGTGATTACTCTGAGG
TGAGTGCTTCTAAATGCGCTA | GGAATCCAGTTGAGGTGGAAAG
GATACAGGCAGGGTAGCTATAG | GGAATCCAGTTGAGGTGGAAAG

GACTGTAATGAACTGGAATGAG | CTGGCCCGCTAAGCTAAACTAG
GACTGTAATGAACTGGAATGAG | TATAGGGAGCCAGGACAGGTGG
GTGGTGACCCCTGGCAGAGCAGC | TATAGGGAGCCAGGACAGGTGG

TGGAATGAACTTCATTAATCTA | GGTGTAATAGAGCTAAACTCTA
TGGAATGAACTTCATTAATCTA | AGAGCATCTATAGGGGAACCAG
GTGGAAATGTGGTGACCCAGGC | AGAGCATCTATAGGGGAACCAG

AGGCACCGCAAATGGTAAGCCA | GAGGCAGCCACAGCTGTGGCTG
AGGCACCGCAAATGGTAAGCCA | TGACCCAGGCAGGACATCTATA
GCCAGGACAGGTGGAAAGTGTGG | TGACCCAGGCAGGACATCTATA

IgE

GGACAGTGCTTAGATCCAAGGT | GAGTGTGAGAGGACAGGGGCTG
GGACAGTGCTTAGATCCAAGGT | AAATA | ACTGAACTAGGCAAGGCTGGGG
TGGCTAAGCTAAGCTGAGCTAC | ACTGAACTAGGCAAGGCTGGGG

TAACCAATAATCATAGAGCTCA | TGGTATTTTGGAGAAATCTAG
TAACCAATAATCATAGAGCTCA | CTG | ACTAGGCAAGGCTGGCTGGAA
AAGCTAAGCTGAGCTACACTGA | ACTAGGCAAGGCTGGGCTGGAA

ACTCATAAAGCTTGCTGAGCAA | AATTAAGGGAACAAGGTTGAGA
ACTCATAAAGCTTGCTGAGCAA | TAAACTGGGTTGCACTGGCTGG
CCTGGGCTGGACCATACTGGGT | TAAACTAGGTTGCACTGGCTGG

TGAGATACTCTGGAGTAGCTGA | GATGGGCTGAGATGGGGTGAGC
TGAGATACTCTGGAGTAGCTGA | CTACACTAGCCTGACCTGAGCT
GGCTGGGCTAAGCTGAGCTGGT | CTACACTAGCCTGACCTGAGCT

Microhomology

IgG1

ATACGCAGAAGGAAGGCCACAGCTGTACAGAATTGAGAAAGAAT
ATACGCAGAAGGAAGGCCA**CA**GGCAGAGCAGCTGCAGGGCA
GACAGGTGGAAAGTGTGGTGACCCAGGCAGAGCAGCTGCAGGGCA

GGTGAGATGGGGTGAGCTGAGCTGGGCTGAGCTAGACTGAGCTG
GGTGAGATGGGGTGAGCT**GAGC**AGCTACAGGGGAGCTAGG
TGGGAGTGTGGTGACCCAGGCAGAGCAGCTACAGGGGAGCTAGG

GGTAAGCCAGAGGCAGCCACAGCTGTGGCTGCTGCTCTAAAGC
GGTAAGCCAGAG**GCAGCCACAG**GGGAGCCAGGAC
GGAGTGTGGTGACCCAGGCAGAGCAGCTACAGGGGAGCCAGGAC

TTCATTAATCTAGGTTGAATAGAGCTAAACTCTACTGCCTACAC
TTCATTAATCTAGGTTGAATAG**G**TAGGGAAATCAGGACAGGTAC
TGGGACCCCTGTAGGGCAGCTGTAGGGAAATCAGGACAGGTAC

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GCCAGACTCATAAAGCTTGCT**TG**CAAAACAGCTCCAGGGGAGC
CAGGTGGAAAGTGTAGGGATTATGCAAAACAGCTCCAGGGGAGC

CTGGAAGAAAAGATGTTTTT**AG**TTTTTATAGAAAACACTACTAC
CTGGAAGAAAAGATGTTTTT**AG**CTATAAGGGAGCCAGAACAG
AGTGTGGAGACCCAGGCAGAGCAGCTATAAGGGAGCCAGAACAG

GCCTACACTGGACTGTTCTGAGCTGAGATGAGCTGGGGTGAGCT
GCCTACACTGGACTGTTCT**GAG**TCAGGACAGGTGGGAGTGT
ACCCTGGCAGAGCAGCTATAGG**AG**CCAGGACAGGTGGGAGTGT

CTACACTGGACTGTTCTGAGCTGAGATGAGCTGGGGTGAGCTCA
CTACACTGGACTGTTCTGAGCT**TC**CAAAACAGAAAGACTACAGAG
AGGAGAAATGGAAAGATGCAGAT**TC**CAAAACAGAAAGACTACAGAG

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AAAATGTTGCCTGTTAAACCA**AT**GGTGACCCAGGCAGAGCAGCT
GGAGCCAGGACAGGTGGAAAGTGTGGTGACCCAGGCAGAGCAGCT

TACTTCCTGGTTGTTAAAGAA**T**GGTATCAAAGGACAGTGCTTAG
TACTTCCTGGTTGTTAAAGAA**T**TGGGAGCCTGAACAGATAGAA
TGGATCCATGCAGTGTAGTGCTTGGGAGCCTGAACAGATAGAA

GCTGAGCTTGGCTGAGCTAGGG**T**GAGCTGGGCTGAGCTGGGGTG
GCTGAGCTTGGCTGAGCTAG**GG**GAGGCAAGACAGGTGGAAAG
GACTCCAGGCACAGTAGCTATAGGGGAGCCAAAGACAGGTGGAAAG

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TTGTCTGGAATATTTTCAGTTA**AG**CAGGTGGAAAGTGTAGTGACCC
AGCTACATACGGGTAAGCAGGG**AC**AGGTGGAAAGTGTAGTGACCC

IgE

TAAAATGGATACTCAGTGGTITTTAATGGTGGGTTTAAATATAG
TAAAATGGATACTCAGTGGT**T**GGGAGGGCTGGTCTCAGCTA
ACTGGCTGGTCTGGGCTGGAC**T**GGGACAGGGCTGGTCTCAGCTA

GTGTGAACTCCCTCTGGCC**CT**GCTTATTGTTGAATGGGCCAAAG
GTGTGAACTCCCTCTGGCC**CTG**GGCTGGCTGGGCTGGGCT
AGCTGGGTTAAGTATGGCTGGGCTGGGCTGGCTGGGCTGGGCT

TTAGATAAAATGGATACTCAGTGGTITTTAATGGTGGGTTTAA
TTAGATAAAATGGATACTC**AG**GGCCGGCTAAGCTAAGTAAGG
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CTGAGCTGAGATGGGTTGGCTTCTCTGAGTCTTCTAAATGCG
CTGAGCTGAGATGGGTTGGCT**T**GGCCTGGTCTGGGCTGGACTG
GCTGAGCTAGGCTGACCTGAAC**T**GGCCTGGTCTGGGCTGGACTG

CTGAGCTAGGGTGAGCTGAGCTGGGTGAGCTGAGCTAAGCTGGG
CTGAGCTAGGGTGAG**CTGAGCT**AGATTTGTATATTC
GGCTAGGCTGGGACAGGGCTGGACT**GAGCT**AGCTTTTGTATATTC

GAGTACCGTTGTCTGGG**CACT**CACATTTAACTTTCTTTGAAAA
GAGTACCGTTGTCTGGG**CACT**AAGCAGGACTAGGCTGGAA
TAGTATGAGCTGGTCTGA**CACT**AAGCAGGACTAGGCTGGG

Sequences of CSR joins from Mre11H129N/- stimulated B cells

Figure S6 Mre11 -/-

Blunt

IgG1

AGAATCAGTAAGGAGGGACCCA | GGCTAAGAAGGCAATCCTGGGA
 AGAATCAGTAAGGAGGGACCCA | CAGGACAGGTGGAATGTGGT
 GGCAGAGCAGCTCCAGGGGAGC | CAGGACAGGTGGAATGTGGT

AGCCAGCCTCGTGGCTTTGAA | GGAACAATCCACACAAGACT
 AGCCAGCCTCGTGGCTTTGAA | AGGACAGGTGGAAGTGTAGGA
 GCAGAGTAGCTCTTAGGGAGCC | AGGACAGGTGGAAGTGTAGGA

CTGAAATGAGATACTCTGGAGT | AGCTGAGATGGGTGAGATGGG
 CTGAAATGAGATACTCTGGAGT | CAGGACAGGTGGGAGTGTGGT
 GGCAGAGCAGCTCAGGGGAGC | CAGGACAGGTGGGAGTGTGGT

AATTAAGGGAACAAGGTTGAGA | GCCCTAGTAAGCAGGCTCTAA
 AATTAAGGGAACAAGGTTGAGA | TGACCAGGCAGAGCAGCTGC
 AACCAGGACAGGTGGAAGTGTGG | TGACCAGGCAGAGCAGCTGC

CAGTAAGGAGGGACCCAGGCTA | AGAAGGCAATCCTGGGATTCTG
 CAGTAAGGAGGGACCCAGGCTA | CAGGAAGGTGGAAGTGTGGT
 GGCAGAGCAGCTCCTAGGGCAGC | CAGGACAGGTGGAATGTGGT

AGCTGGCCGCTAAGCTAAACT | AGGCTGGCTTAACCGAGATGAG
 AGCTGGCCGCTAAGCTAAACT | CAGGGAAGCTATAGGAAACCA
 AGCAGTGCCTTAGGAGGAGC | CAGGGAAGCTATAGGAAACCA

TGAGATGGGTGGGCTTCTCTGA | GTGCTTCTAAATCGCTAAAC
 TGAGATGGGTGGGCTTCTCTGA | CCAGGACAGGTGGGAGTGTGG
 AGGCAGAGCATCTATAGGGAGC | CCAGGACAGGTGGGAGTGTGG

AATTGAGAAGAATAGAGACCT | GCAGTTGAGGCCAGCAGGTCCG
 AATTGAGAAGAATAGAGACCT | ATAGAAGTTTGTTA | AATTGAGAAGAATAGAGACCT
 CCAAGACAATAGAAGTGTGTG | AATCCAGGCAGAGCAGTGCCTT

IgE

GCTGGCCGCTAAGCTAAACTA | GGCTGGCTTAACCGAGATGAGC
 GCTGGCCGCTAAGCTAAACTA | TAAGGCTGCCTGAACTGAGCA
 AGATGGCCGCTAAGCTAAG | TAAGGCTGCCTGAACTGAGCA

GTTTATGAATTTGAAGTTGCC | AGTAATGTACTTCTGGTTGT
 GTTTATGAATTTGAAGTTGCC | GGCTGAGCTGAGTCAAGATGTT
 TAGACTGGCTGAGCTGGGCT | GGCTGAGCTGAGTCAAGATGTT

TTGTGTCTTTTGTAGTACCGT | TGTCTGGGCTCACTCACATTTAA
 TTGTGTCTTTTGTAGTACCGT | A | CTGGGTTAGACTTGGCTGAGCT
 GGGTTAACTAGGTGCACTGGCTGGGTAGACTTGGCTGAGCT

GTCACTCACATTTAACTTTCT | TGAAAACTAGTAAAGAAAAA
 GTCACTCACATTTAACTTTCT | ACCTGGGCTGGACCACTAGTGG
 TCAGTAGACTACACTGAGTTA | ACCTGGGCTGGACCACTAGTGG

CTGAGCAAAATTAAGGGAACAA | GGTTGAGAGCCCTAGTAAGCGA
 CTGAGCAAAATTAAGGGAACAA | ACTGGGCTGAGCTAAGTTGCAC
 GACCTGAGCTAGGTAGGCTGG | ACTGGGCTGAGCTAAGTTGCAC

Microhomology

IgG1

ACCAGGCTAAGAAGGCAATCCTGGGATTCTGGAAGAAAAGATG
 ACCAGGCTAAGAAGCAATCAGATGCAAGGGCAGCCAGGACA
 GAGTGTGGTACCCAGTCAAGAGCAGCTGACAGGGCAGCCAGGACA

TTTGAAGGAACAATTCACACAAGAAGCTCTGGACCTCTCCGAAA
 TTTGAAGGAACAATTCACACAAGCTACAGGGGAGCCAGGACA
 AAGTGAAGGGAGCCAGGCAGAGCAGCTACAGGGGAGCCAGGACA

GCTGCTGCTCTTAAAGCTTGTAACTGTTTCTGCTTAAAGGGGA
 GCTGCTGCTCTTAACTTGTAACTGTTTCTGCTTAAAGGGGA
 GAGCAGCTATAGGAGAGCCAGGAGCAGGTGGAATGTGGTACCC

AATGTTGCCTGTTAAACCAATATCATAGAGCTCATGGTATTTG
 AATGTTGCCTGTTAAACCAATATCATAGAGCTCATGGTATTTG
 CCAGGGCAGCCAGGACAGGTGGAAGTGTGGTACCCAGGCAGAG

ATGGTGGTTTAATATAGAAGGAATTTAATTGGAAGCTAATTT
 ATGGTGGTTTAATATAGAAGGACAGGACCTCCAGGGCAG
 ACAGGTGGGAGTGTGGTACCCAGGACAGCAGCAGCCTCCAGGGCAG

GTAATGAAGTGAATGAGCTGGCCGCTAAGCTAACTAGGCTG
 GTAATGAAGTGAATGAGCTGGCCGCTAAGCTAACTAGGCTG
 GCAGCCAGGACAGGTGGAATGTGGTACCCAGGCAGAGTAGCT

AGTAAAAGAAAAATGTTGCCTGTTAAACCAATATCATAGAGCT
 AGTAAAAGAAAAATGTTGCCTGTTAAACCAATATCATAGAGCT
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CTTGAAGGAGGCTGATACAATGTTGGAATTTTTCAGTAAAG
 CTTGAAGGAGGCTGATACAATGTTGGAATTTTTCAGTAAAG
 CAGGACAGGTGGAAGTGTGGGATTTATGCAAAAACAGCTCCAGG

GGCTGCTGCTCTTAAAGCTTGTAACTGTTTCTGCTTAAAGGGG
 GGCTGCTGCTCTTAAAGCTTGTAACTGTTTCTGCTTAAAGGGG
 AGCTCCAGGGGAGCCAGGACAGGTTGGAAGTGTGGATCCAGGC

CAGGAAAGCCAGACTCATAAAGCTTGTGAGCAAAAATTAAGGG
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TAGGCTGGCTTAAACCGAGATGAGCCAACTGGAATGAATTCAT
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 AGTATTCAATTTAGGAGAAATCTTTTTTTTAAATGAATGCAA
 GCAGCTATAAGGGAGCCAGAACAGGTTGGGAGTGTGGGATCCAG

AATAATCATAGAGCTCAGGTAATTTTGGAGAAATCTTGAAGAAC
 AATAATCATAGAGCTCAGGTAATTTTGGAGAAATCTTGAAGAAC
 GCAGCTGATAGGAAATCAGGACAGGTAACAAGTGTGTGGATTCAT

CAGACTCATAAAGCTTGTGAGCAAAAATTAAGGGAACAAGTTG
 CAGACTCATAAAGCTTGTGAGTACCTTAGGAGCAAGG
 TAGAAGTGTGTAATCCAGGCAAGCAGTACCTTAGGAGCAAGG

GCTTAAAGGGGACTGAGTCTTCACTAGTCTTTTGGGGGAGAA
 GCTTAAAGGGGACTGAGTCTTCACTAGTCTTTTGGGGGAGAA
 AGGACAGGTGGAAGTGTGGTACCCAGGCAGAGCAGCTATAGGG

ACTGTTCTGAGCTGAGATGAGCTGGGGTGAGCTCAGCTATGCTA
 ACTGTTCTGAGCTGAGATGAGCTGGGGTGAGCTCAGCTATGCTA
 CCAGGCAGAGCATCTATAGGGGAGCCAGGACAGGTGGGAGTGTG

CTGGGCTGAGCTGGGGTGAAGCTGAGCTGAGCTGGGGTAAAGCTGG
 CTGGGCTGAGCTGGGGTGAAGCTGAGCTGAGCTGGGGTAAAGCTGG
 TGTGTGACCCAGGCAGAGCATCTATAGGGTACCCAGGACAGGT

ACGCTGTGTTGGGCTGAGCTGATCTGAAATGAGATACTCTGGAG
 ACGCTGTGTTGGGCTGAGCTGATCTGAAATGAGATACTCTGGAG
 CCCAGGCAGAGCAGCTCCAGGGAGCCAGGACAGGTGGGAGTGT

GGTATGGATACGCAGAAAGGCCACAGCTGTACAGAATTGAG
 GGTATGGATACGCAGAAAGGCCACAGCTGTACAGAATTGAG
 GCTATAGGGAGCCAGGACAGGTGGAGTGTGTTGATCCAGACAA

GTCTTTTGTAGTACCGTTGCTGGGCTCACTCACATTTAACTTTCC
 GTCTTTTGTAGTACCGTTGCTGGGCTCACTCACATTTAACTTTCC
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TTGGAAGCTAATTTAGAAATCAGTAAGGAGGCCAGGCTAAGA
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 GAGCAGCTCCAGGGACCCAGGACAGGTGGAAGTGTGGTACCC

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 GTGGTTTTAATGGTGGGTTTTAATATAGAAGAAATTTAAATGG
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 CAGGCAGAGTAGCTATAGGGGAGCCAGGAGAAATGGAAGAATGC

GAAGTTGCCAGTAAATGTACTTCTGTTGTTAAAGAATGGTAT
 GAAGTTGCCAGTAAATGTACTTCTGTTGTTAAAGAATGGTAT
 GGGGAGCCAGGAAAGTGGAAATGTGGTACCCAGGCAGAGCAG

IgE

AGGTTGAATAGAGCTAAACTCTACTGCCTACACTGGACTGTTCT
 AGGTTGAATAGAGCTAAACTCTACTGCCTACACTGGACTGTTCT
 AGCTGGCTTACACTAGCTGACTGAGCTAGGCTAGGCTGGACT

CAAAATTAAGGGAACAAGGTTGAGAGCCCTAGTAAGCAGGCTC
 CAAAATTAAGGGAACAAGGTTGAGAGCCCTAGTAAGCAGGCTC
 TGGGTTAACTAGTTGCAGCTGCTGGTGTAGACTTGGCTGAGC